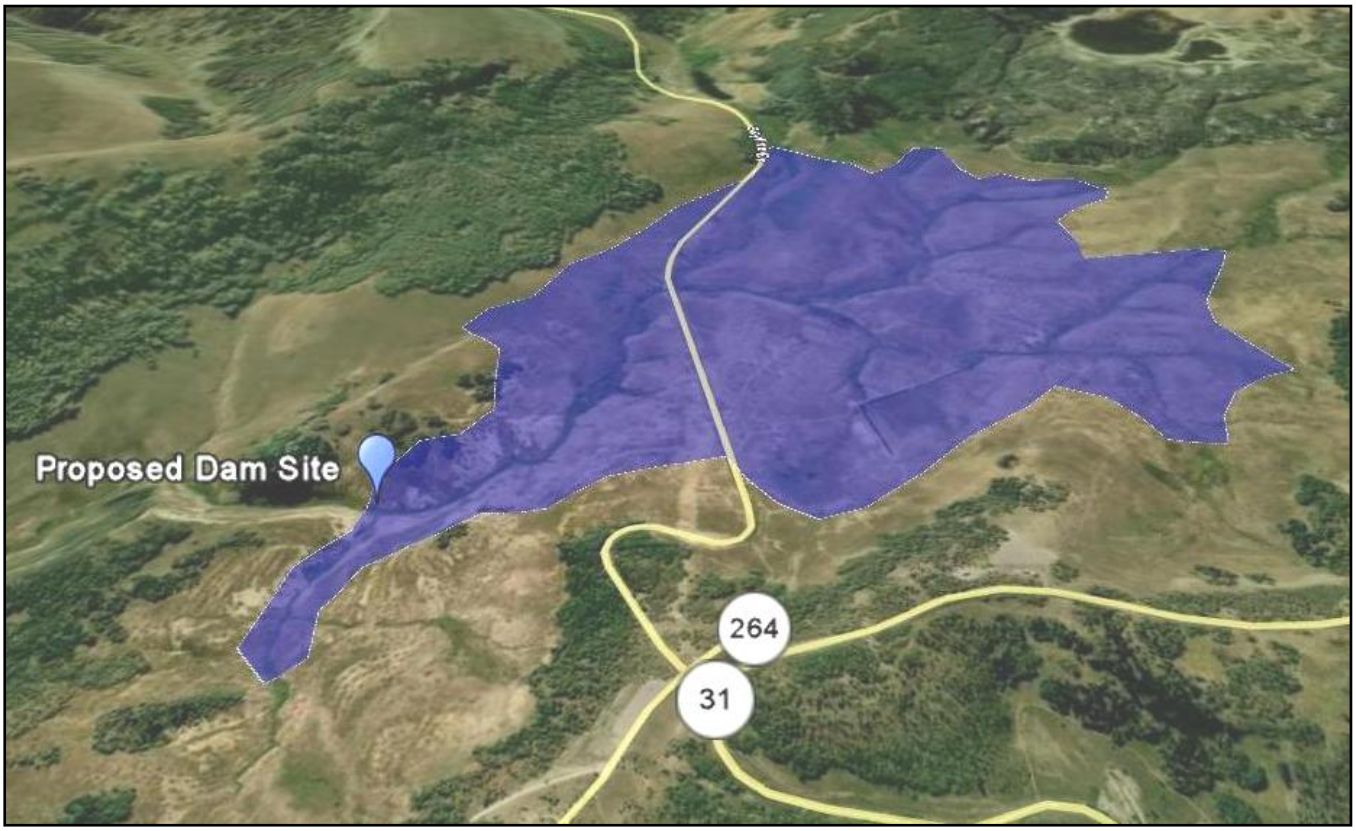
RECLAMATION

Managing Water in the West

Narrows Project Supplemental Draft Environmental Impact Statement

Narrows Project, Sanpete County, Utah



U.S. Department of the Interior
Bureau of Reclamation
Upper Colorado Region
Provo Area Office
Provo, Utah

March 2010

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Narrows Project
Supplemental Draft Environmental Impact Statement

Lead Agency: United States Department of the Interior, Bureau of Reclamation

Cooperating Agencies: United States Department of Agriculture, Forest Service
United States Department of the Army, U.S. Army Corps of Engineers

Abstract:

The Bureau of Reclamation (Reclamation), the Federal agency with administrative authority under the Small Reclamation Projects Act (SRPA), in cooperation with the U.S. Department of Agriculture Forest Service and U.S. Army Corps of Engineers, has prepared this supplemental draft environmental impact statement (SDEIS) pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended, and the Council on Environmental Quality and U.S. Department of the Interior regulations implementing NEPA. This SDEIS updates a previously released draft environmental impact statement (EIS) and describes the effects of granting a SRPA loan and authorizing use of withdrawn lands to the Sanpete Water Conservancy District (SWCD) to construct the Narrows Dam and Reservoir and to rehabilitate the existing Gooseberry (Narrows) Tunnel. The purpose of the Proposed Action is to enable the SWCD to develop an existing Gooseberry Project right to 5,400 acre-feet of water.

If the SRPA loan is approved and funds are obtained, SWCD would implement its plan to develop a supplemental water supply for agriculture and municipal and industrial water use in northern Sanpete County, Utah. Under the Proposed Action Alternative, if the SRPA loan is approved, Narrows Dam and Reservoir would be constructed on Gooseberry Creek to store and deliver project water through the Narrows Tunnel to Cottonwood Creek. Project water would be conveyed through three pipelines for delivery to existing water distribution systems in the project area. This supplemental draft EIS updates data and analyses from the 1998 draft EIS, for the Proposed Action Alternative, action alternatives, and the No Action Alternative and outlines mitigation measures that would be implemented as part of the Proposed Action.

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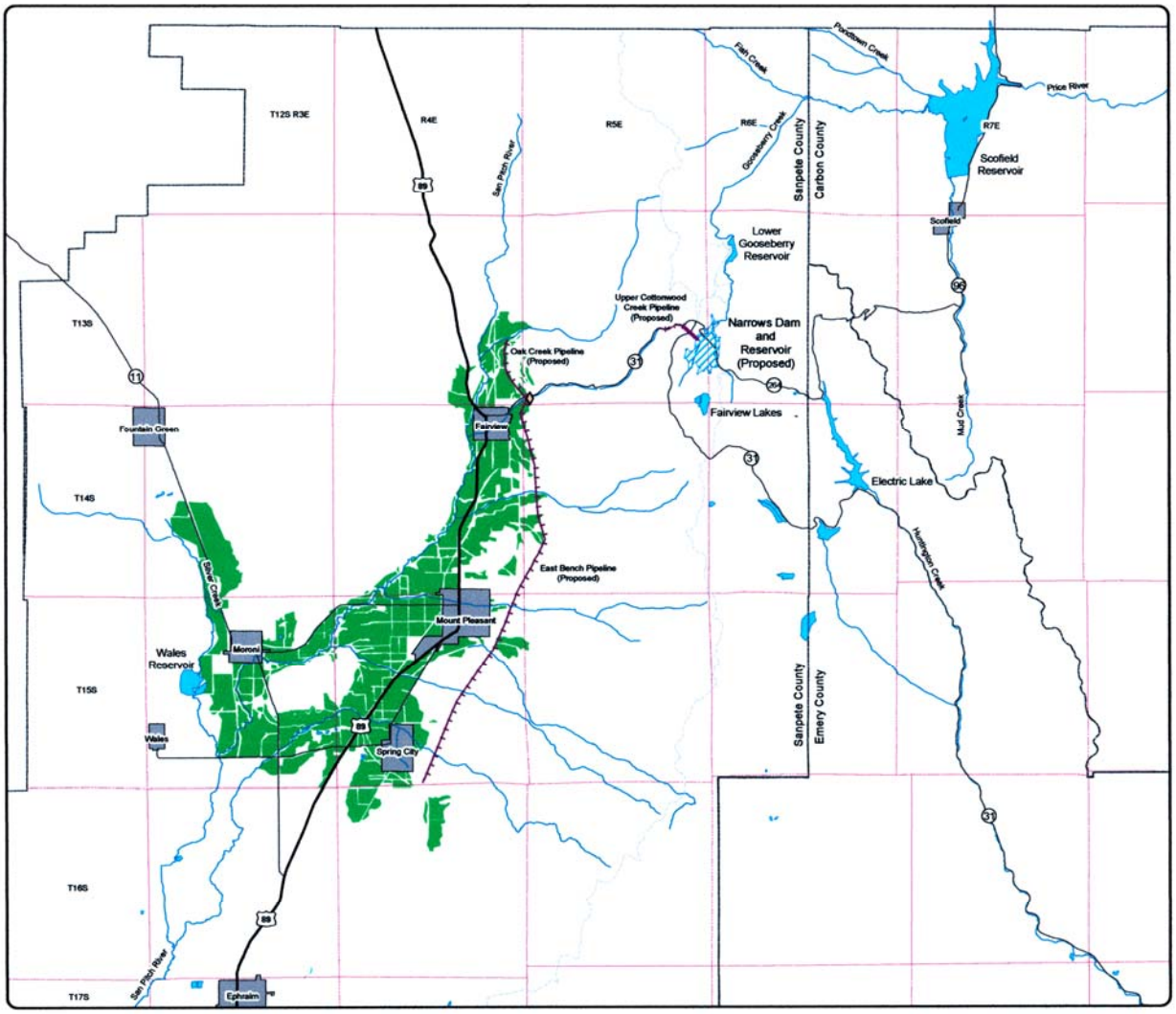

Legend

- Municipalities
- Lakes and Reservoirs
- Proposed Reservoir
- Lands to Receive Project Water
- County Boundaries
- Township and Range
- East Bench Diversion Dam
- Narrows Tunnel Rehabilitation
- Proposed Pipeline
- Unimproved Roads
- State Route
- U.S. Highway

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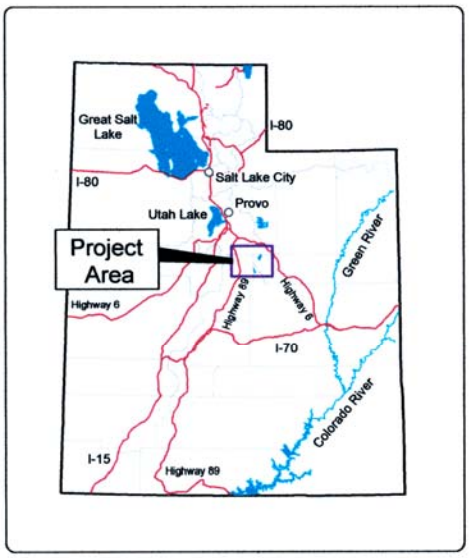
0 1 2 3 4 5 Miles

Narrows Project

Location Map

Project Area and Facilities

Sanpete Water Conservancy District



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EXECUTIVE SUMMARY

Narrows Project Supplemental Draft Environmental Impact Statement

S1.0 INTRODUCTION

The Narrows Project Supplemental Draft Environmental Impact Statement (SDEIS) updates information and analyses contained in the *Draft Environmental Impact Statement, Narrows Project* (DES-98-10) published in March 1998 (1998 DEIS). The SDEIS discloses the direct, indirect, and cumulative effects of the Proposed Action and alternative actions for water development for northern Sanpete County. This is an executive summary of the SDEIS.

S1.1 THE PROPOSED ACTION ALTERNATIVE

The Sanpete Water Conservancy District (SWCD) has applied to the Bureau of Reclamation (Reclamation) for a Small Reclamation Projects Act (SRPA) loan to help finance construction of a reservoir and related facilities (Proposed Action). SWCD also has requested authorization to use federally administered withdrawn lands as the site for dam construction. Most of the reservoir basin would be located on adjacent, privately owned land. If Reclamation approves the SRPA loan and land use and Congress appropriates the necessary funds, a supplemental water supply would be developed for presently irrigated lands and municipal and industrial (M&I) water users in northern Sanpete County. A dam and reservoir would be constructed on Gooseberry Creek, and water would be diverted through an existing tunnel and a proposed pipeline to Cottonwood Creek; the existing tunnel would be rehabilitated. Pipelines would be constructed to deliver the water to existing water distribution systems. Recreation facilities would be developed, and a 2,500-acre-foot minimum pool for fish habitat would be provided. The resulting water storage and delivery system would be a non-Federal project owned and operated by SWCD.

Mitigation measures would be implemented to offset adverse impacts. Additional water conservation measures would be required independent of the Proposed Action. To be eligible to receive water from the Narrows Project, water users would be required to use, or agree to implement, conservation measures.

S1.2 LEAD AND COOPERATING AGENCIES

Reclamation is the lead agency in preparing the SDEIS. The two cooperating agencies are the U.S. Department of Agriculture Forest Service (USDA Forest Service) and the U.S. Army Corps of Engineers (USACE).

S1.3 HISTORY AND BACKGROUND OF THE NARROWS PROJECT

The Narrows Project, as defined in this document, is a non-Federal project that

fulfills the intent of the larger Federal Gooseberry Project that was formulated more than 70 years ago but not completed. The original Gooseberry Project was formulated over a period of several years in response to efforts by Sanpete County individuals and entities to supplement existing irrigation water supplies and to alleviate shortages that consistently have occurred during the late irrigation season. The portion of that project that was not built was the proposal to appropriate and store Gooseberry Creek waters originating in Sanpete County and to transport those waters through a transmountain tunnel for use in north Sanpete County. The other component of the original Federal project, which was completed, was to enlarge Scofield Reservoir by 35,000 acre-feet to compensate Carbon County water users for the transmountain diversion of water to Sanpete County.

S1.4 PURPOSE AND NEED

Reclamation has received from SWCD its original application for a SRPA loan to build the Narrows Project, Utah (Narrows Project) and a request for authorization to use withdrawn lands to construct and operate the proposed dam and reservoir. Reclamation will receive an updated application for evaluation; and, in addition, Reclamation will complete National Environmental Policy Act (NEPA) compliance. SWCD's stated purpose and need in making its application to Reclamation serve to clarify and disclose the environmental effects of the proposed use of Federal funds and lands.

The primary purpose of the Narrows Project is to enable SWCD to develop an irrigation and M&I supply source for users in north Sanpete County, Utah, whereby the average annual shortages to irrigators in the project area might be reduced as nearly as possible to 5 percent (%), which is considered full irrigation supply for Reclamation projects. Specifically, the following are water-related needs addressed by the proposed project:

- Demand for municipal water for present and future use exceeds the currently available supply. The proposed Narrows Project would develop, through exchange, an additional supply of municipal water to offset current shortages and accomodate anticipated population growth in the project area.
- The current water supply for agricultural irrigation does not provide adequate supply and storage at the times when it is needed—typically in July, August, and September of each year. The proposed Narrows Project would provide late season irrigation water to offset at least some of the current shortages.
- The Narrows Tunnel in Sanpete County needs to be rehabilitated and improved to maintain and enhance its dependability and capability to deliver water to Sanpete County users. The proposed Narrows Project would include such rehabilitation work to prevent failure of the tunnel and ensure its continuing usefulness.

In addition to the primary purpose of supplying water to Sanpete County, the project would have the additional benefit of providing improved and additional recreation and fishery opportunities in Sanpete County.

For purposes of complete analysis and potential impacts of this project, a broad range of alternatives has been evaluated thoroughly to fully comply with NEPA requirements. Reclamation's release of this Supplemental Draft EIS does not imply either approval or denial of the SRPA loan application or the request for authorization to use withdrawn lands.

S1.5 Relationship to Other Projects

The Bonneville and Great Basins and the Upper Colorado River Basin have been the subject of several projects, plans, and programs. Construction and operation of the proposed project would reflect consideration of, and cooperation with, the following existing projects described in the SDEIS:

- Central Utah Project
- Scofield Project
- Fairview Lakes, Gunnison Reservoir, Wales Reservoir
- Price-San Rafael Rivers Unit, Colorado River Salinity Control Program
- Upper Colorado River Endangered Fish Recovery Program

S1.6 Decisions To Be Made Based on This Analysis

Based on the analysis documented in the SDEIS, the responsible official for Reclamation will make the following decisions:

- Whether Reclamation should approve SWCD's application for a SRPA loan to construct the Narrows Project
- Whether Reclamation should approve SWCD's use of Reclamation withdrawn lands for the Narrows Project, in accordance with Reclamation law
- Under what terms and conditions (of a local supplemental agreement between Reclamation and the USDA Forest Service) should the agencies administer resources within the total areas of project influence

In addition, the cooperating agencies may use the SDEIS to aid them in making the following decisions:

- Whether the USDA Forest Service should:
  1. Amend the Forest Plan to reflect Narrows Project land use changes
  2. Authorize mitigation measures on USDA Forest Service administered lands outside the Reclamation withdrawn lands
  3. Issue necessary easements to the Utah Department of Transportation (UDOT) for relocating State Route (SR) 264
  4. Accept responsibility for management of the recreation facilities
  5. Sign various agreements, such as memoranda of understanding (MOU), easements, and rights-of-way (ROW)
  6. Amend grazing permits and allotment management plans
- Whether the USACE should approve the SWCD's application for a Clean Water Act Section 404 permit authorizing the placement of discharged dredge or fill material into waters of the United States for constructing the Narrows Dam and other features of the Narrows Project

S1.7 ENVIRONMENTAL ISSUES ASSOCIATED WITH THE PROPOSED ACTION ALTERNATIVE

The issues identified through the initial scoping effort are listed below. The issues are phrased as questions. Chapter 2 of the SDEIS contains a comparison summary of the alternatives and their responses to the issues.[1] Chapter 3 presents the existing environment and the environmental consequences as they relate to the resource issues.

Issue No. 1 – How would threatened and endangered species be affected by the Narrows Project?

Issue No. 2 – How would the Narrows Project affect wildlife resources?

Issue No. 3 – What effects would there be on water resources from the Narrows Project?

Issue No. 4 – How would the Narrows Project affect the fishery resource?

Issue No. 5 – How would water quality be affected by the Narrows Project?

Issue No. 6 – What would the effect be on wetland resources from the Narrows Project?

Issue No. 7 – What would the effect be on aquatic and riparian resources from the Narrows Project?

Issue No. 8 – How would the Narrows Project affect the recreation and visual resources within the project area?

Issue No. 9 – What effect would there be on cultural resources from the Narrows Project?

Issue No. 10 – What social and economic effects would be expected from the Narrows Project?

Issue No. 11 – What effect would there be on existing land uses, rights-of-way, and potential mineral leasing?

Issue No. 12 – What effects on public safety would there be from the Narrows Project?

Issue No. 13 – What would be the effects upon air quality associated with constructing the Narrows Project?

Issue 14 – Would the slopes of Fairview Canyon be affected by construction and operation of the Narrows Project? What effects will there be on channel stability from the Narrows Project

Issue No. 15 – What would the geologic hazards and earthquake hazards be from the Narrows Project?

Issue No. 16 – What would the effect be upon the soils of the area from the Narrows Project?

Issue No. 17 – What would the effect upon levels of trace elements in the ground water supply be from constructing the Narrows Project?

Issue No. 18 – What would the impact of the Narrows Project be on Indian trust assets (ITA)?

Issue No. 19 – What would the impact of the Narrows Project be on environmental justice?

Issue No. 20 – What climate change issues might affect, or be affected by, the proposed action?

[1] References to chapters, tables, and figures within the Executive Summary are to the respective chapter, table, or figure within the main portion of the SDEIS.

S1.8 PERMITS, AUTHORIZATIONS, AND AGREEMENTS

Implementation of the Proposed Action could require a number of authorizations or permits from State and Federal agencies. These are summarized below.[2]

- Reclamation approval of the SRPA loan and congressional approval of the necessary funds to construct the Narrows Project
- Reclamation authorization for SWCD use of withdrawn lands to construct and operate Narrows Dam and Reservoir
- Utah Division of Water Quality authorization needed for a Storm Water Discharge Permit (Section 402 of the Clean Water Act, as amended)
- A USACE permit in compliance with Section 404 of the Clean Water Act, as amended, or Utah Department of Natural Resources authorization for a State Stream Alteration Permit (Section 404 of the Clean Water Act, as amended)
- Utah Division of Water Quality authorization for a Utah Pollution Discharge Elimination Permit (Section 402 of the Clean Water Act, as amended)
- Reclamation consultation with the State Historic Preservation Office (SHPO)

[2] Before beginning activities under the Proposed Action, SWCD would consult with both USACE and the Utah Department of Natural Resources to determine which permits would be necessary.

S2.0 THE ALTERNATIVES CONSIDERED INCLUDING THE PROPOSED ACTION ALTERNATIVE

As the lead Federal agency for the SDEIS, Reclamation's action under review is whether or not to approve SWCD's application for a SRPA loan and request to use withdrawn lands to construct and operate the Narrows Project. USACE and USDA Forest Service must also make decisions based on the environmental impact statement (EIS). To fully explore the effects of the proposed action and possible alternate courses of action SWCD, working with Reclamation and the other cooperating agencies, developed an array of alternatives to answer the issues raised in section S1.7 and chapter 1.

S2.1 DESCRIPTION OF ALTERNATIVES

S2.1.1 No Action Alternative

The No Action Alternative represents the conditions of the affected area if Reclamation does not approve the SRPA loan and use of withdrawn lands by SWCD for the Narrows Project (figure 2-1). It establishes the baseline for evaluating the environmental impacts of providing a supplemental water supply to north Sanpete County. It also establishes anticipated conditions in the affected areas without further development and assumes that irrigation operations would continue according to historic use.

Under this alternative, the Narrows Dam and Reservoir would not be constructed. Without the dam construction, there would be no need to relocate SR-264; and there would be no recreational facilities constructed at the reservoir site. The East Bench, Oak Creek, and Upper Cottonwood Creek Pipelines

would not be built. The existing Narrows Tunnel would be rehabilitated at some future date with other funding. The Cottonwood Creek Irrigation Company could not risk complete collapse and failure of the tunnel. If the tunnel were to collapse, the Cottonwood Creek Irrigation Company would have to acquire some type of emergency funding and would be required to repair it. The demand on municipal water supplies in Fairview, Mount Pleasant, Spring City, and Moroni would continue to increase as supplies for outdoor municipal uses run short and as the population increased. Most likely, there would be a conversion of agricultural water to municipal use as the demand for municipal water increased with a growing population.

Water conservation measures would continue to be implemented. These conservation measures would reduce average shortages on irrigated farmland to about 29.5% or about 15,250 acre-feet per year. Implementing new conservation measures most likely would reduce irrigation return flows now supplying wetlands, aquatic habitat, and downstream users by an estimated 3,500 acre-feet per year.

There would be no wetlands, wildlife, or fisheries mitigation measures implemented under the No Action Alternative because there would be no impact to existing wetlands and wildlife habitat. Streamflows in Gooseberry and Fish Creeks would remain unaltered from their present state. Under this alternative, no flatwater fishery would be developed in the proposed reservoir basin.

S2.1.2 Proposed Action Alternative

If Reclamation approves the SRPA loan and Congress appropriates the necessary funds and lands, a supplemental water supply would be developed for municipal water users and agricultural use in north Sanpete County under the Proposed Action. This additional water supply would satisfy the 1984 Compromise Agreement.

The Proposed Action would provide north Sanpete County an average annual supply of 4,281 acre-feet of supplemental irrigation water for 15,420 acres of presently irrigated farmland and 855 acre-feet of water for municipal use. The project would include construction of the 17,000 acre-foot Narrows Dam and Reservoir on Gooseberry Creek, pipelines to deliver the water to existing water distribution systems, rehabilitation of the existing 3,100 foot Narrows Tunnel, and relocation of 2.9 miles of State Road (SR) 264. The dam would be 120 feet high with a crest length of 550 feet and crest width of 30 feet.

The Narrows portion of the Gooseberry Project Plan would include a transmountain diversion of water from the Gooseberry Creek drainage of the Price-Green-Colorado River Basins to the San Pitch-Sevier River of the Great Basin. Geographically, the project facilities are located in close proximity to the drainage divide between the Price River system and the San Pitch River system. The general location is shown on the location map in the front of this document.

The Price River flows southeast to the Green River, a tributary of the Colorado River. The San Pitch River flows southwest to the Sevier River, which is completely consumed in the Bonneville Basin, a part of the arid Great Basin. The county line dividing Sanpete County and Carbon County is located more than 6 miles downstream from and about 3 miles east of the proposed Narrows damsite on Gooseberry Creek.

The proposed damsite, the transmountain Narrows Tunnel, and the project water distribution facilities are all located in Sanpete County. The source of the project water supply generally arises in Sanpete

County and naturally flows into Carbon County and the Price River system, unless the flows are captured and diverted transmountain to Sanpete County. The service area of the Narrows Project would be situated in the San Pitch River drainage.

A dam and reservoir would be constructed on Gooseberry Creek, and water would be diverted through an existing tunnel to Cottonwood Creek. Pipelines would be constructed to deliver the water to existing water distribution systems located near Fairview, Utah. Recreation facilities would be developed at the reservoir, and a 2,500-acre-foot minimum pool for fish habitat would be maintained.

Mitigation measures would be implemented to offset adverse impacts to wetlands, terrestrial wildlife, and stream fisheries. In addition to mitigation measures to offset project impacts, other measures would be included to enhance or improve fish and wildlife habitat. Additional water conservation measures would be required independent of the Proposed Action. However, only those water users who have implemented or would agree to implement water conservation measures would be eligible to receive project water. These practices would include improved water conveyances such as lined canals, pipelines, or improved irrigation practices such as sprinklers or gated pipe.

S2.1.3 Mid-Sized Reservoir Alternative

This alternative would be similar to the Proposed Action except that the reservoir capacity would be limited to 12,450 acre-feet. Of that amount, 9,950 acre-feet would be active capacity, and 2,500 acre-feet would be inactive storage. The 110 feet high dam, with a crest length of 475 feet and crest width of 30 feet, would be in the same location as that for the Proposed Action (figure 2-11). Other features of the project would be the same as those for the Proposed Action and would include the construction of pipelines, rehabilitation of the existing Narrows Tunnel, relocation of SR-264, and provide recreation opportunities. Exceptions and differences between this alternative and the Proposed Action are described in the SDEIS.

S2.1.4 Small Reservoir Alternative

This alternative would be similar to the Proposed Action except that the reservoir capacity would be limited to 7,900 acre-feet. Of that amount, 5,400 acre-feet would be active capacity, and 2,500 acre-feet would be inactive storage. The 100-feet-high dam, with a crest length of 425 feet and crest width of 30 feet, would be in the same location as that for the Proposed Action (figure 2-12). Other features of the project would be the same as those for the Proposed Action and would include the construction of pipelines, rehabilitation of the existing Narrows Tunnel, relocation of SR-264, and provide recreation opportunities. Exceptions and differences between this alternative and the Proposed Action are described in the SDEIS.

S2.2 ALTERNATIVES CONSIDERED AND ELIMINATED FROM THE STUDY

Several alternatives considered were determined to be nonviable. Those alternatives are listed below and described in detail in the SDEIS.

- Direct Diversion Without Reservoir
- Direct Diversion with Reservoir in Sanpete Valley

- Conservation Without Development of Other Water Supplies
- Mammoth Damsite Alternative
- Valley Damsite Alternative
- Skyline Mine Alternative
- Year-round Release with Ground Water Exchange and Pumping Alternative
- New Ground Water Development
- New Surface Water Development in Sanpete County Alternative
- Central Utah Project Water Alternative
- Conservation Through Retirement of Irrigation
- Purchase of Sanpete County's Water Rights by Carbon County Water Interests
- Carbon County Proposed Recharge Alternative

S2.3 COMPARISON OF ALTERNATIVES

Table 2-8 in the SDEIS compares the closely examined alternatives against the issues associated with the Proposed Action that are outlined in chapter 1. The scientific and analytical basis for these comparisons can be found in chapter 3.

S3.0 AFFECTED ENVIRONMENT/ PREDICTED EFFECTS

This section summarizes chapter 3, which discusses the affected environment and environmental consequences that would result from the construction, operation, and maintenance of the project features associated with the Proposed Action and alternatives of the Narrows Project. The affected environment discussions describe existing conditions for resources within the project area. The impact analyses focus on potential direct, indirect, total, and cumulative impacts on these resources. Potentially significant impacts, together with criteria developed at the beginning of this study for assessing the significance of potential impacts, are identified. Resource specialists reviewed all data and results of the 1998 DEIS analysis and updated data where appropriate in the SDEIS. Mitigation measures that would reduce or avoid certain adverse impacts or would compensate for some unavoidable adverse impacts also are identified.

S3.1 THREATENED AND ENDANGERED SPECIES

No plant species currently receiving protection under the Endangered Species Act are known to exist in the project area.

A biological assessment of potential effects on endangered, threatened, and candidate wildlife and fish species was conducted for the Narrows Project. Federally listed or otherwise protected species addressed in the assessment included: bald eagle (*Haliaeetus luecocephalus*); Colorado pikeminnow, (*Ptychocheilus lucius*); bonytail chub (*Gila elegans*); humpback chub (*Gila cypha*); and razorback sucker (*Xyrauchen texanus*).

The U.S. Fish and Wildlife Service (Service) issued a final biological opinion on August 24, 2000, (appendix C) that found that the proposed project would have no effect upon the bald eagle, which was subsequently delisted in 2007. The Service believes that the southwestern willow flycatcher (SWWF) found at the Fish Creek site is not the endangered subspecies; therefore, no discussion was offered specifically in

reference to the SWWF. The Service concluded, however, that the project and associated depletion of water from the Colorado River system may affect the four endangered Colorado River fishes. While the opinion concluded that the proposed project may affect the four endangered fishes, it also stated that the project is not likely to jeopardize their continued existence, provided measures are implemented to offset project impacts (i.e., payment of a one-time financial contribution by SWCD).

S3.2 WILDLIFE

The wildlife species found in the general project area are common in the Great Basin Desert valleys and Rocky Mountain Range. There are about 364 species of terrestrial vertebrates that may inhabit the project area. Approximately 88 bird species and 33 mammal species use the habitats that would be disturbed by the proposed project.

Table 3-1 summarizes the impacts to wildlife habitat that would result from construction of the Proposed Action. In an assumed worst-case situation where the most habitat would be lost at one time, it would take the reservoir 2 years to fill to capacity. The *1994 Fish and Wildlife Coordination Act Report* evaluates the impacts of the proposed Narrows Project on fish and wildlife resources and recommends appropriate mitigation (see appendix D).

A wildlife mitigation program has been designed to provide at least full mitigation for each impacted species. Because the wetland and upland wildlife mitigation measures are intended to provide full mitigation for project impacts, there would be no residual impacts.

S3.3 WATER RESOURCES

Gooseberry Creek and its three unnamed tributaries are located high in the Price River drainage. This tributary of Fish Creek flows directly into Scofield Reservoir (see the location map at the front of this document). Other tributaries to Scofield Reservoir include Mud Creek and Pondtown Creek. The Price River, which flows out of Scofield Reservoir, is a tributary of the Green River—a tributary of the Colorado River. These three rivers are all located in the Colorado River Basin.

Cottonwood Creek, located in the San Pitch River Basin, is located on the opposite side of the divide from Gooseberry Creek.

Cottonwood Creek and the San Pitch River are located in the Sevier River subbasin of the Great Basin.

Typical of Wasatch Mountain streams, flows in these creeks are greatest in the spring, when snowmelt runoff is peaking. Peak flows during May and June are estimated to range from 15 to over 100 cubic feet per second (cfs) in Upper Gooseberry Creek near the proposed damsite. The flow declines considerably in late summer and reaches a minimum in late fall or winter. Late-season flows are estimated to be 1.5 to 5 cfs in Upper Gooseberry Creek.

The average annual natural runoff volume of Upper Gooseberry Creek, near the proposed damsite, is 9,032 acre-feet. Of this amount, an average of 1,815 acre-feet presently is stored in Fairview Lakes and diverted transmountain to Cottonwood Creek through the Narrows Tunnel. The remaining water continues down Gooseberry Creek to Fish Creek. An average of 35,800 acre-feet per year enters Scofield Reservoir from Fish Creek. The total annual inflow to Scofield

Reservoir from all tributaries averages 57,500 acre-feet. The average total contents of Scofield Reservoir are about 42,360 acre-feet. All of these values are for the 1960–2002 hydrologic period.

The Price River below Scofield Reservoir, referred to as lower Fish Creek, has a wide range of flows that vary according to downstream water demands and hydrologic conditions. Releases consist of direct flow right bypasses and Scofield Reservoir storage deliveries for Scofield Project users. Spills occur when the reservoir is full and water flows over the spillway or when releases are made in excess of downstream demands. These total releases and spills have averaged 51,815 acre-feet for 1960–2002 but historically have varied from 13,762 to 154,475 acre-feet. Low flow conditions generally occur from November through March. There are no minimum flow requirements in the Price River, and it is not unusual for the flow below the dam to be completely shut off during winter months. Peak flows below the dam occur in wet years when the reservoir spills. While normal dam releases in June are about 150 cfs, the total releases with these spills have ranged up to more than 1,100 cfs. Since spills are in excess of downstream consumptive use requirements, they usually increase river flows throughout the lower Price River to the confluence with the Green River. From 1960 to 2002, the reservoir filled and spilled 17 times. This indicates that, on the average, the reservoir historically has spilled about every 2 to 3 years.

About 25 miles downstream from Scofield Reservoir near the small community of Heiner, the average annual flow of the Price River is about 81,000 acre-feet based on 1935–81 data. Within 5 miles of Heiner, numerous diversions from the river occur. The largest diversion is the head of the Carbon and Price Wellington Canals, located about 1.5 miles south of Spring Glen. Except during high water conditions when the flow of the river exceeds the capacity of the canals, the river essentially is dry below this diversion. In addition to irrigation water, winter flows also are diverted for stockwatering.

Irrigation return flows in this area discharge back to the river, and the flow of the river increases after passing through the Price-Wellington area. Near its confluence with the Green River, the average annual flow of the river is 94,929 acre-feet, based on 1960–92 records. The stream gauging station on the Price River at Woodside was discontinued in September 1992 and renewed in July 2000.

As mentioned previously, Cottonwood Creek, located in the San Pitch River Basin, has typical flow conditions as compared with other streams in the area with one noted exception. After spring runoff flows subside in late May or early June, natural flows are supplemented with releases from Fairview Lakes. These releases are made through an existing transmountain tunnel. Flows from Fairview Lakes are used by the Cottonwood-Gooseberry Irrigation Company as a source of supplemental irrigation water in the Fairview area. These supplemental releases generally occur in July and August. The historic average annual flow volumes at the tunnel outlet and the mouth of Cottonwood Creek have been 2,055 and 8,600 acre-feet, respectively.

Operation of the Narrows Project would affect streamflows in Gooseberry Creek, Fish Creek, Price River, Green River, Colorado River, Cottonwood Creek, and about 3 miles of the San Pitch River. Table 3-2 provides a comparison of average monthly streamflows under the four project alternatives evaluated. Monthly streamflow data were used to develop this table because reliable daily streamflow data were not available.

Impacts to Lower Gooseberry Creek and Fish Creek would occur primarily during the spring snowmelt period as water is stored in Narrows Reservoir for release later in the summer. Impacts to Lower Gooseberry Reservoir would consist of reduced inflow. However, the effect would be negligible because the reservoir is not operated as a storage reservoir. As a result, the outflow would be reduced in the same proportion as the inflow would be reduced. Impacts to Scofield Reservoir would be in the form of reduced inflows, resulting in a lowering of average reservoir storage. Impacts to regulated releases from Scofield Reservoir for Scofield Project use would occur only during multiple successive drought years, such as occurred in the early 1960s, early 1990s, and the early 2000s. Impacts to the Price, Green, and Colorado Rivers would result primarily in reduced spills from Scofield Reservoir.

The impacts of the Narrows Project on water resources are most pronounced near the reservoir. About 1 mile of Upper Gooseberry Creek and 4.3 miles of small streams in the proposed reservoir basin would be inundated by the reservoir. In addition, annual flows in the middle 3 miles of Gooseberry Creek between Narrows Reservoir and inflow into Lower Gooseberry Reservoir would be reduced by about 74%. Under the Proposed Action, a 1.0-cfs minimum flow would be made from Narrows Reservoir to Gooseberry Creek to provide a 1.5-cfs minimum flow at the USDA Forest Service campground ⅛ mile downstream from the proposed damsite. If the 1.5-cfs flow at the campground is not met, up to an additional 0.25 cfs would be released from the reservoir to meet the required flow. Minimum streamflow releases from Narrows Reservoir would eliminate periodic dry stream channels in the Middle Gooseberry Creek segment. An average of 300 acre-feet per year also would be released for channel maintenance or other instream flow purposes.

Flows in Cottonwood Creek would increase during the irrigation season, with the import of project water through Narrows Tunnel. However, during the irrigation season, these flows would be less than peak flows that occur naturally during the spring snowmelt period. The Upper Cottonwood Creek Pipeline would convey these increased flows outside the stream channel between the tunnel outlet and the confluence with Left Hand Fork. About 300 feet below the Left Hand Fork confluence, the project flows would be discharged to the stream. At this point, the increase in average July and August flows from current conditions would be about 200%.

Depletions to the Price River drainage would average 5,597 acre-feet per year. This amount would consist of 5,227 acre-feet of transbasin diversions and 370 acre-feet of increased evaporation in the Price River Basin. When measured in Gooseberry Creek below Narrows Reservoir, the reduction in annual streamflow varies between 1,760 and 10,200 acre-feet, depending on the storage level of Narrows Reservoir and the magnitude of the streamflow into the reservoir. As shown in table 3-2, the greatest impact would occur during the spring snowmelt runoff period. Releases from Narrows Reservoir to Gooseberry Creek would remain at a minimum of 1.0 cfs; and when the reservoir is spilling or when flushing releases are made, the flow would be greater.

As a result of constructing Narrows Reservoir, the operation of Scofield Reservoir would be altered within the normal historic range. Scofield Reservoir would operate at a lower level with implementing the Proposed Action, as shown in figure 3-1. Under project conditions, the average total contents of Scofield Reservoir would be reduced from about 42,360 acre-feet to about 31,500 acre-feet. Average reduction in storage releases to irrigators in the Price area

would be about 753 acre-feet per year. Total depletions to the Price River drainage would average 5,597 acre-feet per year. Both the volume and frequency of spills from the reservoir would be reduced. The average reservoir surface area would be reduced from 2,370 acres in the No Action Alternative to about 2,125 acres. This is about a 10% reduction or about 245 acres of the surface area of the No Action Alternative.

Since Scofield Reservoir would operate at a lower level, there is an increased potential for the reservoir to be drained to the bottom of its active storage. The frequency of this occurrence increases from 3 times in 43 years for the No Action Alternative to 12 times in 43 years with the Proposed Action.

During most years, controlled releases from Scofield Reservoir to meet Scofield Project demands would remain unaltered.

In summary, the residual impacts (after mitigation) of the Proposed Action include the inundation of 1.0 mile of Gooseberry Creek and 4.3 miles of unnamed tributaries. Flows in Gooseberry Creek below Narrows Reservoir, Fish Creek, and the Price River would be reduced as shown in table 3-2. The flow in Cottonwood Creek below the confluence with Left Hand Fork would be increased during the nonrunoff portions of the irrigation season. Scofield Reservoir would operate at a lower level in most years; and reductions in storage releases to irrigators in the Price area would occur only after several successive years of drought but would average about 753 acre-feet per year. However, on the average, these reductions would be about 1,500 acre-feet less than those that would have occurred if Scofield Reservoir had not been enlarged to accommodate the Gooseberry Project (Narrows Project).

S3.4 FISHERIES

Most of the Narrows Project alternatives have the potential to affect aquatic resources in Gooseberry Creek, Fish Creek, three unnamed headwater tributaries to Gooseberry Creek, Cottonwood Creek, Lower Gooseberry Reservoir, Fairview Lakes, and Scofield Reservoir (see the location map). Cottonwood Creek is in the San Pitch River Basin, whereas all of the others are in the Price River drainage. Cottonwood Creek flows into the San Pitch River downstream from Fairview, Utah; but the San Pitch River, within the project area, does not support a sport fishery because of low summer flows.

Flows in Gooseberry Creek, its unnamed tributaries, and Cottonwood Creek presently are affected by the operation of Fairview Lakes, which store water during spring runoff. Water from the lakes is delivered during the irrigation season via one of the unnamed tributary streams and a canal to the Narrows Tunnel that discharges into Cottonwood Creek. The released water then is diverted for irrigation in Sanpete County.

Lower Gooseberry Creek and Fish Creek downstream from the confluence with Gooseberry Creek also are affected by the operation and limited regulation offered by Fairview Lakes. If the project is approved, an operating agreement would have to be negotiated between SWCD and Cottonwood-Gooseberry Irrigation Company (CGIC) to regulate seasonal releases from Fairview Lakes in connection with downstream discharges from the Narrows Reservoir.

Aquatic resources vary considerably between the different reservoirs and stream segments that could be affected by the Narrows Project. Fish habitat study reaches are shown in figure 3-4.

The State Engineer stipulates that a minimum of 1.0 cfs is to be released downstream from the proposed Narrows Dam; and, if the flow is not 1.5 cfs at the Gooseberry campground, SWCD is required to release 1.25 cfs from the dam. It also is stipulated that the dam be constructed with a multiple-level outlet to regulate water temperature for the trout located downstream from the dam.

The proposed project would cause flow reductions in Gooseberry and Fish Creeks as shown in table 3-2. Flows in Middle Gooseberry Creek immediately downstream from the proposed dam would be expected to be reduced on average by 74%, whereas flows downstream from Lower Gooseberry Reservoir would be expected to be reduced by 43%. In Fish Creek, flows would be expected to be reduced approximately 15%.

The 5,400-acre-feet diversion of project water into Cottonwood Creek would cause about a 200% increase in the base summer flow in Upper Cottonwood Creek (table 3-2). As shown, the base summer flows in Lower Cottonwood Creek would be increased by about 160%. However, the increased flows would occur only during the July-to-October period and not during the peak runoff or the low flow months (November–April). Additionally, these base summer flows would be less than the peak flows that currently shape the stream channel. Therefore, the stream channel itself would remain stable.

Providing a 2.0-cfs winter release through the Narrows Tunnel is expected to greatly increase the weighted usable area (WUA) for all fish species in Cottonwood Creek. This increased flow particularly would benefit the upper reaches of the creek and would be expected to facilitate the overwintering of fish.

The length of time required initially to fill Narrows Reservoir would, of course, depend on hydrologic conditions in the basin. During wet years, the reservoir could fill during a single spring runoff. For more normal conditions, if no diversions were made to Cottonwood Creek until the reservoir filled, it likely would fill in 2 years—almost certainly within 3 years. Under dry conditions, if diversions to Cottonwood Creek did occur during the filling period, it could take 5 to 15 years to fill Narrows Reservoir. Due to these hydrologic uncertainties, there is no firm filling schedule for the reservoir.

At maximum storage, the proposed Narrows Reservoir would inundate about 1 mile of Upper Gooseberry Creek and approximately 4.3 miles of the three headwater tributaries with permanent flows that join to form Gooseberry Creek.

Based on the stream habitat that would be inundated by the proposed reservoir, it is expected that 1.3 and 2.1 acres of stream-based aquatic habitat would be lost in Gooseberry Creek and the tributaries, respectively. Using the standing crop estimates, approximately 230 pounds of stream-based cutthroat trout would be lost, of which 22% would occur in Gooseberry Creek and 78% would occur in the tributary streams, although the trout biomass likely would be converted into a flat-water equivalent.

The Utah Division of Wildlife Resources (UDWR) does not recognize the creation of a reservoir fishery as adequate compensation for the loss of stream aquatic resources. Creating an additional reservoir fishery would compensate for adverse effects that may occur on Lower Gooseberry Reservoir and Scofield Reservoir. This would represent a cumulative beneficial project impact to reservoir fishery.

In summary, the Proposed Action would result in loss of cutthroat trout stream habitat attributable to reservoir inundation and flow alteration. The project also would result in more reservoir habitat for cutthroat trout. The

reservoir cutthroat trout habitat that would be created by the project would compensate for any adverse impacts that may occur on Gooseberry or Scofield Reservoirs. Therefore, mitigation for reservoir habitat has not been proposed.

A total of 11 fishery improvement and mitigation measures have been proposed by SWCD to compensate for the adverse aquatic impacts that have been identified with the proposed project. To the extent possible, an attempt was made to mitigate "in place" and "in kind." These measures have been developed in coordination with various Federal and State agencies and were described in detail in chapter 2, section 2.2.2.2.1. Table 3-11 is a summary of the aquatic impacts and proposed improvement and mitigation commitments for the Proposed Action.

The intent of the aquatic mitigation measures is to provide full mitigation for all adverse impacts resulting in no residual cumulative or overall impacts.

S3.5 WATER QUALITY

S3.5.1 Upper Gooseberry Creek

On the basis of data collected from Upper Gooseberry Creek and Cottonwood Creek, where much of the flow is from Gooseberry Creek through the Narrows Tunnel, the water is considered very good quality. As shown in table 3-14, the dominant chemical constituents are calcium and bicarbonate, with other common ions being minor in concentration. Total dissolved solids (TDS) are low, ranging from 184–258 milligrams per liter (mg/L) in Gooseberry Creek, and 160–316 mg/L in Cottonwood Creek. Trace elements are very low in concentration, with most below detection limits.

Although most of the phosphate levels in these samples were considerably less than 0.05 mg/L, previous studies conducted by the UDWR indicate that the 0.05-mg/L guideline for streams is often exceeded in Cottonwood Creek. Existing soil and rock erosion may be the major sources of phosphates exceeding this pollution indicator, with livestock grazing, recreation, and wildlife also contributing. At levels of 0.05 mg/L or greater, Utah Division of Environmental Quality (UDEQ) indicates that investigations should be conducted to develop more information concerning the sources of the phosphate.

S3.5.2 Lower Gooseberry Reservoir

The Utah Division of Water Quality completed a limnological assessment of Lower Gooseberry Reservoir that indicates it is a fairly stable mesotrophic (moderate levels of organic and mineral nutrients) system with good water quality (State of Utah, Department of Environmental Quality, Division of Water Quality, 2008). The only parameters to exceed State water quality standards for defined beneficial uses are phosphorus, pH, and dissolved oxygen (DO). The average concentration of total phosphorus in the water column has not exceeded the recommended pollution indicator for phosphorus of 0.025 mg/L; but on occasion, higher values are reported at various depths in the water column. On occasion, DO levels and pH values have violated State standards near the bottom of the reservoir, mainly during winter ice coverage. The extensive macrophyte coverage of the bottom of the reservoir is the only factor in the reservoir responsible for this phenomenon. The reservoir is shallow, with a mean depth of 3.7 feet, has good light penetration throughout the water column, and does not stratify. UDWR has expressed

concern about nutrient loading of Lower Gooseberry Reservoir and its effect upon DO levels in the reservoir. The oxygen depletion of the reservoir during the winter is believed to result from low winter inflows combined with decomposition of organic material resulting from the extensive macrophyte growth during the summer, as mentioned above.

S3.5.3 Scofield Reservoir

Recent studies indicate that Scofield Reservoir is mesotrophic in its present state. Data collected in 1990 and 1991 depict the reservoir as hypereutrophic, while data in 1992 after treatment and eradication of trash fish indicate a moderately eutrophic system. Data collected between 1995 and 2003 indicate a mesotrophic system (State of Utah, Department of Environmental Quality, Division of Water Quality, 2006). Eutrophication is a term applied to the organic degradation of a body of water and is associated with elevated levels of carbon, nitrogen, phosphorus, and other inorganic nutrients. The degree of eutrophication generally is exhibited by the growth and appearance of large colonies of algae in highly eutrophic waters, coupled with a green cast or color to the water. This generally occurs during the warm summer months.

Trophic State Index (TSI) is a general measure of the level of eutrophication in a reservoir. The Carlson TSI is determined using measures of secchi depth, chlorophyll, and phosphorus (Carlson, 1977). TSI values greater than 50 are indicative of a eutrophic system, and TSI values between 40–50 are indicative of a mesotrophic system. The average TSI value for Scofield Reservoir of 53.3 (for 1979–80) was reported by UDEQ in a report entitled *Scofield Reservoir Restoration Through Phosphorus Control*. For the period 1981-2007 the average TSI value was computed to be 47.1 (see figure 3-5).

The water quality of Scofield Reservoir is considered fair. Average constituent levels of the reservoir and its tributaries are listed in table 3-15. The average detention time is about 1.4 years. The maximum depth is 66 feet, and the mean depth is 26 feet. The shallow areas with water less than about 15 feet deep normally are covered with extensive macrophyte growth, although these are normally submergent. This adds to the oxygen deficit problem during parts of the year.

The principal pollutants are nutrients, sediments, and trace elements associated with erosion and mining and nonpoint sources such as construction of roads and mine portals, domestic waste disposal, animal grazing, and natural deposits of rock containing phosphates.

Several independent water quality studies of Scofield Reservoir (listed in the "Bibliography") show that phosphorus is the limiting nutrient. This means that all available phosphorus is used up in producing algae or other cell bodies, while there remains a surplus of carbon, nitrogen, and other nutrients. Thus, without the input of additional phosphorus into the system, no additional algal cells can form. About 53% of the phosphorus loading to Scofield Reservoir enters from Fish Creek, according to a 1983 Utah Department of Health study. Indications are that the source of most of the phosphorus consists of naturally occurring, phosphorus-laden soils in the upper watershed.

Fish kills in Scofield Reservoir have been reported during 14 of the 46 years from 1960–2005. These fish kills are minor and generally occur in late summer. They are an indicator of water quality problems with low DO levels being the most probable cause of the fish dying.

In 1984, UDEQ received a Clean Lakes Phase II grant pursuant to the Clean Water Act, Section 314, to rehabilitate Scofield Reservoir through a program to reduce total phosphorus loading to the reservoir. UDEQ had concluded that

> *"the most pragmatic and effective means to control the further eutrophication of Scofield Reservoir, or possibly to effect a moderate reversal of the eutrophication process, appears to be a reduction of the phosphorus load to the lake."*

The restoration project consisted of installing stream revetments and checkdams, revegetation of denuded streambanks, replacing water diversion systems for irrigation, providing a fish cleaning station, and developing a public awareness and education program to alert people of the pollution problem and solicit their support in reducing phosphorus loads to the reservoir. Streambank rehabilitation activities occurred on segments of Mud Creek and Fish Creek. The overall streambank work was designed to reduce stream sediments and erosion through streambank stabilization and revegetation of denuded soils in highly eroded areas.

A postproject monitoring program indicated that the project was initially effective. Streambank stabilization and revegetation occurred in the project area. Visual observations indicated that sediments were being removed from the streams. Although there is insufficient empirical data to conclusively support the effects of the implementation effort, the data indicated a decline in total phosphorus concentrations. However, many aspects of the project were voluntary on the part of the landowners. Since the project completion, many of the project measures have not been maintained. In particular, one aspect included fencing Mud Creek to prevent cattle from entering the stream, damaging the streambanks, and defecating in the stream. This was initially effective, but the landowners currently keep the gates open, thus allowing cattle access to the stream.

Utah Division of Water Quality officials believe that the presence of "rough fish," such as carp and suckers, also contribute to the water quality problems in Scofield Reservoir. These fish feed on the reservoir bottom and stir up sediments. This agitation could increase the internal phosphorus loading of the reservoir. In critical water quality years, removal of these fish species might improve the water quality of the reservoir. For example, 1992 was a critical year for Scofield Reservoir operation. Reservoir levels were extremely low, and fish kills were anticipated. However, a fish eradication program was conducted the previous year that killed the undesirable fish. No fish kills were observed in 1992 even though water levels were critically low.

In 2000, the Utah Department of Water Quality submitted, and the U.S. Environmental Protection Agency (EPA) approved, a phosphorus total maximum daily load (TMDL) for Scofield Reservoir (State of Utah, Department of Environmental Quality, Division of Water Quality, 2000). The TMDL identifies total phosphorus and DO as pollutants of concern, which have attributed to the impairment Scofield Reservoir's Class 3A beneficial use for cold water species of game fish. The TMDL focuses on total phosphorus as the pollutant of concern because low DO is linked to high phosphorus levels. The loading assessment quantified the current total phosphorus load to the reservoir at 6,723 kilograms per year (kg/year). The TMDL identified three endpoints to improve reservoir water quality:

1. Shift in phytoplankton dominance from blue-green algae

2. DO level of no less than 4.0 mg/L in 50% of water column
3. TSI values between 40 and 50

These endpoints are to be met by reducing the total phosphorus load to the reservoir by 1,881 kg/yr.

S3.5.4 Colorado River Salinity

At its headwaters in the mountains of north-central Colorado, the Colorado River has a salinity concentration of 50 mg/L. As a tributary to the Colorado River, the Price River contributes to the salinity load of the river system. The concentration progressively increases downstream as a result of water diversions and salt contributions from a variety of sources. Near Yuma, Arizona, the Imperial Dam, built in the 1930s, diverts Colorado River water into three different canals and holds the river water until it can be directed into a desilting plant. Annual salinity concentrations at Imperial Dam are expected to decrease from the 1987 measured average level of 850 mg/L to an estimated average of 779 mg/L by the year 2025, assuming continuing successful implementation of the salinity control program.

Water in the Price River suffers major quality deterioration as the stream crosses the irrigated sectors of the river basin. The deterioration results from both geologic and human factors. From about November–April, little water is released from Scofield Reservoir, and the upper portion of the basin contributes little water to the river. During this period, irrigation return flow is not significantly diluted by better quality water. Although major releases are made from Scofield Reservoir from May–October, a large part of the flow is diverted during this period into major irrigation canals in the upstream part of the basin. Significant amounts of irrigation return flow of poor quality enter the river downstream from points where most of the flow is diverted from the river.

Accordingly, during most of the year, the flow in Price River in the central basin is composed of relatively small amounts of good quality water from the upper basin and variable amounts of irrigation return flow and natural flow from tributaries that drain the marine shales. This increases the TDS level from about 300 mg/L to about 2,000 mg/L as measured above and below the areas of principal use. Although some deterioration in the chemical quality of the Price River probably would occur in the absence of stream regulation and irrigated agriculture in the central basin, deterioration is intensified with the presence of both.

S3.5.5 Cottonwood Creek and San Pitch River

As indicated above, Cottonwood Creek has good water quality and generally meets all of its present beneficial use classifications. The San Pitch River is also generally good quality water above Fairview. However, the San Pitch River degrades downstream since most of the water is diverted; and near Moroni, the river is composed mostly of return flows from irrigation and municipal waste water. However, the TDS levels are generally below 500 mg/L in this reach, and the water is very suitable for irrigation. Most of the water is diverted from the stream about 2.5 miles west of Mt. Pleasant. Table 3-16 summarizes the water quality in this reach of the San Pitch River. Levels of trace elements (metals) in both streams are normally below detection levels.

Table 3-17 summarizes the water quality in the lower section of the San Pitch River and in Sixmile Creek near the mouth. Water in Sixmile Creek is very good quality with

TDS levels averaging about 350 mg/L. Waters in the lower San Pitch River consist of mostly return flows and are further degraded below the proposed project area. The average TDS in the San Pitch River above Gunnison Reservoir is about 1,050 mg/L and is about 1,635 mg/L below Gunnison Reservoir. The recommended TDS criteria for irrigation water are 1,200 mg/L. Levels of trace elements (metals) in both streams are normally below detection levels.

S3.5.6 Predicted Water Quality Effects

Under the Proposed Action, there could be some water quality impacts during construction; however, measures would be implemented to minimize those impacts. The contractor would be required to comply with applicable Federal and State laws, orders, and regulations concerning the control and abatement of water pollution. The contractor's construction activities would be performed by methods that would prevent entrance or accidental spillage of solid matter, contaminants, debris, and other objectionable pollutants and wastes into streams, lakes, and underground water sources. Sanitary wastes would be disposed of by approved methods.

The construction contract would require the contractor to develop and implement a Water Quality Management Plan (Erosion Control Plan) and a Storm Water Pollution Prevention Plan. The contractor also would be required to implement the best management practices (BMPs) specified in the *Nonpoint Source Water Pollution Control Plan for Hydrologic Modifications in Utah*, which is an addendum to the *Utah Nonpoint Source Management Plan*. Specifically, applicable sections, such as Hydromod Planning Process, Measures to Control Construction Activities, and Impoundments, would be followed and implemented. Under a worst case scenario, if sediment control facilities temporarily failed and any stream sections were significantly impaired, remediation/restoration work would be implemented to the satisfaction of the appropriate government agencies.

Any construction work occurring in streams or associated wetlands would be conducted in compliance with USACE's 404 Permit and/or Utah State Engineer's stream alteration permit, which would include the State 401 certification process.

S3.5.6.1 Lower Gooseberry Reservoir

The average annual inflow (based on 1978–2005 data) to Lower Gooseberry Reservoir would be reduced by 40%. The average annual phosphorus load levels below the proposed Narrows Reservoir would be reduced by about 113 kg/yr, resulting from phosphorus export and uptake in the Narrows Reservoir. This would result in a 45% reduction in the average nutrient load in the total inflowing water. The average in-lake phosphorus concentration would be reduced from 0.0131 to 0.0119 mg/L, and the probability of eutrophication would be reduced from 24.3 to 19.7%. Because the DO levels are greatest near the stream inlet, a decrease in inflow is expected to decrease the overall DO level of the reservoir in winter during iced-over conditions, thus increasing the potential for fish kills, unless mitigation were implemented. Mitigation is planned for this, which would include additional storage in the Narrows Reservoir and minimum streamflow releases as discussed in section 3.4, "Fisheries."

S3.5.6.2 Scofield Reservoir

The results of the eutrophication study (Franson-Noble Engineering) with the Narrows Dam and Reservoir show that, under the Proposed Action, there would be a reduction of average annual phosphorus

mass loading into Scofield Reservoir (105 kg/yr) and a slight increase of 10.8% in phosphorus in-lake concentration from 0.0279 to 0.0309 mg/L. The reduction in phosphorus loading results from basin export and uptake in Narrows and Lower Gooseberry Reservoirs. The overall probability of eutrophication for the period studied shows an increase from 68.3 to 73.5% (about a 5.2% increase). The probability of eutrophication was increased slightly every year except 1984. Figure 3-6 shows a comparison of the future without project and project phosphorus level in Scofield Reservoir based on external loading.

As a result of the Proposed Action, the inflow to Scofield Reservoir would be reduced by an annual average of 5,726 acre-feet (about 9.2%). This means that Scofield Reservoir generally would operate at a lower elevation and smaller surface area. Its average flushing rate would decrease slightly, from 1.15 to 1.14. However, the flushing rate would drop below 0.85 in 10 of the 46 years studied, instead of 8 of 46 years as would occur in the future without the project (see figure 3-7). The critical low flushing rate would occur 22% of the time with the project as compared to 17% of the time without the project. During these periods of critical flushing rate, the probability of fish kills could be somewhat higher.

Taking into account the slight increase in in-lake phosphorus concentration and essentially no change in flushing rate, professional judgment would indicate that the overall water quality in Scofield Reservoir would be degraded only slightly by the Proposed Action without mitigation. Mitigation measures to offset this potential impact are described in section 3.5.3.2.6.

S3.5.6.3 Proposed Narrows Reservoir

The overall water quality in the proposed Narrows Reservoir is projected to be good. The probability of eutrophication would be about 12% (compared to 73.5% for Scofield Reservoir and 19.7% for Lower Gooseberry Reservoir). The proposed Narrows Reservoir is not expected to strongly stratify due to its shape, water budget, and location. The active pool (the storage above the inactive pool) would only be 45 feet in depth, with an average drawdown of 9 feet during the recreation season and 12 feet annually. The proposed plan is to have three outlets spaced 20 feet apart, at elevations 8,640; 8,660; and 8,680 feet, respectively. The normal water surface elevation is 8,690 feet. If a mild thermocline develops, it normally would start at about 16 to 20 feet and, over the summer season, migrate down to a depth of 32 to 45 feet depending upon the release pattern, level of water withdrawn, and type of year. Once the reservoir was constructed, filled, and operated for several years, an operating plan would be developed jointly with the State and Federal agencies to enhance habitat for fish and wildlife downstream. As a result of the small releases and stream channel conditions downstream, the water would reach ambient conditions within the first one-fourth to one-half mile downstream, relative to temperature and dissolved oxygen, even if conditions were less than optimum in waters released.

Water quality at the proposed Narrows Reservoir would be protected by establishing protection zones adjacent to the reservoir. Within these protection zones, land use practices would be restricted to eliminate activities that would impact reservoir water quality.

S3.5.6.4 Price and Colorado Rivers

The Narrows Project would have virtually no effect on the lower Price River water quality during the November–April high TDS period,

because the effects of depletions caused by the proposed Narrows Project would consist primarily of reduced spills from Scofield Reservoir during the snowmelt runoff period.

Implementing the Proposed Action would have a slight detrimental impact on Colorado River salinity. Construction and operation of the proposed Narrows Dam and Reservoir would remove about 1,520 tons of salt per year from the Colorado River system.

However, the project also would cause a depletion of about 5,597 acre-feet of water to the Colorado River system. An increased salinity concentration of about 0.54 mg/L would occur at Imperial Dam.

S3.5.6.5 Cottonwood Creek and San Pitch River

The overall water quality of Upper Gooseberry Creek is better than that of Cottonwood Creek (see table 3-14), so the additional water imported to Cottonwood Creek would improve slightly its quality. The exception may include temporary periods of slightly higher turbidity from the increased summer flows. Flows in Cottonwood Creek (below Left Hand Fork) would increase in July and August due to the increased irrigation releases, but these flows would be significantly less than peak flows that naturally occur during the spring snowmelt period. As discussed in the DEIS and the FEIS in section 3.14, "Slope and Channel Stability," the Narrows Tunnel operating gate would be automated to regulate releases through the tunnel so that even during thunderstorms, the channel forming discharge would not increase above historical conditions. Consequently, even though the Proposed Action would increase the summer base flow, it would have no effect on Cottonwood Creek channel stability because the increase would be well below the 50-year channel forming discharge.

Except during spring runoff and winter conditions, flows in the San Pitch River below the project area consist mostly of return flows from irrigation and municipal waste water. The project would increase the volume of return flows from both of these sources; but since no new lands receive project water, the quality of return flows would be similar to existing flows or possibly be of slightly better quality because lands would receive a more complete water supply. Consequently, the concentration of dissolved salts should be more diluted in the increased volume of return flows. The potential decrease in irrigation return flows resulting from increasing agricultural efficiencies would be offset by the increase of return flow from the additional project irrigation water. Even if the overall volume of return flow were reduced significantly due to increased efficiencies, the quality of the return flows likely would not change significantly, nor would the existing quality of the San Pitch River change significantly since it is already composed mostly of return flows.

As shown in table 3-17, the salinity of lower San Pitch River is about 1,150 to 1,635 mg/L TDS compared to about 350 mg/L in Sixmile Creek. If the Manti Meadows Alternative wetland mitigation area is selected, and water is delivered from Sixmile Creek and replaced with project return flows delivered to Gunnison Reservoir in exchange, there could be some impact to effected irrigated lands.

Diversions to the wetland area would have to be timed to not significantly affect the exchanged irrigation water supply, or replacement waters would need to be blended with higher quality Sixmile water to avoid impact to crops using the water. Under worst case conditions, an agreement with the Manti Irrigation Company might be needed, and minimal compensation might be required.

S3.6 WETLAND RESOURCES

The wetlands affected by the project are not unique to the area. They consist of wetland plant communities common to high elevation mountain areas. Much of the area has been used for livestock grazing to the extent that rangeland restoration was necessary. In 1908, the USDA Forest Service established a controlled grazing plan for rangelands on the Manti-La Sal National Forest. Cattle and sheep grazing are still allowed in this area.

Major plant community types occurring in the reservoir basin have been mapped (see figure 3-8). The three major plant communities that would be affected most by reservoir inundation are:

1. Vasey sagebrush
2. Silver sagebrush
3. Riparian areas including wetlands

Within the proposed reservoir basin, water collects and forms wet meadows, riparian wetlands, and willow thickets. The wet meadows are located adjacent to streamside vegetation and on higher ridges where spring seeps occur. Vegetation consists of rushes (*Juncus* spp.), sedges (*Carex* spp.), and various hydric grasses, such as tufted hairgrass (*Deschampsia casepitosa*). Riparian wetlands occur in a dendritic pattern along small drainages within the basin. They consist of similar rush, sedge, and grass species and form narrow bands (usually 3–6 feet wide) of streamside vegetation. Less common in the reservoir basin are willow thickets. They occur primarily in the upper reaches of the proposed inundation area, usually along stream channels within the basin, and along Gooseberry and Cottonwood Creeks. Willow species include Drummond's willow (*Salix drummondaiana*), Booth willow (*S. boothii*), and Wolf willow (*S. wolfii*).

The proposed Narrows Reservoir would inundate 89 acres of wetlands.

Hydrologic and hydraulic studies were conducted to determine the potential impacts to the riparian and wetlands vegetation of Gooseberry Creek resulting from decreased flows. Flow measurements conducted by the Utah Division of Water Rights indicate that the stream is a "gaining stream." This means that the stream flow increases as it moves downstream because the stream is being fed by the adjacent ground water aquifer. Because the stream is serving as a drain for the ground water system, an increase or decrease in stream water level would result in a corresponding increase or decrease in the elevation of the ground water table adjacent to the stream.

Water surface profile studies were conducted to determine the depth of flow in Gooseberry Creek between the Narrows damsite and Lower Gooseberry Reservoir. The studies indicated that, with the reduced flows proposed by the Proposed Action and with the existing stream cross section, the depth of flow would decrease by 6 to 11 inches under worst case conditions. However, the project plan includes proposed modifications to this portion of the Gooseberry Creek channel. These modifications include narrowing the channel to maintain the depth of flow. In designing the stream channel modifications, the intent would be to create a stream channel that is more naturally suited to the new flow regime and that will have the same depth of flow as under baseline conditions. Therefore, the depth of ground water adjacent to the stream would not decrease, nor would there be any adverse effects on riparian and wetland vegetation adjacent to the stream. If anything, it is entirely possible that the wetland communities would be enlarged as a result of the project impacts; the current outer bounds of those communities likely would be unchanged as a result of the shallow ground

water flowing toward the stream, but the wetlands likely would be increased precisely to the degree that the stream channel itself (or at least, the open water surface of the stream) narrows.

The process of narrowing the stream, as described in the SDEIS, is planned so that the configuration of the narrowed streambanks would conform to that of the original streambank with respect to slope, materials, material size, and frequency as well as the water depth. The only change would be in the width of the channel and available open water surface. The result is that the same opportunity for overbank flows and wetted perimeter would exist as in the natural configuration. The gaining nature of the stream in this reach means that ground water is flowing toward and into the stream channel and that the stream does not provide the primary supply for the riparian community. The "wetted perimeter," therefore, should continue to be supplied from this source; and the stream will continue to gain as it flows. Bank saturation will not be affected here, as it would on many streams, because the direction of the ground water flows into the stream rather than away from it. While overbank flows may be reduced in frequency, such flows, for this same reason, also are not critical to the bank saturation that supports the riparian community.

About 160 square feet (0.004 acre) of wetlands adjacent to Cottonwood Creek would be impacted by constructing the discharge structure at the end of the Upper Cottonwood Creek Pipeline. The remainder of the stream channel would not be affected. The channel presently is stable and adequately protected by natural cobble armoring.

Wetland mitigation measures are included in the project alternatives to mitigate for impacts to wetlands. The wetland mitigation measures would provide similar wildlife habitat values lost due to the inundation of the reservoir.

S3.7 VEGETATIVE RESOURCES

Vegetation located in the study area consists primarily of plant communities common to high elevation mountain areas. Historically, the area has been used for livestock grazing and other reservoir impoundments. Cattle and sheep were introduced into the area in the 1800s and, subsequently, overgrazed the area to the extent that rangeland restoration became necessary. In 1908, the USDA Forest Service established a controlled grazing plan for the Manti-La Sal National Forest. Cattle and sheep grazing is still allowed in the area.

Major plant community types occurring in the reservoir basin have been mapped (see figure 3-8). The three major plant communities that would be affected most by reservoir inundation include vasey sagebrush, silver sagebrush, and wetlands. There are also areas within the basin that have been disturbed previously by diverting water to Cottonwood Canyon through the existing Narrows Tunnel. In addition, there are those disturbed areas associated with SR-264 that cross the north end of the basin.

The areas that are disturbed during project construction have a high probability of being infested by noxious weed species. People using the area may spread the weeds by carrying the seeds on their person or on their vehicles. Seeds will get into the water and be spread downstream in both Gooseberry Creek and Cottonwood Creek. Control of noxious weeds as part of the Narrows Project would be the responsibility of SWCD.

Areas along the foothills of the west side of the Wasatch Plateau would be dissected with the diversion pipelines. Plant communities such as big sagebrush, (*Artemisia tridentata*

var. tridentata), gamble oak (*Quercus gambelii*), grasslands, and mountain brush communities along with their associated wildlife species would be disturbed by the conveyance pipelines. These disturbances, however, would be only temporary because the pipelines would be buried. Revegetation that reflects the existing plant community would be accomplished with a mixture of grasses, forbs, and shrubs. A total of 30 acres along a 17-mile-long alignment would be disturbed by the pipeline construction.

The reservoir basin was identified to receive the most significant impact by the proposed project. For this reason, the reservoir basin was studied in greater detail than the other areas associated with the project. The affected wetlands in this area occur in a dendritic pattern in the riparian zones along small drainages. As shown in table 3-19, plant communities that would be highly impacted by reservoir inundation include vasey sagebrush, silver sagebrush, and wetlands. All vegetation in the 604 acres listed in the table would be inundated by the reservoir.

S3.8 Recreation and Visual Resources

S3.8.1 Recreation Resources

According to the Utah Division of Parks and Recreation's *1992 State Comprehensive Recreation Plan* (SCORP), the most popular outdoor individual recreational activity in Utah is fishing, followed by walking, golf, and camping. As with other major reservoirs along the Wasatch Front, Lower Gooseberry Reservoir, Beaver Dam Reservoir, and Fairview Lakes are heavily fished and overcrowded.

Boating also ranks as one of the more popular outdoor recreation activities in Utah, and not enough flat-water boating and boat launching lanes presently are available to meet public demand. Information from the Utah SCORP suggests that additional boating facilities are needed for the potential growth in demand for recreation users statewide.

Family-favored activities are sightseeing, developed camping, primitive camping, and fishing, among others. First choices for new facilities near communities are picnicking, fishing, special event areas, ice skating, and snowmobiling.

Beaver Dam is a heavily used day-use area for anglers near the proposed project, and there are several developed USDA Forest Service campground facilities in close proximity to the project area. The Lower Gooseberry Reservoir (16 units); Gooseberry (10 units); Flat Canyon (13 units); and Lake Campground (51 units) are all fee areas, with a 92-day season of use from June 15 through September 15. Water, sanitation facilities, tables, and fire grills are provided. Boulger Reservoir is a nondeveloped, dispersed camping area in the area. There are vault toilet facilities there. These campgrounds (with the exception of Boulger) are typically full on weekends and one-third full on weekdays throughout their season of use.

The proposed reservoir area is known as a very popular location for snowmobile enthusiasts. The USDA Forest Service and UDOT maintain unloading, parking, and sanitation facilities along SR-31, immediately west of the proposed reservoir area, from which snowmobiles embark for travel along groomed trails following Skyline Drive and SR-31, as well as in the proposed reservoir area itself.

Whitewater boating is limited mostly to a relatively short season when flows are peaking, coinciding with the high flows from the White River, when the gates at Scofield Reservoir are closed. In wet years, spills from Scofield may contribute to the peak.

When Scofield releases again are started up to supply irrigation demands downstream, the level of boating falls off significantly. The segment of the river between Scofield Reservoir and the picnic area above Price Canyon Dam (approximately 15 river miles) contains Class I–III rapids. The segment of the river between the picnic area above Price Canyon to Castle Gate (approximately 8.5 river miles) contains Class III–V rapids. This segment of the river is more challenging and requires skill and careful maneuvering to avoid the hazards of the narrow canyon. The segment of the river that receives the greatest use is between Woodside to the confluence with Green River. This segment of the river contains Class III–V rapids. The apparent reason for greater use in this area is the flow regime and the wilderness setting of the river segment.

Under the Proposed Action Alternative, recreation facilities, including a 60-unit campground, boat ramp, 10 picnic sites, and a corresponding number of restroom facilities, would be provided at the proposed Narrows Reservoir. The recreation facilities would draw heavy use from not only Sanpete, Carbon, and Emery Counties but also from the Provo/Orem and metropolitan Salt Lake City areas. The proposed Narrows Project would help meet the demand for additional boating facilities in the area. In addition, it is expected that the reservoir would develop into an excellent flat-water fishery. A conservation pool would be provided to ensure successful overwintering of fish.

The proposed Narrows Reservoir would increase the State and regional inventory for fishing, boating, and water play. At the top of the active capacity water level for the Proposed Action, the proposed project's facilities are expected to attract a total of 43,911 additional visitor days per year of total developed recreation use. These use rates are based on use rates of Joe's Valley Reservoir.

Construction of the proposed Narrows Project and its associated recreation facilities would cause the loss of 237 acres of "Roaded Natural" dispersed recreation on Reclamation withdrawn lands and 466 acres on private lands. It is estimated that these 703 acres would provide approximately 910 visitor days at 1980 levels of use and would provide about 2,670 visitor days of use in 2030. This reduction in dispersed use would be offset by the new facilities that would act as an attraction to local communities and individuals from the Wasatch Front who already contribute above 60% of the use on the Manti-La Sal National Forest. It is anticipated that the 43,911 visitor days of newly developed recreation use would be paralleled by an equal amount of dispersed recreation in the reservoir vicinity within the first 5 years of operation. This growth in recreation use would be a direct effect of the project and would require more intensive management in the area surrounding it (approximately, the area 8–10 miles in each direction).

At times when this newly developed recreation site and others in the area are at capacity (most of the summer season and particularly holiday weekends), users would move into nearby nondeveloped or dispersed areas. Some reservoir users actually would prefer dispersed sites regardless of developed site availability, and others would use dispersed sites to avoid associated fees.

The amount of dispersed use within 8–10 miles of the proposed reservoir is already at a level considered to be crowded during holidays and big game hunting seasons. The additional attraction of the new flat-water fishery in this area is expected to increase dispersed use to a point that the USDA Forest Service would need to place restrictions on areas available for this type of use. Such restrictions may include special measures for sensitive areas such as

wetlands. In addition to increased resource protection and rehabilitation costs, conflicts among such activities as ice fishing and snowmobile use, hiking, and all terrain vehicle users could be expected.

Along with increased dispersed use in the area, nearby developed recreation facilities would be impacted. Gooseberry Campground and the Lower Gooseberry Reservoir units are immediately adjacent to the proposed reservoir, as is the Scenic Byway and snowmobile parking area. Skyline Drive, Flat Canyon Campground, and the limited facilities at Beaver Dam and Boulger Reservoirs are also within reasonably close proximity.

Implementing the Proposed Action would cause Scofield Reservoir to operate at a lower level, thus reducing the surface area available for fishing and other forms of recreation by about 12% (274 acres). It is expected that this would result in the loss of about 12,708 visitor days per year, including fishing, based on the Reclamation data referenced in table 3-20. Based on use rates obtained in a 2005 and 2007 creel survey by UDWR, there would be a loss of 3,239 angler days of fisherman use.

Recreation use of Scofield without enlargement would have experienced fewer visitor days. There would have been fewer angler days of fisherman use had Scofield not been enlarged. The aquatic mitigation measures of restoring year-round flows in two small tributaries to Gooseberry Creek and maintaining Fairview Lakes at a higher elevation during the prime summer recreational season also would provide angler benefits to the area.

Under the Proposed Action, more frequent fish kills and accelerated eutrophication also could degrade the park. However, water quality mitigation has been provided. Whereas the total inventory of water-based recreation may be increased, some of it would be offset by a downgraded State park at Scofield. The higher elevation of the proposed Narrows Reservoir would have a shorter season of use at more than 8,600 feet elevation than would Scofield Reservoir at about 7,600 feet elevation. Greater snow cover would probably occur at 8,600 feet elevation causing less access because of deep snow and later snow melt.

Depending on the type of hydrologic year, water levels in Narrows Reservoir would fluctuate between 25–75% of the full pool area during the recreation period, 25% on average and up to 75% in an extended drought cycle. Recreation action may be affected, particularly for those using the boat dock at maximum draw down.

S3.8.2 Visual Resources

The project features would be located within the Manti-La Sal National Forest on the Wasatch Plateau. The dam and diversion works would be located in the Gooseberry Valley, a tributary to the Price River, at about 9,000 feet elevation.

The characteristic landscape is consistent with typical high elevation mountain areas. The topography on top of this plateau is rolling and contains shallow basins covered with sage/grass communities bordered by spruce/fir, interspersed with aspen.

The Narrows damsite is within 2 miles of the intersection of two State highways, SR-31 and SR-264. Both highways have been designated as National and State Scenic Byways. SR-31 connects Fairview in the Sanpete Valley with Huntington in Emery County. SR-264 connects Scofield with SR-31 at Skyline Drive. These are major commuter routes for miners from the Sanpete Valley working in the coal mines on the east side of the Wasatch Plateau. In addition to commuting and recreation traffic, SR-31

serves as a route for hauling livestock from the Sanpete Valley to summer ranges.

It should be emphasized that scenery is an important natural resource and recreational element in this part of the forest. It is primarily through the visual sense that most visitors perceive the forest and its interrelated components. There is additional visual sensitivity here due to the adjacent Scenic Byway, which serves as a forest gateway/viewing corridor for many recreationists.

Under the Proposed Action, temporary and permanent landscape disturbances would be apparent from the placement of project features such as the re-routing of SR-264 and construction of the Narrows Dam structure. These more permanent features would be acceptable in this area of partial retention, especially in the long term. The dam would be within the setting of other dams in the area, and the rerouted portion of the Scenic Byway would serve as a viewing corridor and not a dominant element. Maintaining views within the parameters of partial retention would be contingent upon successful restoration/ revegetation of the old highway alignment and any scarred areas associated with the dam. Care would need to be taken in developing any associated recreation facilities to ensure their design is subordinate to the surrounding landscape.

The Narrows Reservoir would be the most noticeable feature. The reservoir would have a surface area of 604 acres when full. However, during the recreation season, the surface area would average 454 acres. A body of water is generally considered to be aesthetically pleasing. However, as the reservoir is drawn down, exposed mud flats around the more shallow parts of the reservoir may be visually detractive but should remain naturally appearing as they follow the natural line of the reservoir's shore. Although viewed from the Scenic Byway and the reservoir itself, these mud flats primarily would be located on private lands that have no Visual Quality Objective (VQO) designation. However, it is anticipated that these areas would become more naturally appearing over time; and the additional variety provided by the new water body would well offset any negative effect. In the short term, it is anticipated that the visual impact of exposed mud flat or shoreline would be negligible due to steeper topography and the duration and angle of view.

The aquatic mitigation measures of restoring year-round flows in two small tributaries to Gooseberry Creek and maintaining Fairview Lakes at a higher elevation during the prime summer recreational season also would provide aesthetic benefits to the area.

During project construction, increased human activity, heavy machinery, and surface excavation would temporarily detract from the scenery. Such detractions would be visible in localized areas where construction would occur. Minor disruption of traffic on SR-264 would be expected since the existing road would not be inundated until dam construction was completed and the relocated road is serviceable. Temporary disruption on SR-31 is expected.

S3.9 CULTURAL RESOURCES

Cultural resources are defined as physical or other expressions of human activity or occupation. Such resources include culturally significant landscapes, prehistoric and historic archaeological sites as well as isolated artifacts or features, traditional cultural properties (TCPs), Native American and other sacred places, artifacts, and documents of cultural and historic significance. Section 106 of the National Historic Preservation Act of 1966 (NHPA) stipulates that Reclamation take into account

the potential effects of a proposed Federal undertaking on historic properties. Historic properties are defined as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the *National Register of Historic Places* (NRHP).

The affected environment for cultural resources corresponds to the area of potential effect (APE) as defined in the regulations to Section 106 of the NHPA (36 Code of Federal Regulations [CFR] Part 800). According to 36 CFR 800.16(d), the APE

> *"means the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist."*

The APE for the proposed Narrows Project includes the areas impacted by construction activities associated with the construction of the dam as well as the land areas eventually inundated by the reservoir pool area. Also included would be any disturbed areas associated with the construction of a proposed pipeline to Cottonwood Creek as well as additional pipelines to deliver water to existing water distribution systems. Finally, impacts from the proposed rehabilitation of an existing tunnel to Cottonwood Creek, the development of recreation facilities, staging areas, access roads, borrow areas, and any other ancillary facilities linked to the proposed Narrows project would be included in the APE.

Reclamation will complete cultural resource compliance as stated in Appendix F, "Environmental Commitments," of the SDEIS, as a means to fulfill Section 106 of the NHPA. These commitments state that any areas associated with the construction of the proposed project will be subject to Class I and Class III cultural resource inventories to identify and evaluate all cultural resources. If historic properties are located within the APE, and if they will be adversely affected by construction activities associated with the proposed project, a memorandum of agreement (MOA) will be developed. The MOA would be among Reclamation, the Utah State Historic Preservation Office, the USDA Forest Service, the Advisory Council on Historic Preservation (ACHP), if it chooses to participate, and SWCD. The MOA would outline cultural survey protocols, report and treatment plan requirements, and procedures for mitigation on potential impacts to identified and unidentified (inadvertent discovery situations) historic properties. The MOA also would include, among other stipulations, a Native American consultation summarization and would identify the cultural resource APE for the proposed project.

Numerous cultural resource inventories previously have been conducted within the proposed project area. Under a contract with Dames and Moore in 1979, the University of Utah conducted a Class I and Class III cultural resource inventory on a portion of the proposed project APE.

The 1979 Class III inventory identified two prehistoric archaeological sites near the proposed dam and reservoir area. The sites were open lithic scatters with few formal tools. No further evidence of cultural materials was present on these sites. From the limited data available, the proposed project area appears to support the idea that high altitude areas were utilized as temporary, seasonal hunting grounds during the Archaic period, about 2,000–4,000 years before present. In addition, a total of 26 isolated artifacts were recorded during the cultural resource inventory.

Also, one historic cultural resource site, a stone structure foundation, was located during the 1979 inventory. The three cultural resource sites were not evaluated for their

NRHP eligibility in 1979. As a result, the sites will be revisited and evaluated for eligibility as stated in the environmental commitments for cultural resources.

The design and, therefore, the APE of the proposed project have changed since the 1979 cultural resource inventory. Class I and Class III cultural resource inventories have not been performed for the Upper Cottonwood Creek, Oak Creek, or East Bench Pipeline alignments, new road alignments, borrow areas, staging areas, new campgrounds, marinas, wetland mitigation areas, or haul roads. Class I and Class III inventories covering the entire APE of the proposed project will be conducted prior to initiation of final design and construction in accordance with 36 CFR Part 800.

Predicted effects to cultural resources as a result of the proposed project will be determined following the Class I and Class III inventories of the entire project APE.

S3.10 Economic and Social Resources

Social and economic conditions in Carbon and Sanpete Counties are underscored by a century-long dependence upon agriculture. Both valleys originally were developed for agricultural use. However, rich coal deposits were discovered in Carbon County during the 1860s. As a result, the mining industry has become the principal economic activity in the area. Agriculture still remains a significant economic activity in both Carbon and Sanpete Counties. Lack of sufficient irrigation water and concerns over neglected longstanding agreements on water rights constrain the agricultural sector in Sanpete County.

Population in the two-county project area is 43,185 according to the 2000 census. Carbon County had a 2000 population of 20,422. A 2007 census population estimate for this county was 19,364, which is about a 5% decrease since 2000. Sanpete County's population in 2000 was 22,763. For 2007, the population estimate was 24,644, which is an increase of approximately 8% from the 2000 census. The largest community in the two counties is Price with latest census population data from 1990 and 2000; for 1990, the population was 8,712, which decreased to 8,402 in 2000.

The College of Eastern Utah in Price and Snow College in Ephraim are significant cultural and economic resources for Carbon and Sanpete Counties, respectively. The two counties have had a higher than average rate of unemployment since 1960 (refer to table 3-24). For 2007, the unemployment rate for Carbon County was 4.6%, Sanpete County was 3.6%, and the State of Utah was 3.0%. The leading economic sectors in Carbon County in 2006 (in order of importance) are mining, services, government, trade, and manufacturing. Leading economic sectors in Sanpete County include government, services, trade, agriculture, and manufacturing. Because of a larger population base, the city of Price rates higher on community facilities than do the north Sanpete County communities. Moroni and Spring City both have a particular need for improvements in police and fire protection, health care, housing, restaurants, day care facilities, youth recreation facilities, and cultural opportunities. In recent years, the construction and continued growth of the State Correctional Facility at Gunnison has created a sharp increase in the demand for housing in the project area, resulting in housing shortages. Educational facilities in the project area appear average, based on statewide norms.

Agriculture in Sanpete County is of major economic significance and involves a sizable number of people. From 1992 to 2002, the census of agriculture data shows the number

of farms increased by 9%, whereas the number of acres in production changed by less than 1%. The average farm size decreased from 643 acres in 1992 to 471 acres in 2002. About 55% of the land in Sanpete County is used for agriculture. Of that amount, a total of 113,647 acres or 32% is cropland.

Agriculture plays a much smaller role in Carbon County's economy. Only 21% of Carbon County's total acres is used for agriculture. Of that amount, 18,247 acres or 9% is cropland in the 2002 agricultural census. Since 1992, the number of farms increased by 33.5%; but average farm size declined from 1,604 to 821 acres.

As discussed in the SDEIS, agricultural development is limited severely by inadequate water supplies. The limited precipitation, averaging just above 4 inches during the summer months, makes irrigation essential to successful crop production. Yet the demand for irrigation water cannot be met by the fluctuating direct flows in local streams or the limited storage supplies currently available. Present irrigation practices in the project area encourage excessive early season diversion and low farm efficiency. Because of inadequate storage, there is a tendency to apply excessive water during spring and early summer when water is plentiful to obtain maximum soil moisture and sustain crops as long as possible after streamflows have diminished. Water supply studies show that shortages occurred during 1960–2002 on lands that would be served by the Narrows Project. Shortages during those years ranged from 3 to 44% of the diversion requirement. Because shortages are unpredictable, irrigators are unable to implement crop rotation and other practices necessary for optimum production. Table 3-25 presents the annual diversion requirements of the project-eligible lands within the Narrows Project area, quantifying the total water needs of currently irrigated lands and the extent to which these needs have been satisfied on an average annual basis.

Principal crops grown in the project area in order of importance include pasture, alfalfa hay, small grains (barley, oats, and wheat), and meadow hay. Under existing conditions, two crops of alfalfa are harvested each year; and in some years (less than 25% of the time) when weather conditions are favorable, a small third crop is harvested. One crop of meadow hay normally is harvested and the aftermath used as late summer and fall pasture. Small grains are used as rotation crops for hay and pasture. Small grains also sometimes are used as a "nurse" or companion crop for alfalfa. The most common small grain crop is barley. Corn silage, which makes up less than 1% of the irrigated area, is raised primarily by dairymen and livestock feeding operations. Present and projected project crop distribution and yields in Sanpete County are summarized in table 3-26.

Of the 15,420 acres of irrigated farmland within the Sanpete County project area, an estimated 9,252 acres are irrigated by sprinkler. The remaining acreage is flood irrigated. Water shortages within the project area average about 30% annually. Each pressurized pipeline distribution system generally has a regulating pond at its head. Water is diverted out of the streams into these ponds to provide system regulation and to allow sediments to settle out.

Irrigators in the Fairview area rely on the Narrows Tunnel to convey water stored in Fairview Lakes to Cottonwood Creek. As described in chapter 2, the tunnel is in a critical state of disrepair.

S3.10.1 Regional Impact Analysis

The number of jobs created in Sanpete and Carbon Counties during construction of the Narrows Project would not be significant based on a regional impact analysis conducted for this study on the Proposed Action, Mid-Sized, and Small Reservoir Alternatives. At the regional level, the project would cause positive economic output to the study area. Potentially, the most significant short-term impact would occur from construction activities.

The modeling package used in this study to assess the regional economic effects of construction of each alternative is IMpact Analysis for PLANning (IMPLAN). IMPLAN is an economic input-output modeling system that estimates the effects of economic changes in an economic region.

IMPLAN data files are compiled for the study area from a variety of sources, including the U.S. Bureau of Economic Analysis, the U.S. Bureau of Labor, and the U.S. Census Bureau. This analysis used 2004 IMPLAN data for Utah's Sanpete County, where most of the construction activity would occur for the regional impact analysis.

The expenditures associated with construction were placed into categories that represent different sectors of production in the economy. The expenditures that are made inside the study region were considered in the regional impact analysis. Expenditures made outside the study area were considered "leakages" and would have no impact on the local economy. Some construction items (specialized equipment and skilled labor) are more likely to be purchased outside the region and brought to the construction site because of their high cost and lack of availability in the region.

Because of the scale of the construction project, it was assumed that local suppliers and contractors would be able to supply only a portion of the necessary construction, equipment, supplies, and expertise. The regional impact analysis assumed that approximately 50% of the labor wages would be spent locally and approximately 45% of the construction equipment and supplies would be purchased locally.

This analysis also assumed that the majority of the construction expenditures will be funded from sources outside the study area. Money from outside the region that is spent on goods and services within the region would contribute to regional economic impacts, while money that originates from within the study region is much less likely to generate regional economic impacts. Spending from sources within the region represents a redistribution of income and output, resulting in a negligible increase in economic activity.

For the purpose of this study, the construction costs allocated to labor and construction materials spent in the region were used to measure the overall regional impacts. These overall impacts would be spread over the construction period and would vary year-by-year proportionate to actual expenditures. It was estimated that the regional impacts on employment, regional output, and income would be less than 1% of the study area's base employment, output, and income (see table 3-27).

The regional impacts from the construction costs for all the alternatives would be similar in that the impacts would be less than 1% of the regional employment, output, and income.

These regional construction impacts would be lost after construction was completed. A small amount of regional impacts related to operation and maintenance (O&M) activities would be expected but would not significantly impact the overall regional economy in the study area. The additional

water amount provided by each of the alternatives would support the existing community lifestyles and social structure in the study area.

S3.11 LAND RESOURCES

The proposed Narrows Project is located near the exterior boundaries of the Manti-La Sal National Forest. The damsite and other project features would be located on 225 acres of Reclamation withdrawn land. SWCD has acquired 366 acres of private lands for project uses from owners by perpetual easement or in fee. SWCD would purchase 1,340 additional acres of private and State School Trust lands for project needs (table 2-4).

While there are some private in-holdings, the majority of the lands located within the forest boundaries are federally owned and are administered by the USDA Forest Service pursuant to specific authorities granted by Congress to the Secretary of Agriculture and pursuant to the public land laws.

Lands within forest reserves may, however, be appropriated and used for irrigation works constructed under authority of the Reclamation Act of 1902 (32 Statute 388). Therefore, by Secretarial Order dated April 1, 1941, Reclamation withdrew certain forest lands from public entry under the first form of withdrawal (as provided in Section 3 of the 1902 Act). These lands were withdrawn for the construction, operation, and maintenance of the Gooseberry Project. The Gooseberry Project, as originally planned, was never constructed. However, a portion of the original project was constructed as the Scofield Project. The remainder of the Gooseberry Project, subsequently, was renamed the Narrows Project and is presently proposed as a non-Federal project. Today, approximately 6,728 acres of the lands originally withdrawn by Reclamation for the Gooseberry Project remain under Reclamation withdrawal for the Narrows Project.

The 1941 Reclamation withdrawal of lands within the Manti-La Sal National Forest created the potential for two Federal agencies—Reclamation and the USDA Forest Service—to have overlapping jurisdiction on the same lands. However, the authority of the Secretary of the Interior under the 1902 Act to withdraw and administer lands for Reclamation purposes is limited to the specific uses provided for in that Act, that is, Reclamation projects. As a result, whereas Reclamation's withdrawal is dominant, its jurisdiction has been somewhat nominal because no Reclamation project actually was constructed on those lands; as a result, the USDA Forest Service exercised the only meaningful jurisdiction over them per the master interagency agreement between Reclamation and the USDA Forest Service. Once Reclamation initiated planning and environmental compliance activities for the Narrows Project, however, the overlap between the authorities of the Secretary of the Interior under the 1902 Act and those of the Secretary of Agriculture became real.

At present, both agencies have administrative authority over these lands—but each for activities related only to its own mission. Thus, Reclamation has jurisdiction over the withdrawn lands for uses associated with or incident to environmental compliance, planning, construction, or O&M of projects under the Reclamation laws, such as the Narrows Project; and the USDA Forest Service has jurisdiction over the withdrawn lands for uses associated with or incident to national forest activities, such as recreation, grazing, and timber sales. If the Narrows Project were constructed, it is anticipated that the Reclamation withdrawal would be revoked for any lands not needed for the project.

Land ownership and use characteristics of Sanpete and Carbon Counties are summarized in tables 3-28 and 3-29, respectively. Federal and State-owned land comprises approximately 60% of each county's total land base; whereas, privately owned land accounts for 38% of the land base in Sanpete County and 41% of the land base in Carbon County. Of the total agricultural land in Carbon County, only 2% has been developed for cropland, and the remainder is rangeland. Comparatively, 36% of the total agricultural land in Sanpete County has been developed for cropland. An inventory of prime and unique farmland (Public Law 95-87) did not reveal any prime or unique farmland in the project area.

Lands approximately 3 miles east of the project area are under a Federal coal lease and are currently being mined. Additional mineable coal reserves are believed to exist beneath lands east of the East Gooseberry Fault approximately 1 mile east of the project area. A nearby landowner with both land and mineral rights to the east of the proposed reservoir, between the proposed dam and the currently operating Skyline mine, expressed to Reclamation in April 2009 his intent to mine his coal, but exact plans and timing are unknown at this time. Lands immediately adjacent to the project area (within the Gooseberry Graben) are not believed to have mineable coal reserves due to an offset of several hundred feet within the Gooseberry Graben area.

Agricultural land use within the project area is based on the livestock economy of the area—principally, cattle and sheep operations and a number of Grade A dairies. Other land uses include the turkey industry, large garden spots, potatoes, raspberries, and Christmas or ornamental trees.

The majority of the land area that would be inundated by the reservoir is privately owned; the dam, however, would be on Federal land. Some of the private land near the proposed dam and reservoir within the national forest boundary has been subdivided for summer homes and recreation development. Such development must comply with the zoning and building codes of the Sanpete County Commission and the sanitation requirements of UDEQ. The area adjacent to the proposed Narrows Reservoir is county-owned and is zoned as Forest Watershed 1–10 (one dwelling per 10 acres). The primary areas now under development include the area approximately 2 miles east of Lower Gooseberry Reservoir and the area on the north side of privately owned Fairview Lakes.

The Fairview Lakes development contains approximately 150 to 200 memberships in the privately owned Fairview Lakes Association. The memberships include the right to use a specific lot in the area north and east of Fairview Lakes and south of the project area to park a trailer or construct a cabin. This area has been rezoned, and the one dwelling per 10 acres development ratio does not apply to this area. As a result, it has been developed with lots every 1+ acre each. About 50 cabins have been constructed within the past 5 years. The cabins are used during the winter as well as the summer since the general area is a popular cross-country skiing and snowmobiling area. Many of the other lots have one to three trailers parked on them for the summer season (June–September). The private landowners allow their members to use some of the area southwest of Fairview Lakes for recreation use.

Portions of three grazing allotments occur within the project area. They include Swen's Canyon allotment, the Gooseberry-Cottonwood allotment, and the Beaver Dams-Boulger allotment.

Additional allotments that may be impacted by the mitigation measures include the Fairview, Cabin Hollow, and Pondtown allotments.

Swen's Canyon allotment is located in two watershed drainages. That portion which is located in the same drainage as the proposed Narrows Dam and Reservoir consists of 583 acres, of which all is suitable for grazing land in fair range condition. Grazing capacity of that portion is about 115 animal unit months (AUMs).

The Beaver Dams-Boulger allotment is a combination of two allotments. Grazing use includes 1,200 head of sheep with a season of July 6 to October 5. It is grazed with a rest rotation grazing system where part of the allotment is rested each year.

The Cottonwood-Gooseberry allotment is grazed by 900 head of sheep with a season of July 6 to September 30 using a rest rotation grazing system. Suitable grazing land was determined during a range analysis conducted during 1976.

A summary of information concerning the three grazing allotments and four grazing permits is presented in table 3-30. Range conditions and grazing were discussed in the vegetation section of chapter 3.

Under the Proposed Action, major changes in land use are not anticipated. Construction of summer homes outside of platted subdivisions might be accelerated but would be limited by zoning restrictions of one dwelling per 10 acres. Development of the Fairview Lakes complex would continue as previously planned, although build-out may occur earlier. Narrows Reservoir, SR-264 and forest development roads relocation, the recreation area, and the conservation easements adjacent to the reservoir would reduce the available grazing area by 856 acres. This area is about 10% of the suitable grazing acreage in the area. The Proposed Action may result in the direct loss of 114 AUM grazing use (856 project acres per 1.5 acres per sheep month = 571 sheep months per 5 sheep months per AUM = 114 AUM); however, indirect loss of grazing (estimated to be about 1,014 acres) may occur on adjacent areas around the reservoir, between the highway and the reservoir and around camping and residence areas. The total grazing impact is estimated to be 249 AUM (1,870 acres per 1.5 acres per sheep month = 1,247 sheep months per 5 sheep per AUM = 249 AUM). This impact of grazing includes both private and Federal lands. Restrictions on the number of sheep and cattle allowed and/or realignment of grazing allotments may be required due to implementing the Proposed Action.

As the recreation use increased and summer home development proceeded, there could be additional areas in the upper Gooseberry drainage which would not be available for livestock grazing due to anticipated or existing livestock-people conflicts. For every 7 to 10 acres of additional land which cannot be grazed due to conflicts with traffic and/or people, there may be a loss of 1 AUM (5 sheep months) grazing use. Grazing permits and allotment boundaries may need to be adjusted. Land use in the Manti-La Sal *National Forest Land and Resource Management Plan* would change to reflect project implementation.

No reduction of acres of mineable coal reserves is anticipated as long as the dam is designed to withstand the effects of induced seismicity from mining approximately 1 mile away.

S3.12 PUBLIC SAFETY

The public safety issues raised, related to development of the Narrows Project, deals with increases in recreational traffic. The

area adjacent to the proposed Narrows Reservoir is served by two State highways, SR-31 and SR-264. These two-lane roads are narrow and winding. Both highways are maintained for year-round use by the Utah Department of Transportation.

Average daily traffic (ADT) numbers for these roads are listed in table 3-31. ADT values shown in the table are based on UDOT traffic counts taken in 2000.

ADT on SR-31 would increase by 252 or 16% under the Proposed Action. ADT on SR-264 would increase by 31%. However, even with these increases, both roads would still be well within their design capacity. In order to increase safety, additional turning lanes with adequate sight distance would be provided at recreation area entrances and exits.

S3.13 Air Quality Resources

Ambient air quality is monitored by UDEQ, Division of Air Quality, at locations throughout the State of Utah. There are no existing monitoring sites near the proposed Narrows Project located in Sanpete County. The closest monitoring station is located in north Provo. Data from this station cannot be used as an estimate of the existing air quality in the impact area of influence because Provo is an urban/suburban area. The actual ambient air quality in Sanpete County most likely is much better than that in north Provo because of the lower population density and lack of significant major emission sources.

For the purposes of air quality management, geographic areas of the country are classified as “attainment” or “nonattainment” with the National Ambient Air Quality Standards (NAAQS). All air quality standards are classified as being met in Sanpete County and, therefore, would have an “attainment” classification.

The Narrows Dam and Reservoir area is located in a fairly remote and rugged mountainous terrain. The air quality associated with this area is generally excellent. Primary sources of existing air pollutants in the project area include dust, smoke from campfires in area campgrounds, and exhaust emissions from intermittent traffic and recreational vehicles. Dozens of summer homes are located in the vicinity of the project. High levels of dispersed recreational use of this area are common.

Noise and air pollution are not expected to significantly increase under the Proposed Action (table 3-32).

S3.14 Slope and Channel Stability

Fairview Canyon, which contains Cottonwood Creek, is a steep, narrow canyon located east of Fairview, Utah. Highway SR-31 is located in the canyon. The canyon is approximately 7 miles long. The stream elevation at the mouth of the canyon is about 6,300 feet and about 8,800 feet near the summit. Typical slopes of the canyon wall are 2:1 to 2.5:1 (ratio of horizontal to vertical distance). Numerous landslides are located throughout the canyon on both sides. In several places, continual road maintenance is required to repair damage caused by landslides.

A total of 104 landslides were identified from aerial photographs and during a 1991 field review along the slopes of a 6-mile reach of Cottonwood Creek. The review team was comprised of individuals from various government agencies and private consulting firms. The review was to determine the impact of projected flow increases from

Narrows Tunnel on adjacent slopes of Cottonwood Creek. The state of activity of the slides was noted with 85 slides classified as "active" and 19 classified as "dormant." The certainty of landslide identification included 89 slides as "definite," 13 as "probable," and 2 as "questionable." The distances of the landslides from the tunnel portal ranged from 0.3 mile to 6.1 miles. Dominant types of slope movement of the 104 landslides are shown in table 3-33.

Based on observations during the review, it was determined that landslide activity is not related to stream channel stability or the flow in Cottonwood Creek but is caused by saturation from water sources on the hillsides.

Under the Proposed Action, increased flows in Cottonwood Creek will occur due to releases from Narrows Reservoir through the Narrows Tunnel and Upper Cottonwood Creek Pipeline. These increased flows will occur below Left Hand Fork where the Upper Cottonwood Creek Pipeline will discharge into the creek. Figure 3-10 is a hydrograph based on daily flow data which compares present, or No Action Alternative, flows in Cottonwood Creek with flows that will occur under the Proposed Action. The figure is based on 1968 data, which is an average year. As shown in the figure, the peak discharge of about 112 cfs occurs during the snowmelt runoff period. Presently, summer base flows are about 18 cfs. Under the Proposed Action, the summer base flows would increase to about 50 cfs. The maximum flows possible through the tunnel would increase by 45 cfs, from a preproject capacity of 15 cfs to a Proposed Action capacity of 60 cfs.

The 50-year rainfall peaks expected in the canyon range from 330 cfs below Left Fork to 570 cfs near the mouth of the canyon. The possible maximum increase in tunnel flows is less than 15% of the rainfall peaks. The snowmelt peak is not a consideration because the tunnel will not operate during the snowmelt runoff. Based on the physical characteristics of Cottonwood Creek and the impacts of the proposed project on the flow characteristics, the project is unlikely to have a significant impact on the stability of the creek. To insure that the tunnel releases will not cause an impact, the measures described below will be implemented.

As described in chapter 2, remote control of the Narrows Tunnel operating gate would be provided to automatically regulate the releases through the tunnel. These controls would be coupled to an automated stream gauging station on Cottonwood Creek near the mouth of the canyon. The stream flow in Cottonwood Creek would be constantly monitored by these controls. As the streamflow increases during high runoff events such as thunderstorms, the tunnel operation would be discontinued when the flow exceeds 100 cfs. The project releases would not resume until after the flows drop below 100 cfs. Under this operating regime, the project flows through the tunnel would not increase streamflows above what is considered safe for channel stability. Increased flows under project conditions would be well below the 50-year channel-forming discharge.

Erosion along the banks of Cottonwood Creek would be carefully monitored, especially during the first year of operation, to verify that the project has no effect on Cottonwood Creek channel stability. Appropriate action would be taken if additional erosion above background levels is observed during project operation. Remedial actions could include placing additional armoring materials in the channel or along the bank or revising project operation to avoid more widespread stability problems.

S3.15 GEOLOGIC RESOURCES

The reservoir basin lies within a high elevation, shallow valley in the Wasatch Plateau subprovince of the Colorado Plateau. This subprovince represents the transition between the Colorado Plateau to the east and the Basin and Range Province to the west. Several ridges isolate the valley basin, which lies about 8,680 feet above sea level.

The proposed Narrows Dam and Reservoir area is underlain by the Cretaceous age North Horn formation. This formation consists primarily of interbedded sandy, clayey siltstone, silty claystone, silty sandstone, and limestone with occasional thin seams of coal. Bedrock crops out on the steeper slopes of the left abutment and in the drainage located immediately upstream of the left abutment. There is less exposure of bedrock on the right abutment. Unconsolidated sediments overlying bedrock consist primarily of a mixture of residual soil (weathered rock) and colluvium that generally consists of silty sand with some fine to coarse gravel. A geologic study performed by SWCD indicates that there is low potential for reservoir-induced landslide activity in the reservoir basin.

The North Horn formation is overlain by the Flagstaff Limestone formation which consists primarily of microcrystalline limestone with thinly bedded shale and silty claystone. Abundant fossils are common within the limestone, and the boundary between the formations is transitional. The Flagstaff Limestone formation generally is present in the higher elevations and beyond the actual limits of the proposed dam and reservoir.

The Flagstaff Limestone formation is present at the downstream portal area of the existing Narrows Tunnel.

Bedrock generally is covered by a mantle of residual soils and/or colluvium. These unconsolidated sediments are about 5–10 feet thick with some areas in excess of 27 feet. The unconsolidated sediments are composed of a mixture of clay, silt, and sand with minor amounts of organic deposits. Within the active stream channel of Gooseberry Creek and its tributaries, there are limited deposits of recent alluvial sand and gravel.

The structure of the Wasatch Plateau is dominated by a series of north-trending faults across the broad, west-dipping monocline of the plateau. The Sevier fault zone lies closest to the damsite at a distance of about 20 miles. The local structure is dominated by north-trending faulting around the site area. The dam and reservoir sites are located entirely on a down-dropped block between two fault traces, which is known as the Gooseberry Graben. Variation in orientation of beds indicates that the dam area is located on a westward-plunging synclinal fold with the axis running about 1,000 feet south of the proposed dam axis.

Three faults have been mapped in the vicinity of the Narrows Project. These faults, shown in figure 3-11, are all north-trending normal faults, and the West Gooseberry Fault, the Fairview Lakes Fault, and the East Gooseberry Fault are from west to east.

Observed earthquakes in the region of the Narrows damsite date back to 1853, giving a historical data base of about 157 years. A network of seismograph stations throughout the region currently provides the accurate location of any seismic event. Geologic evaluation of the Wasatch Plateau area indicates that existing faults are not active. Maximum seismic events for the area are, therefore, projected to be controlled by random background earthquakes—that is, events not attributable to specific faults or geologic structures.

The largest earthquake recorded in the Wasatch Plateau Province is a magnitude 4.9 event. The maximum random earthquake

event postulated for the Wasatch Plateau is a 5.5 event, occurring beneath the site at a depth of 3 miles. Such an event would produce a maximum acceleration of approximately 0.35 g (acceleration of gravity). Earthquake activity related to mining activities would not be expected to produce events which exceed magnitude 4.5 and, therefore, would not produce the maximum earthquake. Earthquake epicenters are shown on figure 3-12.

From a geoseismic standpoint, the recommended Narrows damsite is suitable for construction. No significant geologic hazards were found in the embankment or reservoir area, and no seismic activity would be expected to occur from or be induced by this reservoir. Faults which occur in the site vicinity are believed to be inactive. However, design of project facilities would be based on a "maximum credible earthquake" (MCE). Preliminary studies indicate that the appropriate MCE would be of magnitude 5.5. Further review of the appropriate MCE would be performed prior to final design of the dam.

During construction, detailed observations of the subsurface conditions would be monitored by qualified personnel.

There would be no residual geology or seismicity impacts under the Proposed Action. There would be no geology and no seismicity mitigation measures under the Proposed Action.

S3.16 Soil Resources

Soils in the project service area and along the Oak Creek and East Bench Pipelines alignments have developed under semiarid conditions. They are highly calcareous, are high in inherent plant nutrients, have weak to moderate developed soil profiles, and have a wide range of soil textures. They are derived principally from both old and recent alluvial materials eroded from geologic materials of the Wasatch Plateau. The lands are found on benches and terraces formed by the coalesced alluvial fans of the streams tributary to the San Pitch River. A broad area of valley fill material of deeper soils is found west of Mount Pleasant and in small cove areas at the base of the large alluvial fans. Valley fill also is found in the flat valley or river bottom areas west and southwest of Moroni.

Soils within the vicinity of the proposed Narrows Reservoir are formed mostly in colluvial, alluvial, and residuum materials weathered from sedimentary rocks, limestone, sandstone, and shale. Soils on the high ridges along the west side of the area are formed in materials derived primarily from limestone, while soils in the central and eastern sections of the project area are formed in materials dominated by sandstone, (silty) shale, and some limestone.

Soils are dark colored, rich in bases, freely drained, and cold. Mean annual soil temperature is less than 47 degrees Fahrenheit (°F), and the mean summer soil temperature is less than 59 °F. Average annual precipitation ranges from 20–25 inches, and the growing season is approximately 90–100 days. All but two of the soil series described are in the Cryoboroll Great Group, Boroll Suborder, and Mollisol Order of soil classification. The two exceptions, Fairview and Gooseberry series, are classified as being in the Cryaquoll Great Group, Aquoll Suborder, and Mollisol Order.

The erosion hazard for the soils within the vicinity of the proposed reservoir ranges from severe to low with over 80% of the area being classified as having a moderate or low erosion potential. Precipitation runoff rates range from rapid to slow, with most of the area having a moderate to slow runoff rate. Average sediment yields in the vicinity of the proposed reservoir are estimated to be 73 tons

per square mile per year. With a drainage area of about 5.5 square miles, there is an estimated sediment load of 400 tons per year at the proposed damsite. This drainage area excludes the area that drains into Fairview Lakes.

Under the Proposed Action, about 604 acres of land would be inundated by Narrows Reservoir. An additional 32.4 acres would be disturbed by construction of SR-264 relocation and the recreation area. Development of a rockfill material source area outside of the reservoir basin would disturb another 2.0 acres. Earthfill material source areas would be developed within the reservoir basin, and contractor staging areas and tunnel spoil areas also would be located below the low water level of the reservoir basin.

The alignment of the proposed highway relocation crosses relatively gentle terrain, and cut and fill slopes would be minimal. All cut and fill slopes would be revegetated to minimize erosion. Roadways in the recreation area would be paved to minimize dust and soil erosion. Following construction, the rockfill material source area would be recontoured, topsoil would be replaced, and the area would be revegetated. Virtually all runoff from disturbed areas would flow into Narrows Reservoir which would act as a trap for all upstream sediment. The current sediment load in Gooseberry Creek downstream from the proposed Narrows Reservoir would be reduced by about 400 tons per year with construction of the Proposed Action. This sediment would accumulate in the reservoir.

The Upper Cottonwood Creek Pipeline would be constructed in a previously disturbed area along the shoulder of SR-31. Construction of the Oak Creek and East Bench Pipelines would disturb about 30 acres. As part of the construction process, the ground would be recontoured and revegetated with native plants to minimize erosion and to restore the natural appearance.

Mitigation for disturbances to soils under the Proposed Action would be accomplished by revegetating all cut and fill slopes to minimize erosion. Roadways in the recreation area would be paved to minimize dust and soil erosion. Following construction, the rockfill material source area would be recontoured, topsoil would be replaced, and the area would be revegetated.

Residual impacts to soils under the Proposed Action would include inundating 604 acres by Narrows Reservoir and the 32.4 acres that would be covered by relocating SR-264.

S3.17 TRACE ELEMENTS

A trace element survey was conducted in accordance with current Reclamation practices to identify where concentrations of potentially toxic elements, such as selenium, arsenic, and mercury, likely would be to occur in irrigation return flows under project conditions. Accumulations of these substances can be harmful to humans and wildlife. A total of 11 soil samples, collected in 1990, were analyzed by the U.S. Geological Survey (USGS). The results are shown in table 3-34 for arsenic, mercury, and selenium from three representative sites in the project area.

Study results indicate that all three elements analyzed are present in low to moderate concentrations; therefore, further testing for these elements was not considered necessary.

Data was also gathered from the National Geochemical Database which contained extensive information on soils in the vicinity of the survey area. Most of the data was from the National Uranium Resource Evaluation Surveys conducted from 1976–80. The primary objective of these surveys was to

prospect for uranium; however, many other trace elements also were analyzed in the survey. Located in the vicinity of the survey area were 59 soil sampling sites from this. Almost all sites were in Quaternary alluvium.

The data indicate that most trace elements are present in concentrations within the common range for western soils. Cobalt was the only element consistently present in concentrations outside the common range. However, cobalt is not considered hazardous in the alkaline soils of the region. Limited water analysis data indicate cobalt was not detected in the San Pitch River.

Table 3-35 summarizes the number of soil samples with noteworthy concentrations of trace elements. Although these elements were found at elevated concentrations at scattered sites, it appears that none of the elements are present in concentrations of concern in the existing project return flows.

The data indicate that trace elements are present in low concentrations in ground water in or near the proposed Narrows Project. A review of the STORET data for the San Pitch River indicated low concentrations of the same trace elements present in the surface water in the Narrows Unit.

The data presented in table 3-37, from the EPA STORET database, indicates that water quality of the San Pitch River in the project area is generally acceptable. The San Pitch River shows some improvement in water quality through the project area, possibly due to high quality inflows from the Manti-La Sal drainage.

Lands in the project area have been irrigated for more than 50 years, and the results of the data gathered showed no significant quantities of trace or toxic elements in the ground water and in the San Pitch River; therefore, no increase of potentially toxic trace elements is anticipated under project conditions. There would be no residual impacts associated with potentially toxic trace elements under the Proposed Action.

S3.18 Indian Trust Assets

The United States has a trust responsibility to protect and maintain rights reserved by or granted to American Indian tribes or Indian individuals by treaties, statutes, and Executive orders. These rights are sometimes further interpreted through court decisions and regulations. This trust responsibility requires that agencies, such as Reclamation, take actions reasonably necessary to protect these trust assets. Implementation of the Proposed Action would have no foreseeable negative impacts on Indian Trust Assets.

S3.19 Environmental Justice

On February 11, 1994, the President issued Executive Order 12898 on Environmental Justice in Minority Populations and Low Income Populations. As a result of that Executive order, each Federal agency is required to analyze the environmental effects, including human health, economic, and social effects, of Federal actions, including effects on minority communities and low-income communities.

In the project area, there are no minorities or low-income populations.

S3.20 Related Laws, Rules, Regulations, and Executive Orders

The Council of Environmental Quality regulations (40 CFR 1500.2 and 1502.25) encourage related environmental laws, rules,

regulations, and Executive orders to be integrated concurrently to the fullest extent possible in an EIS.

The following environmental laws, rules, regulations, and Executive orders have been considered during the preparation of the SDEIS. It has been determined that the Narrows Project would have no adverse effect upon them.

- Executive Order 11988 (Flood Plain Management).
- Wild and Scenic Rivers Act, Public Law 90-542. In 2007, the USDA Forest Service and Bureau of Land Management evaluated thousands of river miles for potential inclusion in the National Wild and Scenic Rivers System. In determining suitability, a key question was, does the river segment have Outstanding Remarkable Values (ORV). The USDA Forest Service conducted an environmental impact statement to evaluate the suitability of 86 eligible river segments (840 miles) including 21 miles of Fish Creek and Gooseberry Creek. The Record of Decision, signed November 2008, determined that Fish Creek and Gooseberry Creek were not suitable to be designated by Congress as components of the National Wild and Scenic Rivers System. All the nonsuitable river segments are no longer afforded agency interim protection under the Wild and Scenic Rivers Act and continue to be managed under the direction of the respective agencies.
- Executive Order 13007 (Indian Sacred Sites).
- Executive Order 11990 (Protection of Wetlands).

S3.21 CUMULATIVE IMPACTS

The following discussion addresses the cumulative impacts to area resources in the Upper Colorado River Basin. Any analysis of cumulative impacts must deal with the issue of scope, both in terms of spatial and temporal scales. In the following discussions, these scales will vary depending upon the resource under evaluation.

Since 1960, some 30 water resources projects have been built or are under construction by Reclamation in the Upper Colorado River Basin (table 3-38). Reclamation estimates that those projects have provided full irrigation service to 158,460 acres with supplemental service to another 204,870 acres. These developments account for an estimated 62,776,000 megawatt hours of generated power and some 431,100 acre-feet of M&I water supplied annually. Recreational use associated with these projects, including sightseeing, picnicking, camping, boating, fishing, hunting, and other activities, is estimated at 45,068,970 annual recreation days. In terms of average annual permanent employment opportunities, these projects are responsible for some 18,716 jobs.

Aside from providing a net increase of 41,900 annual recreation days, and providing 855 acre-feet of M&I water annually, the Narrows Project would not affect the above resources. No new acres of cropland would be irrigated; no new power would be generated; and no new permanent jobs would be created. Because there would be no net change in existing levels of these resources in the Upper Colorado River Basin, it is assumed that there would be no cumulative impact from the proposed project; and it has been determined that further analysis of cumulative impacts of the above described resources is not necessary.

Several resource issues have been affected by past Reclamation developments and would be affected by the proposed project; thus, they have the potential to contribute to cumulative (additive) impacts within the region and beyond. These issues involve stream depletions that can impact fisheries and endangered native fishes and changes in salt loading within the Colorado River. These issues are treated in the SDEIS under the headings of fisheries, threatened and endangered species, and water resources, use, and quality.

S4.0 CONSULTATION AND COORDINATION

This section details the consultation and coordination between Reclamation and other State, Federal, and local agencies; Native American tribes; and the public in preparation of the SDEIS and the draft EIS published in 1998, which the SDEIS updates and supplements. Throughout the EIS process dating back to 1990, input has been actively solicited from a broad range of public constituencies as part of the ongoing public involvement process. Comments and involvement in the planning for and preparing of the Narrows Project generally were sought through two broad efforts: communication and consultation with a variety of Federal, State, and local agencies; Native American tribes; and interest groups; and the formal SDEIS scoping process and comment process, both of which invited input from the general public.

S4.1 SUMMARY OF INTER-AGENCY COORDINATION 1996–2003

In 1996, Reclamation invited a number of State and Federal agencies to become cooperating agencies in preparation of the DEIS. The two agencies that agreed to become cooperating agencies for the EIS process, including the SDEIS, are the USDA Forest Service and U.S. Army Corps of Engineers. In addition to these two agencies, the following agencies had representation on the interdisciplinary team led by Reclamation that prepared the draft EIS published in 1998:

- U.S. Fish and Wildlife Service
- U.S. Environmental Protection Agency
- Utah Division of Wildlife Resources
- Utah Division of Water Quality
- U.S. Department of the Interior, Office of the Solicitor
- Sanpete Water Conservancy District

Reclamation hosted periodic cooperating agency meetings and interdisciplinary team meetings throughout preparation of the DEIS and the SDEIS, to ensure that all of the agencies were informed of, and involved in, the issues and analyses related to the SDEIS.

S4.2 CONSULTATION

Consultation was conducted as needed with agencies or experts that provided information for preparation of the DEIS published in 1998 and the SDEIS.

S4.3 PUBLIC INVOLVEMENT AND SCOPING

The scoping process for the SDEIS was conducted by Reclamation beginning in November 2003 to provide the general public, organizations, State and local governments, and affected Federal agencies an opportunity to identify issues and concerns they believe should be studied early in the preparation of

the SDEIS. "Scoping" is the public involvement process required by the Council on Environmental Quality regulations to help Federal agencies determine issues and alternatives analyzed in the SDEIS. Results of the scoping meetings and comments received during the scoping process were used to establish the scope of the SDEIS and focus the environmental analysis on the important issues and concerns.

S4.4 DOCUMENT AVAILABILITY

Those who were on the mailing list for the 1998 draft EIS, or who asked to be added to the mailing list in response to the November 2003 Notice of Intent to Prepare a SDEIS, will be provided notification of document availability along with other environmental groups; Federal, State, and local government agencies; and other interested parties. Approximately 425 notifications of the SDEIS have been mailed to interested agencies, organizations, and individuals. The SDEIS is available online at www.usbr.gov/uc/envdocs/index.html#eis.

CHAPTER 1

Purpose of and Need for the Project

1.0 INTRODUCTION

This Narrows Project, Utah (Narrows Project) supplemental draft environmental impact statement (SDEIS) updates information and analyses contained in the Draft Environmental Impact Statement, Narrows Project (DES-98-10) published in March 1998 (1998 DEIS). This SDEIS discloses the direct, indirect, and cumulative effects of the Proposed Action and alternative actions for water development for north Sanpete County.

1.1 THE PROPOSED ACTION ALTERNATIVE

The Sanpete Water Conservancy District (SWCD) has applied to the Bureau of Reclamation (Reclamation) for a Small Reclamation Projects Act (SRPA) loan to help finance construction of a reservoir and related facilities (Proposed Action). SWCD also has requested authorization to use federally administered withdrawn lands as the site for dam construction. Most of the reservoir basin would be located on adjacent, privately owned land. If Reclamation approves the SRPA loan and land use and Congress appropriates the necessary funds, a supplemental water supply would be developed for presently irrigated lands and municipal and industrial (M&I) water users in north Sanpete County. A dam and reservoir would be constructed on Gooseberry Creek, and water would be diverted through an existing tunnel and a proposed pipeline to Cottonwood Creek; the existing tunnel would be rehabilitated. Pipelines would be constructed to deliver the water to existing water distribution systems. Recreation facilities would be developed, and a 2,500-acre-foot minimum pool for fish habitat would be provided. The resulting water storage and delivery system would be a non-Federal project owned and operated by SWCD.

Mitigation measures would be implemented to offset adverse impacts. Additional water conservation measures would be implemented independent of the Proposed Action. To be eligible to receive water from the Narrows Project, water users would be required to use, or agree to implement, conservation measures.

1.2 LEAD AND COOPERATING AGENCIES

Reclamation is the lead agency in preparing this SDEIS. The two cooperating agencies are the U.S. Department of Agriculture Forest Service (USDA Forest Service), and the U.S. Army Corps of Engineers (USACE).

1.3 HISTORY AND BACKGROUND OF THE NARROWS PROJECT

The Narrows Project, as defined in this document, is a non-Federal project that fulfills the intent of the larger Federal Gooseberry Project that was formulated more than 70 years ago but not completed. The original Gooseberry Project was formulated over a period of several years in response to efforts by Sanpete County

individuals and entities to supplement existing irrigation water supplies and to alleviate shortages that consistently have occurred during the late irrigation season. The portion of that project that was not built was the proposal to appropriate and store Gooseberry Creek waters originating in Sanpete County and to transport those waters through a transmountain tunnel for use in north Sanpete County. The other component of the original Federal project, which was completed, was to enlarge Scofield Reservoir by 35,000 acre-feet to compensate Carbon County water users for the transmountain diversion of water to Sanpete County.

The earliest efforts to appropriate Gooseberry Creek water and transport it to use in north Sanpete County began in the early 1900s. In 1924, predecessors to SWCD filed an application with the Utah State Engineer to appropriate 15,000 acre-feet of Gooseberry Creek water and deliver it via a transmountain tunnel to Sanpete County.

Beginning in the 1930s, Reclamation, the Utah Water Storage Commission, and local Sanpete County interests undertook cooperative studies to formulate a water development plan and enhance water supplies in Sanpete County. The first published cooperative study, undertaken by Reclamation and released in May 1933, outlined what would become known as the Gooseberry Project. This report defined the Gooseberry Project as:

- Construction of a reservoir on Gooseberry Creek with an active capacity of 15,000 acre-feet and an annual yield of 9,400 acre-feet.
- Construction of a transmountain tunnel.
- Construction of feeder canals to deliver waters from other streams to the dam for transmountain diversion.

In September 1940, Reclamation released another cooperative study that revised the original plan and included expanding Scofield Reservoir as a principal feature of the Gooseberry Project. On November 2, 1940, the Utah Water Storage Commission recommended construction of the Gooseberry Project, defined as:

- Construction of a dam on Gooseberry Creek providing an annual average yield of 10,800 acre-feet to Sanpete County.
- Construction of a transmountain tunnel to deliver the water.
- Construction of feeder canals.
- Enlargement of Scofield Reservoir to provide exchange water for the unrestricted diversion of Gooseberry Creek water to Sanpete County.

On March 6, 1941, the lands necessary to complete the Gooseberry Project were withdrawn from public entry under a First Form Reclamation Withdrawal, 32 Statute (Stat.) 388; 43 United States Code (U.S.C.) Section (§) 372, et seq.

On January 2, 1942, Reclamation released a draft report outlining the Gooseberry Project Plan, including constructing an additional 43,000 acre-feet of storage capacity in Scofield Reservoir to support the unrestricted transmountain diversion of Gooseberry Creek water to Sanpete County.

In 1943, the United States decided that the Scofield Dam and Reservoir portion of the Gooseberry Project Plan should be completed first because of the hazardous conditions the existing structure posed to the war effort and the health, welfare, and safety of Carbon County residents. Reconstruction of Scofield Dam began the same year and was completed in 1946.

On October 11, 1943, and February 28, 1944, the United States entered into reconstruction and repayment contracts on Scofield Dam and Reservoir with local sponsors. The October 11, 1943, contract has subsequently become known as the "Tripartite Agreement." Among the conditions identified for reconstructing and enlarging Scofield Dam and Reservoir, the agreement:

- Described the United States' intent to construct and operate the remaining Gooseberry Project works.
- Stipulated that the Gooseberry Project has the right to divert and store all flows of Gooseberry Creek at or above the confluence with Cabin Hollow.
- Stipulated that Carbon County's storage rights in Scofield Reservoir are subordinate to those of the Gooseberry Project.

On April 11, 1956, Congress enacted the Colorado River Storage Project Act (CRSP). Priority planning was directed for the Gooseberry Project at 43 U.S.C. 620a.

In September 1961, the Soil Conservation Service of the U.S. Department of Agriculture proposed the North Sanpete Watershed Work Plan to complete the 1942 Gooseberry Project Plan.

In 1962, the USDA Forest Service issued a Special Use Permit to the Gooseberry Project sponsors to construct, operate, and maintain a tunnel and appurtenances for transmountain diversion of water from the proposed Narrows Reservoir in Gooseberry Creek to Cottonwood Creek for irrigation purposes.

On July 22, 1975 with the Federal Gooseberry Project remaining un-built, Reclamation assigned the Narrow's portion of the Gooseberry Project water right to SWCD to complete the Gooseberry Project Plan.

On March 13, 1981, SWCD filed a notice of intent (NOI) to apply for a SRPA loan to help finance the Narrows Project. The project would include:

- The Narrows Reservoir with a capacity of 17,000 acre-feet (10,000 acre-feet active storage and 7,000 acre-feet for fish and recreation).
- Two hydropower plants to provide power for project purposes.
- Improved flows in the San Pitch River by improving select facilities that would allow for more reliable exchanges without interfering with existing water rights.
- An additional 10 to 12 exchange wells in the San Pitch River Basin to provide exchange water to municipalities.
- Rehabilitation of the existing Gooseberry (Narrows) Tunnel.

On June 28, 1984, Reclamation approved the 1984 Compromise Agreement by and among the SWCD, the Price River Water Users' Association, and the Carbon Water Conservancy District (appendix A). According to the agreement's terms, among other things, SWCD:

- Relinquished and withdrew certain water rights.
- Agreed to a much lower transmountain diversion figure than previously contemplated (reduced to 5,400 acre-feet per year).
- Restricted sources of the water supply by excluding certain stream sources of water from the project plan.
- Limited the active and inactive storage capacity of the reservoir.

- Agreed to locate the dam and reservoir site further up the drainage of the Narrows Project site, thereby relinquishing the historic Mammoth site.

On November 1, 1984, SWCD filed an amended NOI to apply for a SRPA loan. The project had been reformulated in response to the 1984 Compromise Agreement. Specifically, SWCD proposed to:

- Construct the Narrows Reservoir to a capacity of no more than 14,500 acre-feet of active storage and 2,500 acre-feet of dead storage for fish and recreation purposes.
- Construct four hydropower plants to provide power for project purposes.
- Improve flows of the San Pitch River by improving select facilities that would allow for more reliable exchanges without interference with existing water rights.
- Drill 5 to 10 exchange wells in the San Pitch River Basin to provide exchange water to municipalities and irrigation companies.
- Rehabilitate the existing Gooseberry Tunnel.
- Enlarge the existing Gunnison Reservoir by at least 5,400 acre-feet.

On January 7, 1985, the Utah State Engineer approved both the Narrows and Scofield portion of the Gooseberry Project Plan water rights. With respect to the Narrows Project water rights, among other things, the approval:

- Set the approximate physical location of the Narrows damsite and its active storage capacity (14,500 acre-feet).
- Reduced the amount of an annual transmountain diversion to 5,400 acre-feet.
- Set the instream flow requirements.
- Restricted the sources of water supply that could be used for project purposes.

With respect to the Scofield Project water rights, the approval provided the legal authority to use 43,000 acre-feet of additional storage water in Scofield Reservoir. Both approvals were expressly made subject to the terms of the 1984 Compromise Agreement.

The effect of this decision was to give SWCD the right to divert the first 5,400 acre-feet of water occurring in Gooseberry Creek at the Narrows damsite. The decision also established a Scofield Project water right for the additional 43,000 acre-feet of storage capacity in the enlarged Scofield Reservoir. Of the 43,000 acre-feet, 8,000 acre-feet is for fish propagation. The remaining 35,000 acre-feet of capacity is for Scofield Project purposes (i.e., project water for use in Carbon County), subject only to an obligation to satisfy early water rights that otherwise would be impaired by the diversion and storage of the Narrows Project. Delays in completing the Narrows Project allow the 5,400 acre-feet of Narrows Project water to be delivered to Scofield Reservoir on a temporary basis for storage and use in Carbon County.

At this time, the hydropower plants, exchange wells, and expansion of Gunnison Reservoir were dropped as part of the project plan because of the technical and financial infeasibility of these components.

On March 7, 1985, the USDA Forest Service notified the Utah State Engineer of its claim to Federal reserved water rights in the Gooseberry Creek drainage. Because of potential conflict between water use under the

Federal reserved water rights and the Gooseberry Project water rights, the United States and the Sanpete Water Conservancy District agreed on July 13, 1989, to a water use plan to allow for continued development of the Gooseberry Project Plan. This agreement stipulated that all Federal reserved water rights, which fall within the Gooseberry Creek drainage, shall be subordinate to the Gooseberry Project water rights.

On July 20, 1990, SWCD filed a second amended NOI to apply for a SRPA loan. The project had been reformulated to conform to the agreements and stipulations contained in the 1984 Compromise Agreement and the State Engineer's Memorandum Decision. SWCD proposed to:

- Construct the 17,000-acre-foot Narrows Reservoir with an active capacity of 14,500 acre-feet supporting an annual transmountain diversion of 5,400 acre-feet.
- Rehabilitate the existing 3,100-foot-long Narrows Tunnel to facilitate releases from Narrows Reservoir.
- Relocate about 2.9 miles of State highway around the Narrows Reservoir.

On May 19, 1992, the draft SRPA Loan Application Report and Environmental Report were submitted to Reclamation for review and comment.

On September 20, 1993, Reclamation released a draft environmental impact statement (DEIS) for public review and comment. Approximately 60 letters of comment were received from various Federal, State, and local agencies as well as members of the public. These comments and accompanying responses were included in the January 1995 final environmental impact statement (1995 FEIS).

On December 23, 1994, SWCD submitted the final Loan Application Report for processing. On January 23, 1995, Reclamation filed the 1995 FEIS with the United States Environmental Protection Agency (EPA).

On May 8, 1995, Reclamation's Upper Colorado Regional Director signed a Record of Decision (ROD). The ROD's recommendation was to proceed with the recommended plan identified in the 1995 FEIS.

On July 28, 1995, a Complaint was filed in United States Federal District Court, District of Utah, by the Carbon Water Committee, Utah Rivers Conservation Council, Utah Wilderness Association, and three individuals (Plaintiffs) against officials of the U.S. Department of the Interior (Interior), alleging that Reclamation failed to comply with the National Environmental Policy Act (NEPA) in preparing the environmental impact statement (EIS).

In response, Reclamation hired the Environmental Chemical Corporation (ECC), an environmental consultant, to conduct an independent review of the 1995 FEIS. ECC concluded that "the Narrows Project FEIS was complete and technically complied with NEPA, fulfilling most requirements of the Council on Environmental Quality (CEQ), Reclamation, and Department of the Interior guidelines."

In September 1995, a Civil Complaint was filed in the Sixth Judicial District Court of Sanpete County, State of Utah by SWCD (Plaintiff) against Carbon Water Conservancy District and Pacificorp, also known as Utah Power and Light (Defendants). The Plaintiffs alleged a breach of contract by the Defendants by willfully interfering and hindering the Plaintiff's attempts to develop its Gooseberry Creek water rights and construct the Narrows Project. In June 1999,

the court dismissed the suit, and SWCD appealed to the Tenth Circuit Court of Appeals of the United States. The court of appeals upheld the original district court ruling.

On September 11, 1995, Reclamation published a *Federal Register Notice* for recision of the ROD on the 1995 FEIS for the Narrows Project, due to certain procedural errors in the final environmental impact statement (FEIS) process.

On February 8, 1996, Reclamation published a *Federal Register* NOI to prepare a new DEIS, wherein it announced that the new DEIS and subsequent FEIS would supersede the 1995 FEIS. Reclamation said it would use the 1995 FEIS, along with other materials submitted by SWCD, as the basis for preparing the new DEIS but would prepare the new EIS itself, rather than use a contractor.

Reclamation's new DEIS was published in March 1998. Comments were received by mail and at public hearings in Price and Mount Pleasant, Utah, on April 22 and 23, 1998, respectively.

The present document is a SDEIS developed through Reclamation's own analysis of the environmental impacts of the Proposed Action. A NOI to prepare this SDEIS was published in the *Federal Register* on November 25, 2003. Based on scoping results, discussions with interested parties and cooperating agencies, existing laws and regulations, and comments on the 1998 DEIS, Reclamation updated or added the hydrology, water quality, population and demographics, water usage, recreation, discussion regarding Skyline Mine water development, fisheries, project cost estimates, wetlands delineations, Wild and Scenic Rivers, and Endangered Species Act compliance in this SDEIS. Resources, issues, and concerns identified during the process of completing this SDEIS were fully considered, and changes were made to this document as appropriate. Since Reclamation is publishing this SDEIS and providing for a new comment period, a formal response to comments received on the 1998 DEIS was not prepared.

Reclamation considers the historical tie between the enlargement of Scofield Reservoir and the transmountain diversion to Sanpete County to be relevant in evaluating the Narrows Project; therefore, the analysis includes references to the effects the enlargement of Scofield Reservoir has had on various resources.

1.4 PURPOSE AND NEED

Reclamation has received from SWCD its original application for a SRPA loan to build the Narrows Project and a request for authorization to use withdrawn lands to construct and operate the proposed dam and reservoir. Reclamation will receive an updated application for evaluation; and, in addition, Reclamation will complete NEPA compliance. SWCD's stated purpose and need in making its application to Reclamation serve to clarify and disclose the environmental effects of the proposed use of Federal funds and lands.

The primary purpose of the Narrows Project is to enable SWCD to develop an irrigation and M&I supply source for users in north Sanpete County, Utah, whereby the average annual shortages to irrigators in the project area might be reduced as nearly as possible to 5 percent (%), which is considered full irrigation supply for Reclamation projects. Specifically, the following are water related needs addressed by the proposed project:

- Demand for municipal water for present and future use exceeds the currently available supply. The proposed Narrows Project would develop, through exchange,

an additional supply of municipal water to offset current shortages and accomodate anticipated population growth in the project area.

- The current water supply for agricultural irrigation does not provide adequate supply and storage at the times when it is needed—typically in July, August, and September of each year. The proposed Narrows Project would provide late season irrigation water to offset at least some of the current shortages.
- The Narrows Tunnel in Sanpete County needs to be rehabilitated and improved to maintain and enhance its dependability and capability to deliver water to Sanpete County users. The proposed Narrows Project would include such rehabilitation work to prevent failure of the tunnel and ensure its continuing usefulness.

In addition to the primary purpose of supplying water to Sanpete County, the project would have the additional benefit of providing improved and additional recreation and fishery opportunities in Sanpete County.

For purposes of complete analysis and potential impacts of this project, a broad range of alternatives has been evaluated thoroughly to fully comply with NEPA requirements. Reclamation's release of this Supplemental Draft EIS does not imply either approval or denial of the SRPA loan application or the request for authorization to use withdrawn lands.

1.4.1 Additional Municipal Irrigation and Culinary Water Supply

Rule 309-203 of the Utah Administrative Code identifies minimum sizing requirements for a public drinking water system facility. Specifically, R309-203-7 requires that water sources "shall legally and physically meet water demands. . ." The rule then indicates amounts of water that are to be provided for indoor and outdoor use. For a public drinking water system to comply with this regulation, the system must demonstrate that the specified source capacity is available.

Based on the average household and lot size in the north Sanpete County area, a total water supply of about 270 gallons per capita per day (GPCD) is required.

Cities within the project area include Fairview, Mount Pleasant, Spring City, and Moroni. To comply with the State code, each of these cities has two water systems—a culinary system that is designed to satisfy indoor demands and an irrigation system that is designed to satisfy outdoor demands.

This practice allows the limited supply of high quality water to be used for culinary purposes and untreated surface water to be used for outdoor irrigation of lawns and gardens.

The United States Geological Survey (USGS) has completed a water use trends study in the desert Southwest, and its 2000 per capita water use data are shown in figure 1-1.

According to these data, Utah has the second highest per capita culinary water use in the region at 293 gallons per day. This is approximately 0.33 acre-foot per year. The United States average is lower than in the desert Southwest, mainly because precipitation received in most other States is enough to make outside watering unnecessary.

To check the validity of the above estimate of 270 GPCD, recent per capita water use data collected for the Wasatch Front area to use in State Water Plan Basin Reports were examined. Approximately 80% of Utah's population lives in the Wasatch Front drainage basins. These basins include Weber River, Jordan River (Salt Lake County), and

Utah Lake drainage areas. Municipal use per capita in the Wasatch Front drainage basins for residential, commercial, and institutional uses is shown in tables 1-1 and 1-2.

Table 1-1.—Current per Capita Culinary and Secondary Use Values for Wasatch Front Drainage Basins

	Culinary per Capita Use					
	Residential Use		Commercial, Institutional, and Industrial		Total Culinary Use	
County	acre-ft/yr[1]	GPCD	acre-ft/yr	GPCD	acre-ft/yr	GPCD
Weber Basin					0.220	197
Summit	0.252	225	0.058	52	0.310	277
Morgan	0.261	233	0.029	26	0.290	259
Weber	0.127	113	0.102	91	0.229	204
Davis	0.114	102	0.088	79	0.203	181
Jordan Basin					0.280	250
Salt Lake	0.198	177	0.082	73	0.280	250
Utah Lake					0.245	218
Utah	0.160	143	0.084	75	0.244	218
Juab	0.181	162	0.072	64	0.253	226
Wasatch	0.199	178	0.049	44	0.249	222
Average overall use	0.171	153	0.085	76	0.256	228

	Secondary per Capita Use					
	Residential Use		Commercial, Institutional, and Industrial		Total Secondary Use	
County	acre-ft/yr	GPCD	acre-ft/yr	GPCD	acre-ft/yr	GPCD
Weber Basin					0.147	131
Summit	0.050	45	0.036	32	0.086	77
Morgan	0.045	40	0.000	0	0.045	40
Weber	0.141	126	0.019	17	0.160	143
Davis	0.129	115	0.016	14	0.145	129
Jordan Basin					0.011	10
Salt Lake	0.006	5	0.006	5	0.011	10
Utah Lake Basin					0.063	56
Utah	0.046	41	0.017	15	0.063	56
Juab	0.040	36	0.006	5	0.046	41
Wasatch	0.058	52	0.025	22	0.083	74
Average overall use	0.048	43	0.012	10	0.059	53

[1] acre-ft/yr = acre-feet per year.

Table 1-2.—Summary of Current Culinary and Secondary per Capita Water Use for the Wasatch Front Drainage Basins

	Culinary and Secondary per Capita Use					
	Residential Use		Commercial, Institutional, and Industrial		Total Culinary and Secondary Use	
County	acre-ft/yr	GPCD	acre-ft/yr	GPCD	acre-ft/yr	GPCD
Weber Basin					0.367	328
Summit	0.302	270	0.094	84	0.397	354
Morgan	0.306	273	0.029	26	0.335	299
Weber	0.268	239	0.121	108	0.389	347
Davis	0.243	217	0.104	93	0.347	310
Jordan Basin					0.291	260
Salt Lake	0.204	182	0.087	78	0.291	260
Utah Lake					0.307	274
Utah	0.206	184	0.101	90	0.307	274
Juab	0.222	198	0.077	69	0.299	267
Wasatch	0.258	230	0.074	66	0.332	296
Average overall use	0.219	195	0.096	86	0.315	281

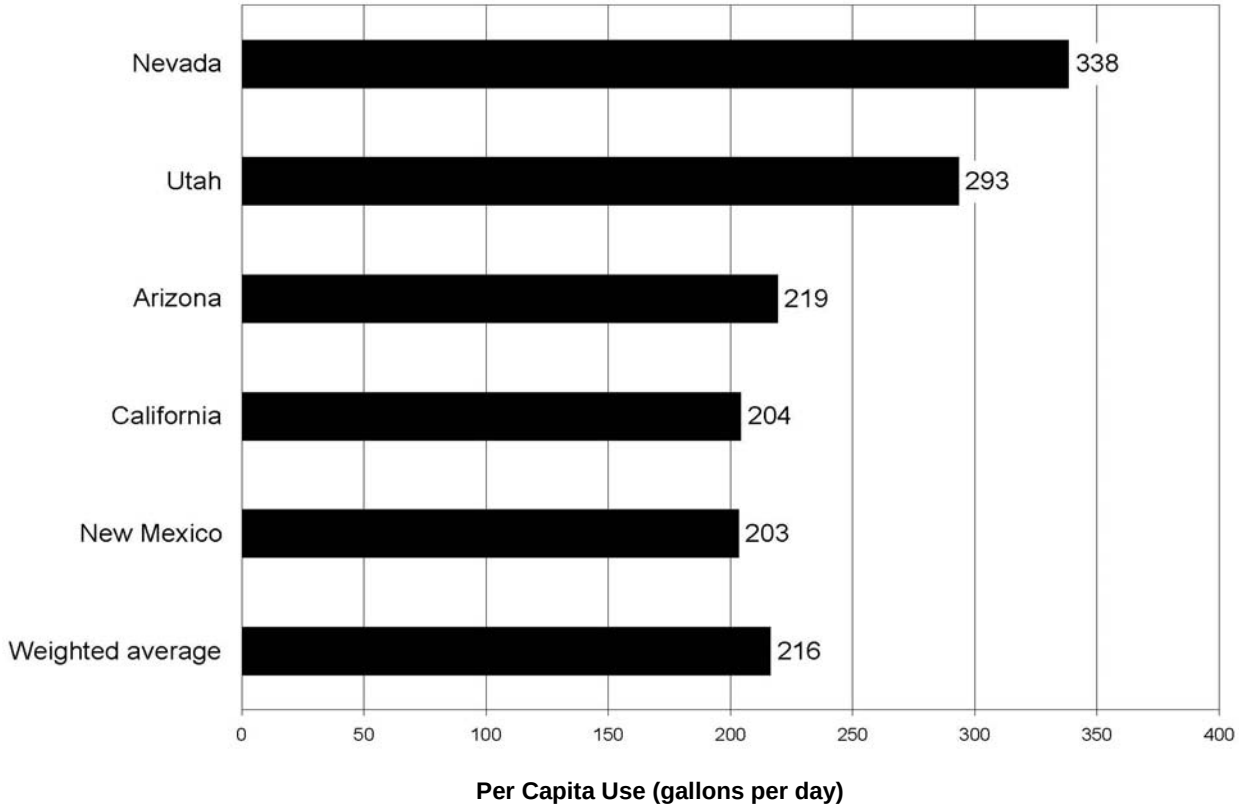


Figure 1-1.—2000 per Capita Water Use of Public Supply Water in Arizona, California, Nevada, New Mexico, and Utah.

Table 1-1 shows the culinary (potable) per capita water uses that include private domestic use as well as public water supply use. The overall culinary water use for the Wasatch Front is 228 GPCD. Specific per capita water consumption data for Sanpete County is not available; therefore, regional information was used. Conditions in Sanpete County are very similar to those generally on the Wasatch Front, so water need could be assumed to be similar to that on the Wasatch Front. However, due to the recurrent shortages in Sanpete County, it is most likely that Sanpete County's usage is lower than the State average.

The secondary (nonpotable) municipal per capita use, also listed in table 1-1, shows that the Weber River Basin uses the largest amount of secondary water. Total municipal use of secondary water is 53 GPCD compared to 228 GPCD for culinary water. Likewise, overall municipal per capita use of culinary and secondary water is 281 GPCD, shown in table 1-2. The residential portion of the total municipal use is 195 GPCD (69%). Commercial and institutional use is 86 GPCD (31%).

Mount Pleasant's irrigation system has a total of 948 shares. The city has a 2005 estimated population of 2,938. Each share of water provides a supply of about 0.45 acre-foot, which is equivalent to a supply of 0.15 acre-foot per capita. The agricultural irrigation systems in the area experience shortages of about 29.5% (average). Since the city's irrigation system is linked to the same water source as the agricultural system, it too would experience the same 29.5% shortage. Therefore, municipal irrigation shortages are estimated to be 0.044 acre-foot per capita (29.5% of 0.15 acre-foot per capita). Applying this per capita shortage to all four cities, which have a combined population of 6,624, the total municipal irrigation shortage is estimated to be 290 acre-feet per year. To offset this shortage, local residents use potable water for some portion of irrigation needs.

The population in the project area is expected to increase, and the current shortages of municipal water are expected to worsen in these north Sanpete County communities. Based on growth projections developed by the Utah Office of Planning and Budget, the population within the project area is expected to increase by about 4,960 residents from 2000 to 2050 (table 1-3). As shown in table 1-4, this population growth would result in an increased municipal water demand of about 1,240 acre-feet annually. However, local officials believe that the State projections underestimate the anticipated population growth. During the past several years, the average population growth in north Sanpete County has been greater than 3% per year and greater than the State's projections. Table 1-5 shows the anticipated population growth based on an average 3% growth rate.

As shown in table 1-5, with a 3% growth rate, the population within the project area would increase to 18,275 by 2030, an increase of about 10,750 residents. Table 1-6 shows that, with 3% annual population growth, the demand for municipal water would increase to 5,528 by 2030, an increase of more than 3,250 acre-feet per year. With existing shortages and anticipated population growth, there would be a demand for an additional 3,550 acre-feet of municipal water by the year 2030.

1.4.2 Additional Agricultural Irrigation Water Supply

The existing water supply for agricultural irrigation does not provide an adequate supply at the times when it is needed. An additional and dependable irrigation water supply is needed to stabilize and improve the agricultural component of the Sanpete

Table 1-3.—Population Projections for Narrows Project Area [1, 2]
Based on State of Utah Economic Demographic Projections – 2005

Population								
Year	Average Annual Population Growth	Fairview	Mt. Pleasant	Moroni	Spring City	Wales	Unincor-porated Counties[3]	Total Project Area
2000		1,160	2,707	1,280	956	219	1,207	7,529
2005	1.9%	1,257	2,938	1,392	1,037	244	1,389	8,257
2010	1.9%	1,378	3,222	1,527	1,137	267	1,523	9,054
2020	1.7%	1,625	3,799	1,800	1,340	315	1,795	10,674
2030	0.7%	1,738	4,062	1,925	1,433	337	1,920	11,415
2040	0.5%	1,821	4,256	2,017	1,502	353	2,012	11,961
2050	0.4%	1,901	4,444	2,106	1,568	369	2,100	12,488

[1] 2000 populations are April 1 U.S. Census populations; all others are July 1 populations.
[2] County populations for 2005–2050 from the Governor's Office of Planning and Budget.
[3] Unincorporated county estimates are prorated based on the total unincorporated estimates.

Table 1-4.—Projected Municipal Water Demands for Narrows Project Area Based on 270 GPCD and State of Utah Economic Demographic Projections – 2005

Acre-feet per Year							
Year	Fairview	Mt. Pleasant	Moroni	Spring City	Wales	Unincor-porated Counties	Total Project Area
2000	351	819	387	289	66	365	2,278
2005	380	889	421	314	74	420	2,498
2010	417	975	462	344	81	461	2,739
2020	492	1,149	545	405	95	543	3,229
2030	526	1,229	582	433	102	581	3,453
2040	551	1,287	610	454	107	609	3,618
2050	575	1,344	637	474	112	635	3,778

Table 1-5.—Population Projections for Narrows Project Area Based on County Projections on Annual Growth Rate of 3%

Population								
Year	Average Annual Population Growth	Fairview	Mt. Pleasant	Moroni	Spring City	Wales	Unincor-porated Counties	Total Project Area
2000		1,160	2,707	1,280	956	219	1,207	7,529
2005	3.00%	1,345	3,138	1,484	1,108	254	1,399	8,728
2010	3.00%	1,559	3,638	1,720	1,285	294	1,622	10,118
2020	3.00%	2,095	4,889	2,312	1,727	396	2,180	13,598
2030	3.00%	2,816	6,571	3,107	2,320	532	2,930	18,275
2040	3.00%	3,784	8,830	4,175	3,119	714	3,937	24,560
2050	3.00%	5,085	11,867	5,611	4,191	960	5,291	33,006

Table 1-6.—Projected Municipal Water Demands for Narrows Project Area Based on 270 GPCD and Annual Growth Rate of 3%

Acre-feet per Year							
Year	Fairview	Mt. Pleasant	Moroni	Spring City	Wales	Unincor-porated Counties	Total Project Area
2000	351	819	387	289	66	365	2,278
2005	407	949	449	335	77	423	2,640
2010	472	1,100	520	389	89	491	3,061
2020	634	1,479	699	522	120	659	4,113
2030	852	1,988	940	702	161	886	5,528
2040	1,145	2,671	1,263	943	216	1,191	7,429
2050	1,538	3,590	1,697	1,268	290	1,601	9,984

County economy. Successful crop production in north Sanpete County depends on irrigation because the average rainfall during the growing season is approximately 4 inches. The present irrigation water supply consists primarily of runoff from the previous winter snowpack. The amount of annual runoff varies widely because of natural precipitation patterns during the winter. The greatest volume of runoff occurs in the early part of the growing season. Although irrigation water users have made numerous improvements to their existing water distribution systems in the past (such as canal lining, piped distribution systems, and conversion to sprinkler irrigation), water shortages still occur (often exceeding 50% in dry years and 30% in average years).

There are about 23,180 acres of irrigated farmland in the project area. Of that acreage, 15,420 acres have been identified as eligible to receive project water. The eligible lands are classified as Class I, II, or III lands according to Reclamation's land classification system. The remaining lands are considered Class VI (ineligible) lands because of poor soil, inadequate drainage, or topographic characteristics.

In determining water requirements, the project lands were divided into three groups representing similar water supplies and irrigation practices. These groups are described below.

Group 1 lands include the areas serviced by the Cottonwood-Gooseberry, Birch Creek, Spring Canyon, North Creek, Pleasant Creek, and Oak Creek Irrigation Companies. Of the 9,777 acres of presently irrigated lands, 5,705 acres are eligible to receive project water. Water is delivered to Group 1 lands through pipeline systems. These lands currently are irrigated by sprinkler systems.

Group 2 lands include the areas served by the Horseshoe, Cedar Creek, and Twin Creek Irrigation Companies. Group 2 contains 6,407 acres of farmland, of which 4,644 acres are eligible to receive project water. Water is delivered to these lands through open canals and ditches. At present, these lands mostly are flood irrigated.

Group 3 lands use the San Pitch River as their principal water supply and are served by numerous irrigation companies. There are 6,996 acres of irrigated land in this group, 5,071 acres of which are eligible for project water. Group 3 lands receive water through open canals and ditches. These lands currently are irrigated with a combination of flood and sprinkler methods.

Principal crops grown in the project area include pasture, alfalfa, grass hay, and small grains. Consumptive use requirements reported in the DEIS and earlier documents were determined for these crops using the modified Blaney-Criddle method as summarized in the Soil Conservation Service publication, *Technical Release No. 21, Irrigation Water Requirements,* April 1967, revised September 1970. The Utah Agricultural Experiment Station has since released updated consumptive use data in its publication, *Consumptive Use of Irrigated Crops in Utah*, October 1994 (*Research Report 145)*. The consumptive use requirements presented here are based on the 1994 data and are higher than previous estimates.

Consumptive use estimates were computed for the principal crops found in each of the groups. The estimates are based on the crop distribution of each group. Average monthly estimates were computed for April through October, as appropriate for each crop. These estimates represent net irrigation requirements since *Research Report 145* deducts effective precipitation from total consumptive use. Curve No. 1 (crop consumptive use), shown in figure 1-2, presents the monthly net irrigation requirements for the 15,420 acres of project-eligible lands. The average net irrigation requirement is approximately 30,400 acre-feet per year.

The net irrigation requirement is the amount of water that must be artificially applied by irrigation and must be present in the root zone and available for evapotranspiration by the plants for normal plant growth and development. It is not the amount that must be diverted into the irrigation system. Because of inevitable inefficiencies of the delivery, distribution, and application systems, a larger quantity of water must be diverted into the irrigation system to meet actual crop needs. Some of the factors contributing to these inefficiencies include seepage and evaporation from the carriage system, evaporation of applied water, deep percolation of excess applied water, and runoff of excess water. The lack of uniformity in applying irrigation water is the major cause of deep percolation and runoff. Traditionally, flood irrigation is the least uniform, and microirrigation systems are the most uniform. The application systems with the highest uniformity generally also have the highest capital and operating costs. Based on the delivery system conditions and application methods in use, the diversion requirement was computed to be an average of about 62,900 acre-feet per year for the project-eligible lands. This demand is shown as Curve No. 2 (diversion demand without efficiency improvements) in figure 1-2.

Data gathering efforts, conducted during the planning stages of the project, identified private parties and canal companies that were planning to install, or were currently installing, a variety of efficiency improvements (efficiency improvement, conservation measures). These improvements consist mainly of pipe delivery and sprinkler irrigation systems. More precise application methods, such as drip irrigation and microspray systems, are not cost effective. These efficiency improvements are expected to be in place by the time project water would become available. Thus, all calculations of project diversion demands made and discussed herein are based on the increased efficiencies produced by these improvements.

Curve No. 3 (diversion demand with efficiency improvements) in figure 1-2 shows the reduced diversion requirement (or demand) of 51,700 acre-feet per year on the average. The efficiency improvements would result in an 11,200-acre-foot reduction in the diversion demand. It should be

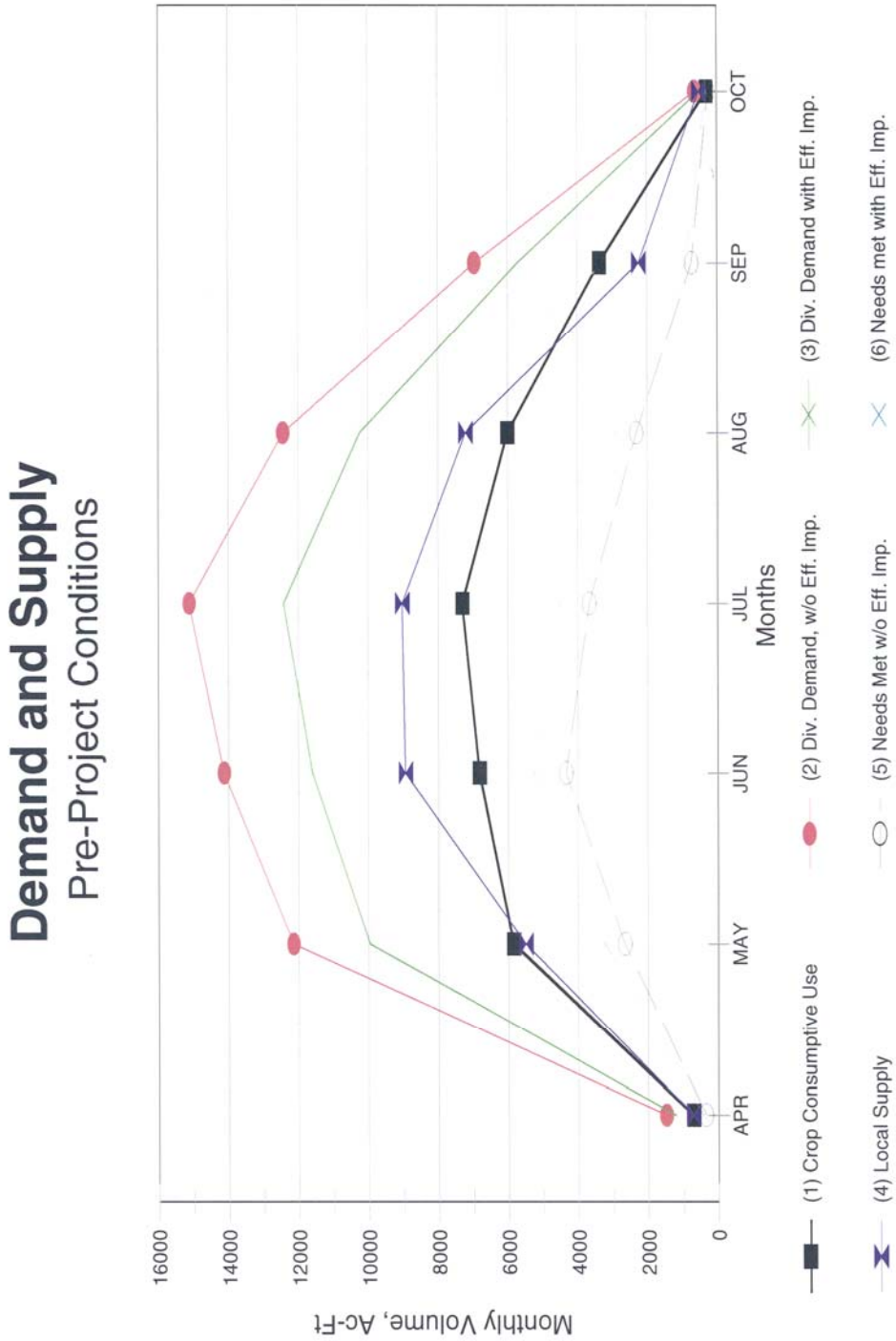


Figure 1-2.—Narrows Project Demand and Supply, Preproject Conditions.

emphasized that the reduced diversion requirement is the effect efficiency improvements would have, not a development of a new water supply. The same irrigated lands require less in physical diversion to receive full irrigation. The efficiency improvements also will mean that a larger percentage of diverted water would become available for plant evapotranspiration.

Local water supplies in the project area consist of a small amount of effective precipitation during the growing season, a small amount of storage, and direct runoff from the snowpack. Curve No. 4 (local supply) in figure 1-2 shows the 34,200 acre-feet (spread over the irrigation season) diverted annually to meet the crop water needs. Curve No. 4 is based on long-term historical diversions. It does not include effective precipitation, which is already accounted for in the net irrigation requirement shown in Curve No. 1. As can be seen from figure 1-2, the local supply is considerably less than the reduced diversion demand (Curve No. 3). This shortage is approximately 17,500 acre-feet on an average annual basis (total volume difference between Curve Nos. 3 and 4).

Research Report 145 indicates that about 3.5 inches of effective precipitation occur during the nongrowing season. Some portion of this effective precipitation would accumulate in the root zone and be available to augment the local supply during the first few weeks of the growing season. There could be as much as 4,500 acre-feet of moisture stored in the soil profile at the beginning of the growing season.

The exact amount of soil moisture has not been determined. In reality, the shortage, therefore, most likely would range between 13,000 and 17,500 acre-feet per year. Assuming that one-half of this precipitation still would be in the root zone at the beginning of the growing season, the average shortage would be about 15,250 acre-feet per year. This represents a 29.5% shortage relative to the diversion demand.

Depending on the efficiency scenario being examined (with or without efficiency improvements), Curve Nos. 5 (needs met without efficiency improvements) and 6 (needs met with efficiency improvements) show that significant soil moisture deficits would occur throughout much of the growing season. With the expected moisture available in the root zone at the beginning of the growing season, the early-season deficits probably would not be as severe, as shown by the graphs. However, serious soil moisture deficits occur throughout much of the latter part of the growing season. This would result in prolonged or frequent water stress for the crops involved. Consequences of this water stress include reduced crop yield, reduced quality, and poor plant vigor. For example, there should be three good cuttings of alfalfa under adequate water supply conditions. Currently, the first cutting is good, the second is mediocre, and the third generally never occurs. Further, evidence of reduced crop vigor was noted during a Reclamation field tour of the project service area. A large number of fields were noted to have unusually high infestations of weeds. Typically, lower water-use weeds quickly infest a field when the crop is seriously water stressed. This problem is exacerbated in north Sanpete County because the short water supply prevents normal crop rotations that help control weeds and maintain field productivity (because rotation crops have higher water requirements).

As previously noted, only a portion of the water diverted for irrigation would be available for crop use. The remaining portion would be lost through evaporation, seepage losses, deep percolation, and runoff. Except for the amount lost through

evaporation, these losses either become part of the water supply for the shallow water table or become return flows to the natural surface streams. These losses support wetlands and aquatic habitat and become part of the water supply for downstream users. Total losses from local supplies would amount to an estimated 17,600 acre-feet per year before efficiency improvements were implemented. The losses would be expected to be reduced to about 14,100 acre-feet per year with implementing efficiency improvements. Thus, efficiency improvements would result in a combined loss reduction of about 3,500 acre-feet per year.

1.4.3 Narrows Tunnel Rehabilitation

The poor condition of the existing Narrows Tunnel threatens the ability to deliver the existing water supply. The 3,100-foot-long Narrows Tunnel was constructed in 1964 to divert water from Gooseberry Creek to Cottonwood Creek and to the Fairview area for irrigation. It was designed to be concrete-lined and also serve as the outlet for the proposed Narrows Reservoir. Since its construction more than 30 years ago, the tunnel has experienced severe stability problems. Steel sets with wooden lagging were installed in certain reaches of the tunnel to provide additional reinforcement. However, the steel sets were widely spaced, and loose rubble from within the tunnel significantly loaded the wooden lagging between sets. As time passed, the lagging began to fail, permitting the roof and rib to slough over significant portions of the tunnel. In the early 1980s when it became evident that the tunnel could eventually collapse, a 36-inch corrugated metal pipe (CMP) was installed through the least stable tunnel sections to maintain the waterway. This measure is considered to be temporary because the CMP eventually will collapse due to rust or excessive earth loads.

1.4.4 Recreation and Fishery Opportunities

In addition to the primary purpose of supplying water to Sanpete County, the proposed project would result in improved and additional recreation and fishery opportunities in Sanpete County. The recreation demand is increasing rapidly in the project area. The most popular outdoor recreational activities in Utah are fishing, boating, swimming, water skiing, camping, picnicking, hunting, and horseback riding. Boating ranks as one of the most popular outdoor recreation activities in the State of Utah. However, adequate flatwater boating and boat launching areas currently are not available in Sanpete and Carbon Counties. This need was included in the top 10 recreation issues in Utah identified in public meetings conducted by the Utah Division of Parks and Recreation in 1985 and 1990. The 1992 Utah State Comprehensive Recreation Plan (SCORP) states that:

> *"As Utah's population continues to grow, so does the demand for recreation facilities and opportunities. Obviously, the recreation system in place in 1970 or even 1980 is no longer adequate in the 1990s."*

The SCORP suggests that additional water-based recreation areas are needed to accommodate the potential growth in demand for recreation use throughout the State.

In identifying priorities for recreation development, the SCORP states that:

> *"Generally, those projects in or near major urban and rural service*

centers would rank higher, particularly if they were water-related with multiple uses . . . .”

According to the Utah Division of Parks and Recreation, the most popular outdoor recreation activity in Utah is fishing.

The 1986 Forest Land and Resource Management Plan for the Manti-La Sal National Forest (Forest Plan) states that:

“. . .the demand for developed recreation sites is expected to triple over the next 50 years. At this rate, demand on the Manti-La Sal National Forest is expected to exceed supply at some sites starting in the year 1990.”

The Forest Plan also states that:

“Some lands, especially those next to reservoirs on the Forest, possess a high recreational value.”

1.5 RELATIONSHIP TO OTHER PROJECTS

The Bonneville and Great Basins and the Upper Colorado River Basin have been the subject of several projects, plans, and programs. Construction and operation of the proposed project would reflect consideration of, and cooperation with, the following existing projects.

1.5.1 Central Utah Project

As part of the master water development plan for Sanpete County, the Narrows Project is intended to provide a supplemental water supply for the northern part of the county. Central Utah Project (CUP) water, delivered by the Sevier River, originally was planned to provide a supplemental supply for the southern portion of the county. However, The Central Utah Project Completion Act (CUPCA), which authorized completion of the remaining features of the CUP, restricted CUP development to the Wasatch Front area of central Utah if construction of facilities did not begin within 5 years of the enactment of the legislation. Sevier and Millard Counties withdrew from the Central Utah Project, and plans to deliver CUP water to the Sevier River Basin have been dropped. The 5-year authorization window has since expired; therefore, delivery of CUP water to the Sevier River Basin and, consequently, to Sanpete County, will not occur.

To compensate for the CUP water supply loss, Section 206 of the CUPCA was designed to provide some funding for supplemental projects in Sanpete County. Section 206 is intended for counties within the Central Utah Water Conservancy District (CUWCD) that were originally planned to receive CUP water but will not (as explained above). These counties are eligible to receive a rebate of the taxes paid to the CUWCD. This rebate may be used for local water projects such as potable water distribution and treatment, wastewater collection and treatment, and agricultural water management. Participating counties will receive a rebate from the CUWCD of ad valorem tax contributions paid, with interest, but less any benefits or administrative expenses. Under Section 206, this rebate represents a 35% local cost share; and a Federal grant from the Secretary of the Interior constitutes the remaining 65% of the project cost.

Through 1996, Sanpete County had paid nearly $2.4 million in ad valorem taxes to the CUWCD, which established the maximum amount of the rebate under CUPCA Section 206. Based on a 65% match, the corresponding amount of matching Federal grant money is about $4.4 million. These two sums provide a total Section 206 amount of $6.8 million

that could be used to fund water development/conservation projects in Sanpete County.

To more effectively utilize these funds, in June 2000, SWCD completed the Sanpete County Water Resources Master Plan (Master Plan) for managing, developing, and conserving the limited water resources of the county. The plan was intended to evaluate and prioritize several water management and/or conservation projects that potentially would be funded by SWCD for implementation. The Master Plan clearly places the Narrows Project as its primary objective in obtaining supplemental water to meet shortages in north Sanpete County. However, other water development/ conservation projects would be needed to further alleviate shortages that occur throughout Sanpete County. Since 1996, Sanpete County has approved approximately $4.8 million in projects to further develop/conserve its water resources using CUPCA Section 206 funds.

1.5.2 Scofield Project

The Scofield Project, authorized on June 24, 1943, arose out of the remnants of various private dams that either failed or never lived up to expectations. The new Scofield Dam and Reservoir replaced the rapidly deteriorating, old Scofield Dam, built by the Price River Water Conservation District. The Scofield Project eventually irrigated area lands originally that were to be served by Mammoth Dam, and later by the defunct Gooseberry Project. Mammoth Dam failed in 1917, before its completion. While the Scofield Project evolved out of the Gooseberry Project, the need to protect vital rail lines from flood damage during World War II was a key to construction of Scofield. Although World War II prompted suspension of construction on most Reclamation projects, the fear that the existing Scofield Dam might fail and cause millions of dollars of damage and disrupt transportation influenced the Federal Government to proceed with the Scofield Project.

The Scofield Project included 30,000 acre-feet of replacement storage capacity (replacing the then existing 30,000-acre-foot structure), 8,000 acre-feet of inactive or dead pool storage (conservation pool), and 35,000 acre-feet of exchange capacity to support the transmountain diversion of Gooseberry Creek water at or near the Narrows damsite. The near doubling in size of Scofield Reservoir was originally accomplished (1943–1946) because of hazardous conditions with the existing structure, the threat it posed to the war effort, and the reservoir's role in accomplishing a portion of the Gooseberry Project Plan, which included an early version of the Narrows Project.

1.5.3 Fairview Lakes, Gunnison Reservoir, Wales Reservoir

Through a proposed operating agreement associated with the Narrows Project, releases would be made from the privately owned Fairview Lakes to re-establish minimum instream flows in two small tributaries to Gooseberry Creek above the Narrows Reservoir site (see frontispiece map). Wales Reservoir is a small, privately owned reservoir that stores winter runoff from the Upper San Pitch River drainage. Gunnison Reservoir is a storage facility, located southwest of Manti, that stores water from the San Pitch River drainage (Wales Reservoir is located about 19 miles upstream of Gunnison Reservoir on Silver Creek, which is a tributary of the San Pitch River).

1.5.4 Price-San Rafael Rivers Unit, Colorado River Salinity Control Program

The Price-San Rafael Rivers Unit of the Colorado River Water Quality Improvement Program under the Colorado River Salinity Control Act would reduce salt contribution to the Colorado River by about 161,000 tons annually through a system of on-farm and off-farm irrigation improvements. The Narrows Project would divert water from the Price-San Rafael River Basins to develop a supplemental irrigation water supply of 5,400 acre-feet per year for municipal use and for approximately 15,420 acres of presently irrigated land in north Sanpete County, Utah. The Price-San Rafael Rivers Unit more than compensates for the trans-basin diversion of 5,400 acre-feet under the Narrows Project.

1.5.5 Upper Colorado River Endangered Fish Recovery Program

A coalition of agencies and organizations came together in 1988 to recover endangered Colorado River Basin fish and provide for future water development for agricultural, hydroelectric, and municipal uses.

Called the Recovery Implementation Program (RIP) for Endangered Fish Species in the Upper Colorado River (Recovery Program), this effort involves Federal, State, and private organizations and agencies in Colorado, Utah, and Wyoming. The Recovery Program complies with all applicable laws, including the Federal Endangered Species Act, State water laws, river laws, and interstate water compacts.

Recovery strategies include conducting research, improving river habitat, providing adequate streamflows, managing nonnative fish, and raising endangered fish in hatcheries for stocking. Ongoing activities include the development of recommended flow regimes for the Price River to benefit endangered fish populations. As of August 2009, the Recovery Program is in the final stages of developing these flow recommendations.[1]

1.6 Decisions To Be Made Based on this Analysis

Based on the analysis documented in this SDEIS, the responsible official for Reclamation will make the following decisions:

- Whether Reclamation should approve SWCD's application for a SRPA loan to construct the Narrows Project
- Whether Reclamation should approve SWCD's use of Reclamation withdrawn lands for the Narrows Project, in accordance with Reclamation law
- Under what terms and conditions (of a local supplemental agreement between Reclamation and the USDA Forest Service) should the agencies administer resources within the total areas of project influence

In addition, the cooperating agencies may use this SDEIS to aid them in making the following decisions:

- Whether the USDA Forest Service should:
  1. Amend the Forest Plan to reflect Narrows Project land use changes
  2. Authorize mitigation measures on USDA Forest Service

[1] http://www.coloradoriverrecovery.org/general-information/about.html.

administered lands outside the Reclamation withdrawn lands

3. Issue necessary easements to the Utah Department of Transportation (UDOT) for relocating State Route (SR) 264
4. Accept responsibility for management of the recreation facilities
5. Sign various agreements, such as memoranda of understanding (MOU), easements, and rights-of-way (ROW)
6. Amend grazing permits and allotment management plans

- Whether USACE should approve SWCD's application for a Clean Water Act Section 404 permit authorizing the placement of discharged dredge or fill material into waters of the United States for constructing the Narrows Dam and other features of the Narrows Project

1.7 Environmental Issues Associated with the Proposed Action Alternative

The issues identified through the initial scoping effort are listed below. The issues are phrased as questions. Following a brief description of the issue, indicators or measures are suggested that may be used to compare how the alternatives answer the question. Indicators measure change from the present condition. Chapter 2 contains a comparison summary of the alternatives and their responses to the issues. Chapter 3 presents the affected environment and the predicted effects as they relate to the resource issues.

Issue No. 1 – How would threatened and endangered species be affected by the Narrows Project?

The project area and potentially affected offsite areas contain the habitat for several federally listed endangered and threatened species, including the Colorado pikeminnow, bonytail, humpback chub, razorback sucker, Canada lynx, Utah prairie dog, black-footed ferret, yellow-billed cuckoo, southwestern willow flycatcher, heliotrope milk-vetch, Graham beard tongue, and the Uinta Basin hookless cactus. Due to the listing of these species as threatened, endangered, candidate, or proposed, the protection of a sensitive species habitat has become a matter of concern to the U.S. Fish and Wildlife Service (Service) and to the public.

Indicators for this issue:

- Acre-feet of water annually depleted from the Colorado River system
- Loss of potential southwestern willow flycatcher habitat

Issue No. 2 – How would the Narrows Project affect wildlife resources?

The project area provides habitat for a wide variety of wildlife species ranging from deer and elk to birds and small mammals. There is concern that the proposed project may disrupt the migration routes and feeding areas for some small animal and bird species, including some neotropical species.

Indicators for this issue:

- Number of habitat units lost for specific indicator wildlife species (i.e., ungulates, small mammals, neotropical migrants, and Utah State sensitive species)

Issue No. 3 – What effects would there be on water resources from the Narrows Project?

The public expressed concerns about the hydrology, water yield, and supply of the Price River as well as whether the winter releases and instream flows from Scofield Reservoir would be affected as a result of current or future use.

Indicators for this issue:

- Acre-feet of depletion from the Price River drainage
- Acre-feet of water available to San Pitch River drainage

Issue No. 4 – How would the Narrows Project affect the fishery resource?

The public expressed concern about the loss of Yellowstone cutthroat trout spawning habitat caused by inundation from the Narrows Project. Changes in the flow regime may cause increased water quality problems and subsequently affect the fisheries.

Concern for the fishery below Scofield Reservoir was expressed, and the question was asked if instream flows would be altered and if minimum flows would be required below Narrows Dam and Scofield Dam.

Indicators for this issue:

- Percent change in weighted usable area in fish habitat as measured by instream flow incremental methodology (IFIM)[2]
- Change in surface area in Scofield Reservoir
- Change in species composition above, below, and within Scofield Reservoir and the proposed reservoir
- Change in species composition and in population dynamics of existing species

Issue No. 5 – How would water quality be affected by the Narrows Project?

Accelerated sedimentation (over natural levels of sediment production) is the most likely factor to affect water quality. Land-disturbing activities, such as road construction and dam building, usually increase sedimentation, at least in the short term.

Concerns were expressed over how the Proposed Action may affect the water quality as measured by phosphorus loading downstream.

The addition of many new recreationists to the Gooseberry Valley could create additional pollution from problems with trash and sewage. Additionally, road material (from rerouting SR-264) may have a temporary and adverse effect on riparian systems.

Indicator for this issue:

- Change in average phosphorus level in Scofield Reservoir based on external phosphorus loading

Issue No. 6 – What would the effect be on wetland resources from the Narrows Project?

Construction of the Narrows Project would inundate existing wetlands. Change in flow (decrease or increase) may change the composition and structure of other existing wetlands.

Indicators for this issue:

- Acres of wetlands lost (function and value)

[2] IFIM is a standard for measuring habitat.

- Function and values measured by habitat evaluation procedures (HEP) analysis in terms of habitat units
- Change in species composition in wetland habitats

Issue No. 7 – What would the effect be on aquatic and riparian resources from the Narrows Project?

Construction of the Narrows Project would inundate and affect wetlands and riparian areas. A decrease in flow may change the wetlands and lower the water table. High flows are needed to re-establish the riparian communities. Concern was expressed about the possibility of high peak flows causing a blowout of the stream channel (Cottonwood Creek).

Indicators for this issue include:

- Change in species composition in aquatic and riparian habitats
- Number of miles of stream lost due to inundation of the reservoir
- Number of miles of stream affected by increase in flow and decrease in flow

Issue No. 8 – How would the Narrows Project affect the recreation and visual resources within the project area?

Currently, the area receives light, nonmotorized, dispersed recreation during the summer and fall, primarily from stream anglers. Moderate levels of winter recreation also occur. If the project is implemented, the nature of the recreational experience may be affected. Motor boating and related water sports, overnight family camping, large group reservation camping, all terrain vehicle (ATV) use, and reservoir fishing activities may replace the current recreation experience in the area inundated by the reservoir.

The surrounding USDA Forest Service lands in this area have been designated by the Forest Plan to have the visual quality objective (VQO) of Partial Retention. One concern is that, with developing the recreational area, associated gravel pits and soil scars may affect the visual quality of the area.

Indicators for this issue:

- Increase in developed recreation visitor days at Narrows (including fishing)
- Increase in dispersed recreation visitor days at Narrows (including fishing)
- Change in projected fisherman days
- Change in VQOs

Issue No. 9 – What effect would there be on cultural resources from the Narrows Project?

A Class III cultural resource inventory was conducted for the proposed Narrows Dam and Reservoir pool area in 1979 (Dames & Moore). Prior to beginning the Class III inventory, records at the Utah Division of State History, Antiquities Division were consulted to identify previously recorded cultural resources that may be adversely affected by the proposed Narrows Project. The *National Register of Historic Places* (NRHP) was also examined. As a result of the 1979 inventory, three cultural resource sites were identified in the reservoir pool area. The sites, however, were not evaluated for NRHP eligibility. Prior to initiation of final design and construction, Class I and Class III cultural resource inventories, as well as consultations with various consulting parties, including Indian tribes, would need to be completed before a determination of effects to cultural resources from the Narrows Project could be made.

Indicators for this issue:

- Number of historic and cultural sites inundated or otherwise impacted by construction of the reservoir and ancillary facilities
- Potential tribal concerns regarding traditional cultural properties or sacred sites within the area of potential effects (APE)

Issue No. 10 – What social and economic effects would be expected from the Narrows Project?

Reclamation recognizes that implementing the alternatives may result in impacts on the local residential community in the vicinity of the Narrows damsite. Aside from the environmental issues previously identified above, local communities often are concerned with intangible quality of life impacts that implementing the alternatives may present. Key community concerns frequently include impacts downstream from Scofield Reservoir and the social and economic effects on Carbon and Sanpete Counties.

Indicators for this issue:

- Number of jobs (Carbon, Sanpete) created during construction
- Change in farm income
- Change in available water supply in Sanpete and Carbon Counties

Issue No. 11 – What effect would there be on existing land uses, rights-of-way, and potential mineral leasing?

Since more than half of the shoreline of the proposed reservoir would be on private land, there would be potential for development of the private land including subdivisions, roads, summer homes, lodges, and utilities. Development of this land could cause problems such as erosion and ground and surface water pollution.

The project would be located within the boundaries of four USDA Forest Service grazing allotments. The reservoir, campgrounds, and additional roads may decrease available forage for livestock and wildlife.

Since the proposed dam and reservoir are in the vicinity of known mineable coal reserves, the project could affect the mineability of Federal and private coal resources.

Indicators for this issue:

- Percentage of shoreline in private ownership
- Change in number of animal unit months (AUMs) of forage use
- Acres of mineable coal reserves not available for mining

Issue No. 12 – What effects on public safety would there be from the Narrows Project?

The finished reservoir would be an attraction to the public, which may increase recreational traffic on SR-31, SR-264, and local USDA Forest Service roads in the vicinity, leading to possible congestion and accidents. Local USDA Forest Service roads may need reconstruction to a higher standard if traffic levels increase appreciably.

Indicator for this issue:

- Percent expected change in the volume of traffic in the project area

Issue No. 13 – What would be the effects upon air quality associated with constructing the Narrows Project?

The Narrows Project is located in a remote and rugged mountainous terrain. The air

quality associated with this area is generally excellent. Noise in the proposed project area is generally low and not disturbing. The construction activities potentially may affect the air quality of the Narrows basin during construction activities.

Indicator for this issue:

- Number of days project will exceed National Ambient Air Quality Standards (NAAQS) for particulate matter
- Noise indicator

Issue 14 – Would the slopes of Fairview Canyon be affected by construction and operation of the Narrows Project? What effects will there be on channel stability from the Narrows Project?

Concern was expressed about the potential impacts from additional flows through Cottonwood Creek to the already unstable Fairview Canyon. Several landslides have been identified in the canyon. Concern was expressed about the adjacent slopes in Cottonwood Creek.

Indicators for this issue:

- Frequency of exceeding the 50-year channel-forming discharge
- Lateral and vertical slope degradation

Issue No. 15 – What would the geologic hazards and earthquake hazards be from the Narrows Project?

The dam and reservoir would lie on the North Horn Formation and colluvium. The dam location and design must ensure long-term stability based on geologic conditions, including seismicity of the area, foundation conditions, permeability of the surrounding materials, and land stability.

Indicator for this issue:

- Number and severity of known geologic hazards within vicinity of dam and reservoir

Issue No. 16 – What would the effect be upon the soils of the area from the Narrows Project?

Concern was expressed about soil erosion in the project area and sediment loads transported in Gooseberry Creek.

Indicators for this issue:

- Acres of new soil disturbance
- Change in sediment loads in Gooseberry Creek

Issue No. 17 – What would the effect upon levels of trace elements in the ground water supply be from constructing the Narrows Project?

Concern was expressed about the salt pickup from the dissolution of salts from the soil and subsurface materials. Deep percolation from irrigation dissolves salts from the soils and shales and conveys them to natural drainages.

Indicator for this issue:

- Increase in levels of select trace elements in ground water

Issue No. 18 – What would the impact of the Narrows Project be on Indian Trust Assets (ITA)?

The United States has an Indian trust responsibility to protect and maintain rights reserved by, or granted to, Indian tribes or Indian individuals by treaties, statutes, and Executive orders, which rights are sometimes further interpreted through court decisions and regulations. This trust responsibility requires that all Federal agencies, including

Reclamation, take all actions reasonably necessary to protect Indian trust assets.

Indicator for this issue:

- Number of ITAs affected

Issue No. 19 – What would the impact of the Narrows Project be on Environmental Justice?

According to Executive Order No. 12898, agencies are required to analyze the environmental effects, including human health and economic and social effects of Federal actions and effects on minority communities and low income communities.

Indicator for this issue:

- Number of low income or minority communities disproportionately affected by the Narrows Project

Issue No. 20 – What climate change issues might affect, or be affected by, the Proposed Action?

Since publication of the draft EIS in 1998, issues associated with climate change have received dramatically increasing national and international attention; and, in recent years, there has been increased research and an increasing database on the topic of how climate change might affect, or be affected by, water supply systems and projects. A recent interagency report, *Climate Change and Water Resources Management: A Federal Perspective* (USGS, 2009), summarizes the issue as follows:

> *Observational evidence shows that many natural systems are being affected by regional climate changes, particularly temperature increases…Climate change is but one of many dynamic processes impacting water resources management. Other processes (for example, change in population size and location, economic development and land use, aging infrastructure, ground-water development, and changing social values) also have major influences on water resources and must be considered along with climate change in a holistic approach to water resources management. Climate change has the potential to affect many sectors in which water resource managers play an active role, including water availability, water quality, flood risk reduction, ecosystems, coastal areas, navigation, hydropower, and other energy sectors. These changes may have adverse or positive impacts on one or more sectors. Any or all of these changes could occur gradually or abruptly.*[3]

Reclamation has undertaken steps to model the effects of climate change on water delivery systems on a regional basis and for its larger reservoirs, such as Lake Powell and Flaming Gorge Reservoir. To date, however, models have not been developed with sufficient detail or sensitivity to capture small projects such as the proposed Narrows Project, which involves storage and distribution of 5,400 acre-feet of water per year. Historic Utah records indicate that both temperatures and precipitation in Utah (http://www.ncdc.noaa.gov/oa/climate/research/cag3/ut.html) have been increasing. However, without verified models addressing climate change at this project level, Reclamation concludes that, at this time, data and modeling tools are not yet developed to the point that meaningful analysis of a small project can be achieved.

[3] *Climate Change and Water Resources Management: A Federal Perspective*, Circular 1331, U.S. Geological Survey, Reston, Virginia, 2009. pg. 1.

1.8 PERMITS, AUTHORIZATIONS, AND AGREEMENTS

Implementation of the Proposed Action could require a number of authorizations or permits from State and Federal agencies. These are summarized below.[4]

- Reclamation approval of the SRPA loan and congressional approval of the necessary funds to construct the Narrows Project
- Reclamation authorization for SWCD use of withdrawn lands to construct and operate Narrows Dam and Reservoir
- Utah Division of Water Quality authorization needed for a Storm Water Discharge Permit (Section 402 of the Clean Water Act, as amended)
- A USACE permit in compliance with Section 404 of the Clean Water Act, as amended, or Utah Department of Natural Resources authorization for a State Stream Alteration Permit (Section 404 of the Clean Water Act, as amended)
- Utah Division of Water Quality authorization for a Utah Pollution Discharge Elimination Permit (Section 402 of the Clean Water Act, as amended)
- Reclamation consultation with the State Historic Preservation Office (SHPO)

[4] Before beginning activities under the Proposed Action, SWCD would consult with both the USACE and Utah Department of Natural Resources to determine which permits would be necessary.

1.9 DOCUMENT ORGANIZATION

This document follows the requirements established in the CEQ regulations (40 Code of Federal Regulations [CFR] 1502.10, and the Interior NEPA regulations, 46 CFR Subpart E). The document consists of the following main chapters:

- Chapter 1 – Purpose of and Need for the Action
- Chapter 2 – The Alternatives Considered Including the Proposed Action Alternative
- Chapter 3 – Affected Environment/Predicted Effects
- Chapter 4 – Consultation and Coordination
- Chapter 5 – List of Preparers
- Chapter 6 – Bibliography, Glossary of Terms, and List of Abbreviations and Acronyms
- Chapter 7 – Index
- Appendix A – 1984 Compromise Agreement
- Appendix B – Evaluation of Potential Damsites in Sanpete Valley
- Appendix C – Biological Opinion
- Appendix D – Fish and Wildlife Coordination Act Report
- Appendix E – Cultural Resource Coordination
- Appendix F – Environmental Commitments

CHAPTER 2

The Alternatives Considered, Including the Proposed Action Alternative

2.0 INTRODUCTION

As the lead Federal agency for this EIS, Reclamation's action under review is whether or not to approve SWCD's application for a SRPA loan and request for use of withdrawn lands to construct and operate the Narrows Project. The USACE and USDA Forest Service also must make decisions based on this EIS. To fully explore the effects of the proposed action and possible alternate courses of action, the Sanpete Water Conservancy District, working with Reclamation and the other cooperating agencies, developed an array of alternatives to answer the issues raised in chapter 1. In chapter 2, you will find:

- A description of the Proposed Action and the other alternatives that were analyzed.
- A comparison of how the alternatives would achieve the purpose of and need for the action.
- A comparison of how the alternatives address the issues identified in chapter 1.

2.1 THE PROCESS USED TO DEVELOP THE ALTERNATIVES

The National Environmental Policy Act requires all agencies to write a detailed statement for major Federal actions having a significant effect on the environment, which must include a discussion of alternatives to the proposed action (see section 102(2)(c) of the Act). In addition, all Federal agencies must study, develop, and describe appropriate alternatives to recommended courses of action in any proposal that involves unresolved conflicts concerning alternative uses of available resources. To be considered reasonable, each alternative in the array (except "no action") must meet the proposal objectives (chapter 1) and the environmental standards (selection criteria).

Reclamation, as the lead agency, formed an interdisciplinary team that consisted of various Federal and State agencies and the SWCD. This team was formed to develop a set of selection criteria that could be used to formulate alternatives to the Narrows Project that would meet the purpose of and need for the proposed project. The selection criteria are:

1. The project must include an agricultural and municipal irrigation water supply as a project purpose and provide expected project benefits for at least the duration of the loan repayment period.
2. The project must provide an additional water supply to north Sanpete County during the season when it is needed.
3. The project must comply with all statutory and regulatory requirements and guidelines including Section 404 of the Clean Water Act, the National Historic Preservation Act, and the Endangered Species Act.
4. The project must satisfy Small Reclamation Project Act requirements. The SRPA requires that a project be technically and financially feasible and in

compliance with environmental requirements. To be considered financially feasible, the following would apply:

- The project sponsor should pay a minimum of 25% of the project costs at the time of construction.
- Loan repayment must use 100% of the project's irrigation amortization capacity (with certain exceptions), and repayment must be completed in 40 years or less. The amortization capacity is a measure of farmers' and ranchers' ability to repay.
- The loan factor (a measure of Federal interest subsidy) for the project must be 0.5 or less.

SRPA allows some flexibility in meeting the financial feasibility requirement. In some situations, the irrigation amortization capacity may result in a repayment period extending beyond 40 years or a loan factor that exceeds 0.5. The sponsor, at its discretion, may use other financial assets to either increase the annual payment or increase the upfront cost share to reduce the amount of the loan. Either, or a combination, of these options may reduce the repayment period and the loan factor to acceptable levels. In other words, the sponsor may contribute funds in excess of its ability to pay, relying then on a "willingness to pay" to ensure financial feasibility.

This willingness to pay component recognizes the limitations placed by Reclamation on computing the agricultural benefits component of the farm budget.[1] The farm budget limitations may underestimate the sponsor's irrigation amortization capacity, suggesting that the farmer's ability to repay the loan may be less than is actually the case. Willingness to pay also allows the sponsor to consider other intrinsic values of the water that normally would not be considered or would be difficult to consider in an economic evaluation (benefit-cost analysis). The sponsor is responsible to determine if the value of the water benefits justifies its cost. In SRPA cases, where Reclamation's involvement is limited to making a loan, use of willingness to pay is an appropriate approach. The SRPA requires the sponsor to demonstrate only that additional financial assets exist and that the sponsor commits to the use of these assets for the project.

5. The project must divert and store water under legal claim of right and priority in full compliance with State law.

2.2 Detailed Description of Alternatives

2.2.1 No Action Alternative

The No Action Alternative represents the conditions of the affected area if Reclamation does not approve the SRPA loan and use of withdrawn lands by SWCD for the Narrows Project (figure 2-1). It establishes the baseline for evaluating the environmental impacts of providing a supplemental water supply to north Sanpete County. It also establishes anticipated conditions in the affected areas without further development and assumes that irrigation operations would continue according to historic use.

[1] The farm budget is used to compute the irrigation amortization capacity.

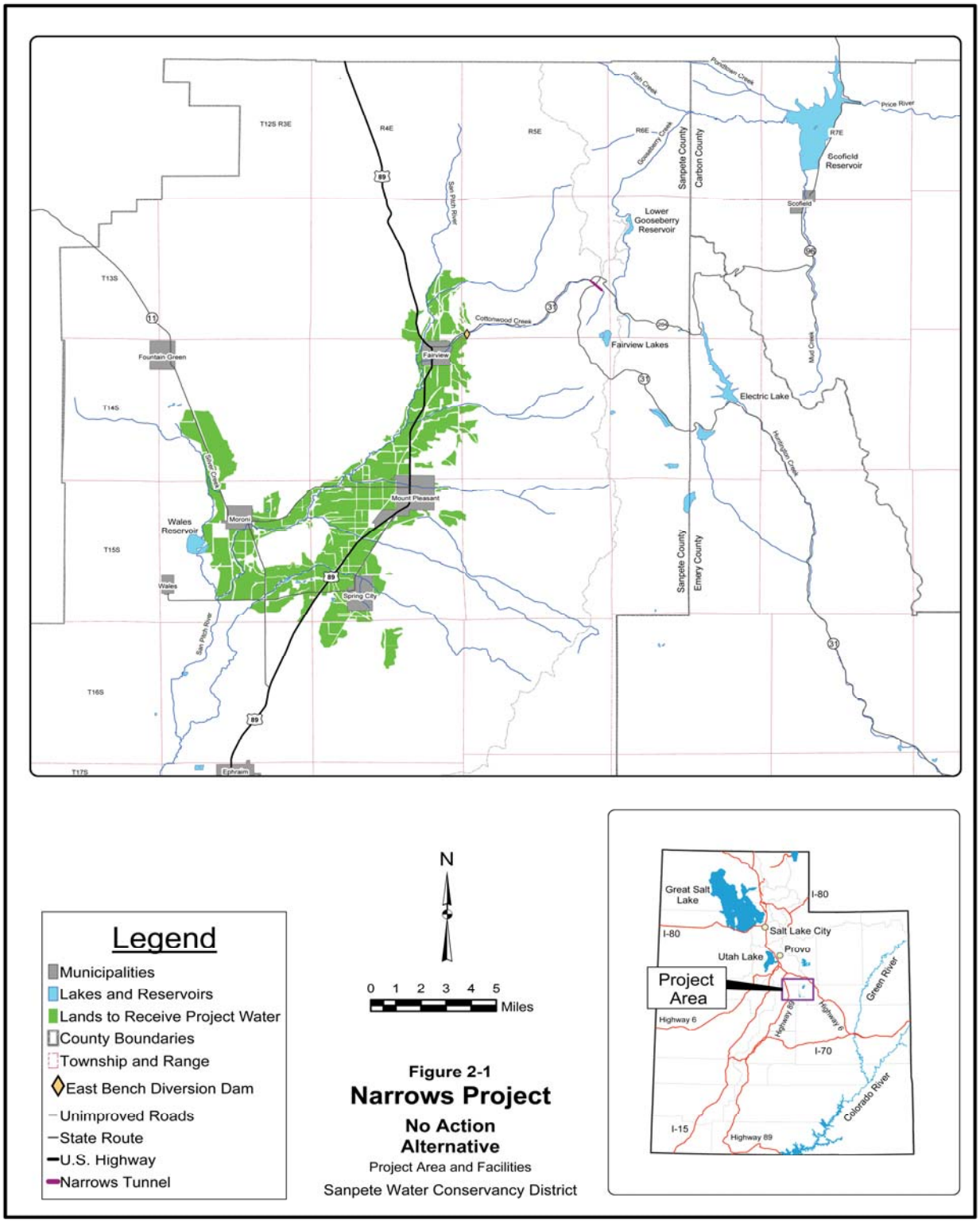


Figure 2-1.—Narrows Project, No Action Alternative, Project Area and Facilities.

Under this alternative, the Narrows Dam and Reservoir would not be constructed. Without the dam construction, there would be no need to relocate SR-264; and there would be no recreational facilities constructed at the reservoir site. The East Bench, Oak Creek, and Upper Cottonwood Creek Pipelines would not be built. The existing Narrows Tunnel would be rehabilitated at some future date and with other funding. The Cottonwood Creek Irrigation Company could not risk complete collapse and failure of the tunnel. If the tunnel were to collapse, the Cottonwood Creek Irrigation Company would have to acquire some type of emergency funding and would be required to repair it. The demand on municipal water supplies in Fairview, Mount Pleasant, Spring City, and Moroni would continue to increase as supplies for outdoor municipal uses run short and as the population increased. Most likely, there would be a conversion of agricultural water to municipal use as the demand for municipal water increased with a growing population.

Water conservation measures would continue to be implemented. These conservation measures would reduce average shortages on irrigated farmland to about 29.5% or about 15,250 acre-feet per year. Implementing new conservation measures most likely would reduce irrigation return flows now supplying wetlands, aquatic habitat, and downstream users by an estimated 3,500 acre-feet per year.

There would be no wetlands, wildlife, or fisheries mitigation measures implemented under the No Action Alternative because there would be no impact to existing wetlands and wildlife habitat. Streamflows in Gooseberry and Fish Creeks would remain unaltered from their present state. Under this plan, no flatwater fishery would be developed in the proposed reservoir basin.

2.2.2 Proposed Action Alternative

If Reclamation approves the SRPA loan and Congress appropriates the necessary funds and lands, a supplemental water supply would be developed for municipal water users and agricultural use in north Sanpete County under the Proposed Action. This additional water supply would satisfy the 1984 Compromise Agreement.

The Proposed Action would provide north Sanpete County an average annual supply of 4,281 acre-feet of supplemental irrigation water for 15,420 acres of presently irrigated farmland and 855 acre-feet of water for municipal use. The project would include construction of the 17,000 acre-foot Narrows Dam and Reservoir on Gooseberry Creek, pipelines to deliver the water to existing water distribution systems, rehabilitation of the existing 3,100 foot Narrows Tunnel, and relocation of 2.9 miles of State Road (SR) 264. The dam would be 120 feet high with a crest length of 550 feet and crest width of 30 feet.

The Narrows portion of the Gooseberry Project Plan would include a transmountain diversion of water from the Gooseberry Creek drainage of the Price-Green-Colorado River Basins to the San Pitch-Sevier River of the Great Basin. Geographically, the project facilities are located in close proximity to the drainage divide between the Price River system and the San Pitch River system. The general location is shown on the location map at the front of this document.

The Price River flows southeast to the Green River, a tributary of the Colorado River. The San Pitch River flows southwest to the Sevier River, which is completely consumed in the Bonneville Basin, a part of the arid Great Basin. The county line dividing Sanpete County and Carbon County is located more than 6 miles downstream

from and about 3 miles east of the proposed Narrows damsite on Gooseberry Creek.

The proposed damsite, the transmountain Narrows Tunnel, and the project water distribution facilities are all located in Sanpete County. The source of the project water supply generally arises in Sanpete County and naturally flows into Carbon County and the Price River system, unless the flows are captured and diverted transmountain to Sanpete County. The service area of the Narrows Project would be situated in the San Pitch River drainage.

A dam and reservoir would be constructed on Gooseberry Creek, and water would be diverted through an existing tunnel to Cottonwood Creek. Pipelines would be constructed to deliver the water to existing water distribution systems located near Fairview, Utah. Recreation facilities would be developed at the reservoir, and a 2,500-acre-foot minimum pool for fish habitat would be maintained.

Mitigation measures would be implemented to offset adverse impacts to wetlands, terrestrial wildlife, and stream fisheries. In addition to mitigation measures to offset project impacts, other measures would be included to enhance or improve fish and wildlife habitat. Additional water conservation measures would be required independent of the Proposed Action. However, only those water users who have implemented or would agree to implement water conservation measures would be eligible to receive project water. These practices would include improved water conveyances such as lined canals, pipelines, or improved irrigation practices such as sprinklers or gated pipe.

2.2.2.1 Water Supply and Use

The project water supply would come from Upper Gooseberry Creek and its tributaries. The Upper Gooseberry Creek drainage (including Fairview Lakes) has an average inflow of about 9,200 acre-feet of water. Of that amount, 2,300 acre-feet are diverted transmountain through the existing Narrows Tunnel by the Cottonwood-Gooseberry Irrigation Company (CGIC). This diversion consists of 1,900 acre-feet from Gooseberry Creek and 400 acre-feet from Boulger Canyon. The Fairview Lakes water (2,300 acre-feet) is not considered part of the Narrows Project water. The majority of the flow in Upper Gooseberry Creek comes from direct snowmelt. Peak flows in May and June are several times greater than flow during the remainder of the year.

Under existing water rights agreements, a maximum of 5,400 acre-feet per year of project water would be released through the Narrows Tunnel. The reservoir would provide long-term carryover storage for consecutive drought years. With the long-term carryover storage, the Proposed Action would produce an annual average yield of 5,136 acre-feet per year. Table 2-1, Water Allocation and Use for the Narrows Project, shows the allocation of project yield between irrigation and M&I uses.

Table 2-1.—Water Allocation and Use for the Narrows Project

Water Source or Use	Acre-feet
Gooseberry Creek drainage	5,136
M&I[1]	855
Irrigation[1]	4,281

[1] It is estimated that the balance between M&I and irrigation water will change as the demand for M&I use increases (M&I use will increase, and irrigation use will decrease).

A review of the Loan Application Report showed references to both 480 and 500 acre-feet of municipal water supply being provided by the proposed project. For consistency, all references to municipal supplies have been changed to 500 acre-feet per year for the initial M&I allotment. Further, the Loan

Application Report shows M&I deliveries increasing from 500 to 1,070 acre-feet per year by the end of the 30-year repayment period. Under this plan, the average annual M&I delivery would be 855 acre-feet per year. This and subsequent analyses in the FEIS will use 855 acre-feet per year for the M&I allotment, whereas the DEIS and earlier documents used 480 or 500 acre-feet per year. Of the 5,136-acre-foot average annual project yield, 855 acre-feet would be used for the M&I allotment and the remaining 4,281 acre-feet for the irrigation allotment.

Project irrigation supplies, along with present irrigation supplies, are expected to be used primarily for production of crops such as alfalfa and grass hay to support beef and dairy enterprises. Project water supplies would be used primarily in the latter part of the growing season when existing water shortages are the most critical. In addition, a total of 500 acre-feet per year of project water would be used initially in Fairview, Mount Pleasant, Spring City, and Moroni. This water would be used to supplement existing water supplies for irrigation of lawns and gardens through secondary irrigation systems, preserving high quality culinary water for indoor use. Future requirements for additional municipal water could be as high as 2,800 acre-feet per year.

Treatment facilities would not be required for the initial 500 acre-feet of water because this water would replace potable water currently being used for outdoor use. Appropriate treatment facilities may need to be built to treat the additional 570 acre-feet of water that ultimately would be produced by the Proposed Action, unless the new water would replace additional potable water used for outdoor use or the new water would be exchanged for ground water requiring no treatment.

Figure 2-2 shows how the proposed project's water supply would be used to augment existing local agricultural supplies. Curve 1 (crop consumptive use) shows the net irrigation requirement (crop water needs) for the project-eligible lands. This is the same as Curve 1 in figure 1-2. Curve 2 (diversion demand with efficiency improvements) shows the diversion demand that would result after implementing the planned efficiency improvements. (See Curve 3 in figure 1-2.) Curve 3 (local supply) shows the local supply, and Curve 4 (local and project supply) shows the local supply augmented by the project supply. Curves 5 (needs met local supply) and 6 (needs met local and project supply) show how the crop water needs would be satisfied by local supplies and local supplies augmented by project supplies. (Curve 5 is the same as Curve 6 in figure 1-2.)

As noted in section 1.4.2, under implementation of the Narrows Project, there would be an estimated 15,250-acre-foot average annual shortage in the diversion demand, assuming a portion of the nongrowing season precipitation was retained in the soil root zone to help meet early-season water needs. With the project water, the annual average shortage could be reduced to about 10,969 acre-feet per year or 21.1% of the diversion demand. With below average precipitation, the remaining shortage would be about 29,698 acre-feet per year or about 57.5%. In either case, the remaining shortage still would be considerably greater than the optimal 5% used for a planning target. Likewise, Curve 6 shows that even though project supplies would provide additional water, significant soil moisture deficits would still be a serious concern. The remaining shortage is great enough to warrant the pursuit of other measures to further improve irrigation efficiencies or augment water supplies.

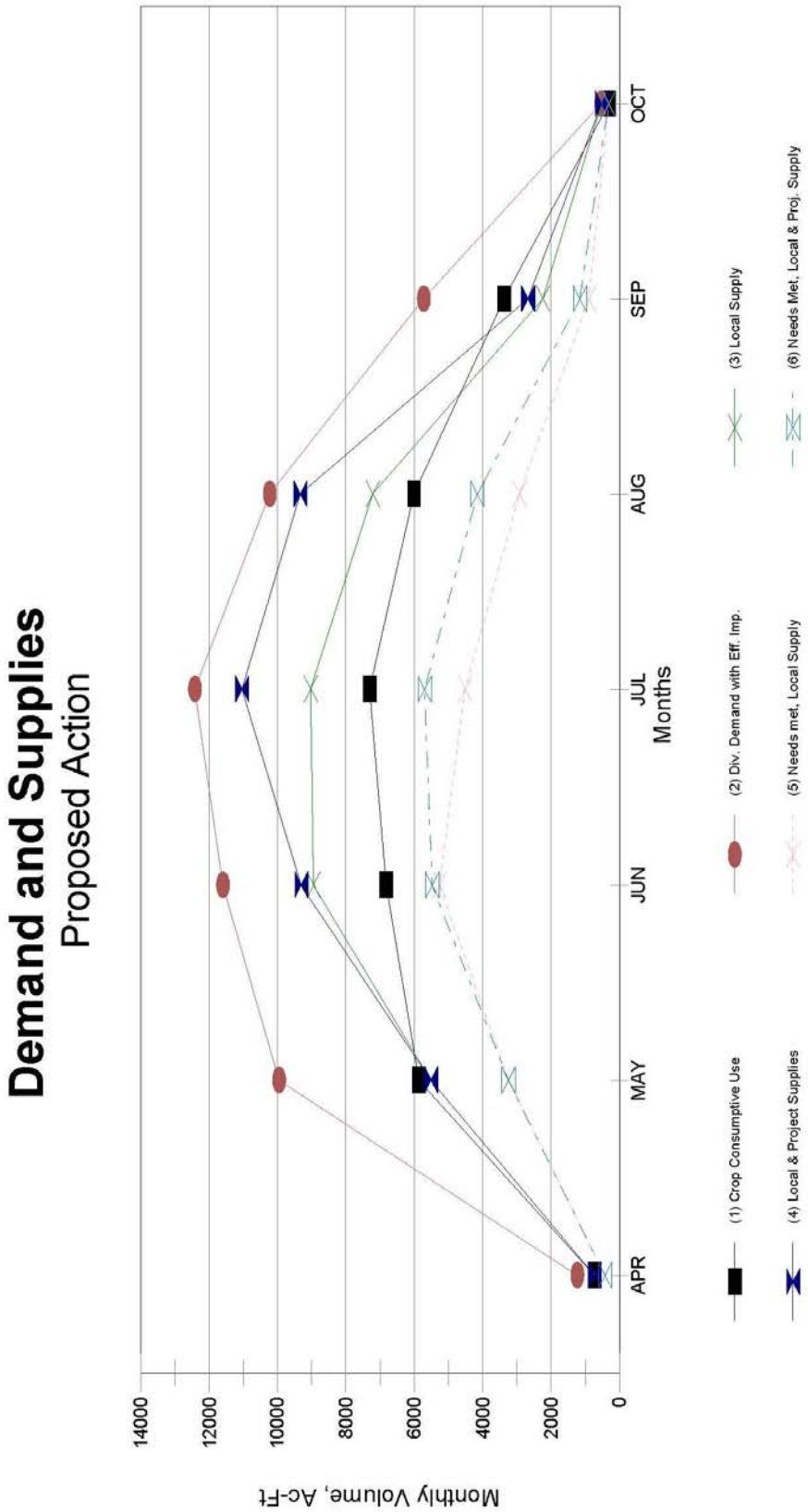


Figure 2-2.—Demand and Supplies, Proposed Action.

Section 1.4.2 discusses how implementing efficiency improvements would reduce the amount of irrigation water losses. The efficiency improvements would be expected to reduce water available to wetlands, aquatic habitat, and downstream users by up to 3,500 acre-feet per year. However, inefficiencies in project water would offset the 3,500-acre-foot-per-year reduction by about 1,820 acre-feet per year. This would result in a net loss to wetlands, aquatic habitat, and downstream users of about 1,680 acre-feet per year.

2.2.2.2 Construction Features and Project Operations

2.2.2.2.1 General

The principal construction features of the Narrows Project would consist of one reservoir and three pipelines. Narrows Dam and Reservoir (figure 2-3) would be constructed on Gooseberry Creek and would provide storage for the project water supply. Oak Creek Pipeline would convey water from an existing diversion dam located on Cottonwood Creek northward to the Oak Creek Irrigation Company, north of the community of Fairview. The East Bench Pipeline would convey project water from the same existing diversion dam on Cottonwood Creek southward to areas of use along the east bench. Upper Cottonwood Creek Pipeline would carry project water from the Narrows Tunnel outlet to a point 300 feet downstream from the confluence of Cottonwood Creek and Left Hand Fork to protect the stream channel above that point from increased flows that would occur without the pipeline.

Other important features of the project would include rehabilitating the existing Narrows Tunnel; relocating SR-264; modifying parts of Forest Development Road (FDR) Nos. 50124, 50150, and 50225; and modifying the snowmobile parking area along FDR No. 50150. Recreation facilities, primarily for boating, fishing, camping, and picnicking, would be provided at Narrows Reservoir to help satisfy projected recreation needs in the area. Title to the dam and appurtenant water facilities would be in the name of SWCD. Title to the land underlying those facilities and associated recreation facilities would remain in the name of the United States and under Reclamation management.

Specific proposed fish and wildlife mitigation measures include the following:

- Restoring year-round flows in two small tributaries to Gooseberry Creek (above the proposed Narrows Reservoir); providing minimum instream flows of 1.0 cubic feet per second (cfs) in Gooseberry Creek below Narrows Dam.
- Providing a multiple-level outlet at Narrows Dam to regulate the temperature of releases to Gooseberry Creek from Narrows Reservoir.
- Modifying and/or stabilizing streambanks and associated riparian zones along Middle Gooseberry Creek.
- Providing releases from the Narrows Reservoir into Gooseberry Creek for flushing flows and for fish habitat during critical periods.
- Acquiring and/or improving stream channel for fish habitat (Middle Gooseberry Creek).
- Providing winter releases to Cottonwood Creek.
- Providing summer flows in lower Cottonwood Creek.

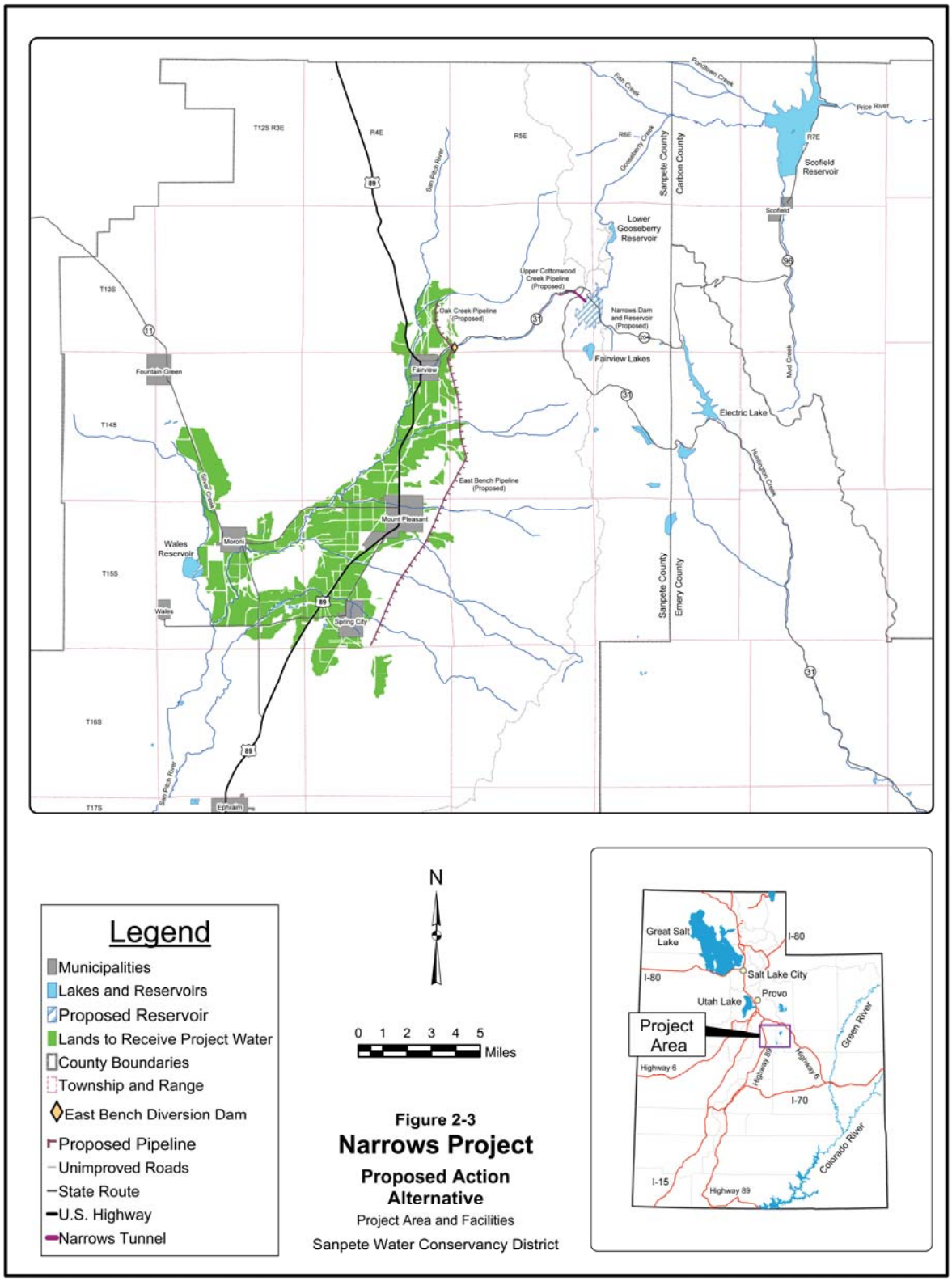


Figure 2-3.—Narrows Project, Proposed Action, Project Area and Facilities.

- Constructing a pipeline in the upper Cottonwood Creek area to convey project water outside the stream channel (from the tunnel outlet to a point 300 feet downstream from the confluence of Cottonwood Creek and Left Hand Fork).
- Providing a minimum 2,500-acre-foot conservation pool in Narrows Reservoir for fish.
- Reducing external phosphorus loading to Scofield Reservoir.
- Providing mitigation and enhancement of upland habitat (quantified in terms of mule deer and Brewer's sparrow habitat units, each of which represent other wildlife species dependent on similar habitat) in the following ways:
  - Acquiring conservation easements around the Narrows Reservoir
  - Acquiring and fencing land adjacent to the Price River below Scofield Reservoir to protect wildlife habitat
  - Creating new wetlands and enhancing existing wetlands to mitigate for 100 acres of wetlands areas inundated by the reservoir and affected by changes in the stream channels

2.2.2.2.2 Design and Operation

2.2.2.2.2.1 Narrows Dam and Reservoir.— Narrows Dam and Reservoir would be constructed on Gooseberry Creek, about 9 miles east of Fairview, Utah (see figure 2-3). The dam would be a zoned earthfill embankment structure using locally available earth material. The surface elevation of the proposed reservoir would be at 8,690 feet mean sea level (msl). The embankment would have 3:1 (horizontal to vertical) slopes upstream and downstream. The proposed crest width of 30 feet would allow SR-264 to cross the dam. The embankment zones would consist of a relatively impervious core, a random zone both upstream of and downstream from the core, and a rockfill zone on the upstream face for slope protection. The embankment would contain an estimated total volume of 363,000 cubic yards of material. The dam would be designed to withstand effects induced by seismicity associated with mining of the coal reserves east of the East Gooseberry Fault (approximately 1 mile away).

Narrows Reservoir would have two main outlets, the Gooseberry Creek outlet and the Narrows Tunnel outlet. The Gooseberry outlet would be constructed through the dam to provide downstream releases for fisheries and emergency evacuation of reservoir water. This outlet would have a 305-cfs capacity. Multiple intakes would be provided to allow temperature control of water released to Gooseberry Creek. The Narrows Tunnel outlet would accommodate releases through the mountain ridge for the transmountain diversion and would have a 60.0-cfs capacity.

Preliminary designs for the dam call for separate low flow intakes at three different levels within the reservoir. These intakes would have their own gates and would be able to deliver up to a 10-cfs release each, even when the main outlet was being inspected or maintained.

The spillway would be a drop inlet (morning glory, so called because of its resemblance to the shape of the flower) structure and would have a 775.0-cfs discharge capacity. The probable maximum thunderstorm flood could be safely stored in the reservoir without overtopping the dam. However, the spillway capacity, combined with that of the two outlet works, would protect the dam against the 100- and 10,000-year snowmelt floods.

The reservoir formed behind the dam would extend about 2 miles up Gooseberry Creek

and would have a total capacity of 17,000 acre-feet and a water surface area of about 604 acres. All of the average annual storable flows (excluding Fairview Lakes) to the reservoir, about 8,185 acre-feet, would come from the Gooseberry Creek drainage.

Narrows Reservoir's active capacity, or that portion of stored water that would be used to satisfy project water needs, would consist of 14,500 acre-feet. Of this amount, 4,500 acre-feet would be dedicated to providing instream flows in Gooseberry Creek below the dam. The dead and inactive capacities of about 2,500 acre-feet would form the reservoir's minimum pool and would not be drawn upon to benefit recreation and fishing use at the reservoir (the 2,500 acre-feet of storage is inactive because it is below the elevation of the tunnel and cannot be diverted to Sanpete Valley).

The proposed reservoir is designed for long-term carryover storage. The dead and inactive storage would be more than adequate to store the 100-year inflow of sediment into the reservoir. Less than 20 acre-feet of sediment would accumulate in a 100-year period, which is less than 1% of the inactive capacity. A summary of the design data for the proposed Narrows Dam and Reservoir, two structural alternatives, and the No Action Alternative is shown in table 2-2.

Narrows Reservoir would fluctuate on a seasonal basis as water is released during the irrigation season. The drawdown would average 9 feet annually. On an average basis, the exposed shoreline area would be 113 acres. This is the difference between the average annual high water surface area and the average annual low water surface area.

Automated flow measurement devices would be installed to collect data in real time using radio or satellite communications. These devices would measure flow at the following locations:

- Discharges from Fairview Lakes
- Discharge from Narrows Dam to Gooseberry Creek
- Flow of Gooseberry Creek at USDA Forest Service campground
- Discharge from Narrows Tunnel
- Flow of Cottonwood Creek near the mouth of the canyon

These data would be made available to the public on an Internet Web site.

2.2.2.2.2.2 Oak Creek Pipeline.—The Oak Creek Pipeline would be a 10-inch-diameter polyvinyl chloride (PVC) buried pipeline with a capacity of 2.5 cfs and a length of 2.5 miles. The pipeline would convey water from an existing diversion dam on Cottonwood Creek to the Oak Creek Irrigation Company, north of Fairview. A right-of-way 30 feet wide and 2.5 miles long would be required.

2.2.2.2.2.3 East Bench Pipeline.—The East Bench Pipeline would convey project water from an existing diversion dam on Cottonwood Creek southward to areas of use along the east bench. The pressurized pipeline would have a total length of 13.5 miles (see figure 2-3) and would have a 21.5-cfs capacity at its head. The pipeline would include 1.4 miles of reinforced concrete pipe, 4.2 miles of concrete cylinder pipe, and 7.9 miles of PVC pipe. Pipe diameters would range from 27 to 18 inches.

The pipeline would deliver water to the Spring Creek, Birch Creek, North Creek, Pleasant Creek, Twin Creek, Cedar Creek, and Horseshoe Irrigation Companies. Water delivered to each irrigation company would be discharged from the pipeline into the existing regulating pond for each company's pressurized irrigation system. This pipeline would also have a 30-foot-wide right-of-way.

Table 2-2.—Summary of Design Data for Narrows Project for All Alternatives

Item	Unit	No Action	Proposed Action	Mid-Sized Reservoir	Small Reservoir
Dam					
Height	feet	N/A	120	110	100
Crest length	feet	N/A	550	475	425
Crest width	feet	N/A	30	30	30
Material volume	cubic yards	N/A	363,000	292,000	220,000
Discharge capacity					
Outlet works	cfs	N/A	305	258	210
Spillway	cfs	N/A	775	775	775
Spillway elevation	msl	N/A	8,690	8,680	8,670
Reservoir capacity					
Active storage	acre-feet	N/A	14,500	9,950	5,400
Inactive and dead storage	acre-feet	N/A	2,500	2,500	2,500
Total	acre-feet	N/A	17,000	12,450	7,900
Surface area					
At top of active capacity	acres	N/A	604	489	362
At top of inactive and dead capacity	acres	N/A	144	144	144
Average during recreation season	acres	N/A	454	277	238
Drawdown					
Average annual	feet	N/A	9	11	14
Average during recreation season	feet	N/A	8	10	11
Maximum	feet	N/A	26	30	22
Average annual	acre-feet	N/A	3,974	3,773	3,478
Average during recreation season	acre-feet	N/A	3,512	3,300	3,007
Pipelines					
Oak Creek					
Length	miles	N/A	2.5	2.5	2.5
Capacity	cfs	N/A	2.5	2.5	2.5
Diameter	inches	N/A	10	10	10
East Bench					
Length	miles	N/A	13.5	13.5	13.5
Capacity	cfs	N/A	21.5	21.5	21.5
Diameter	inches	N/A	27–18	27–18	27–18
Upper Cottonwood Creek					
Length	miles	N/A	0.8	0.8	0.8
Capacity	cfs	N/A	50	50	50
Diameter	inches	N/A	30	30	30
Narrows Tunnel rehabilitation					
Length	feet	N/A	3,100	3,100	3,100
Capacity	cfs	N/A	60	60	60
Diameter	inches	N/A	36	36	36
SR-264 relocation					
Length	miles	N/A	2.9	2.9	2.9
Width	feet	N/A	24	24	24

2.2.2.2.2.4 Upper Cottonwood Creek Pipeline.—A 50.0-cfs capacity, reinforced concrete pipeline would be constructed from the existing transmountain Narrows Tunnel outlet to a point 300 feet downstream from the confluence of Cottonwood Creek and Left Hand Fork. The 30-inch-diameter pipeline would carry project water outside the stream to prevent damage to the channel. The pipeline would be constructed in the shoulder of SR-31 and would have a length of about 0.8 mile.

At the Narrows tunnel outlet, a control structure would divide the flow, allowing for releases into Cottonwood Creek to maintain minimum instream flows and improve the fishery, while the remainder of the flow would be conveyed to the pipeline. The pipeline flow would be discharged into Cottonwood Creek 300 feet downstream from the confluence with Left Hand Fork, where an energy dissipation structure would be constructed to reduce flow velocity and control streambed degradation. Energy dissipation would be provided before flows were discharged into Cottonwood Creek. A highway right-of-way 30 feet wide and 0.8 mile long would be required. About half of this right-of-way would be on Reclamation withdrawn lands and the other half on privately owned lands.

The possibility of extending Upper Cottonwood Creek Pipeline the entire length of the canyon was also explored; but, due to the topography and geology of the canyon, such a pipeline would be infeasible and potentially environmentally damaging. A total of 104 landslides, most of which are active, have been mapped in the canyon. The topography of the canyon suggests that the most likely location for the pipeline would be within the existing highway alignment. However, due to the landslides, the highway has continual stability problems; and repairs are needed on an annual basis. This instability would present unacceptable safety and maintenance problems for the high-pressure pipeline. Construction of the pipeline also would increase significantly project costs and costs to water users.

2.2.2.2.2.5 Narrows Tunnel Rehabilitation.—The Narrows Tunnel is an existing water conveyance tunnel approximately 3,100 feet long. The 8-foot-diameter tunnel, which was completed in 1968, was constructed to divert irrigation water to the Fairview area and eventually to serve as the outlet for Narrows Reservoir. The tunnel was not concrete lined as planned; and since its construction, the tunnel has experienced severe stability problems. Steel sets with wooden lagging were installed in selected areas of the tunnel to support the unstable areas. The steel sets, however, were widely spaced; and loose rubble significantly loaded the wooden lagging between sets. With time, the lagging began to fail, permitting roof and rib sloughing over significant portions of the tunnel. When it became evident that the tunnel could eventually close, a 36-inch corrugated metal pipe was installed through the least stable tunnel sections to maintain a waterway. This measure is considered to be only a temporary fix because the CMP eventually would collapse due to rust or excessive earth loads.

The tunnel rehabilitation would be accomplished by mucking out the tunnel and installing steel sets and lagging for temporary support. Once the tunnel is fully open and clear, a 36-inch-diameter reinforced concrete pipe would be installed through the tunnel and backfilled to a height of 1 foot above the top of the pipe. The backfill would provide lateral pipe support and protect the pipe from impact loads in the event that the temporary tunnel support deteriorated in the future. Alternatively, the tunnel could be lined completely with shotcrete in lieu of the concrete pipe and backfill. A control gate

would be installed near the tunnel inlet to regulate releases through the tunnel. Following rehabilitation, the tunnel would have a 60-cfs discharge capacity.

Remote control of the Narrows Tunnel operating gate would be provided to regulate automatically the releases through the tunnel. These controls would be coupled to an automated stream gauging station on Cottonwood Creek. The streamflow in Cottonwood Creek would be monitored constantly by these controls. As the streamflow increased during high runoff events such as thunderstorms, the tunnel operation would be discontinued when the flow exceeded 100 cfs near the mouth of the canyon. An automated gauging station would measure flow data and communicate with an automated gate controller at the tunnel. Under this operating regime, the project flows through the tunnel would not increase streamflows above what is considered safe for channel stability. Increased flows under project conditions would be well below the 50-year channel-forming discharge.

2.2.2.2.2.6 State Route 264 Relocation.— Narrows Reservoir would inundate about 0.8 mile of SR-264, which provides access between Fairview and Scofield, Utah. Under the proposed project, this road would be routed around the perimeter of the existing snowmobile parking area. The road would be relocated to include 0.3 mile of FDR No. 50150 and No. 50124 (gravel road) to Lower Gooseberry Reservoir and by constructing 2.6 miles of new road and providing asphalt surfacing for the entire length of the relocation. This new road would cross Narrows Dam. The road relocation would increase the travel distance between Fairview and Scofield by 1.2 miles. The relocated road would have a total pavement width of 24 feet and would be designed to the same standard as the existing road.

2.2.2.2.2.7 Recreation Facilities.—Public recreation facilities for the Narrows Project would be located along the northwest shore of Narrows Reservoir (see figure 2-3). The facilities would include a boat ramp, boat slips, a day use area with 10 picnic sites, restroom facilities, and a 60-unit campground. Access for the handicapped would be provided. All recreation facilities and water systems (nonsurface source) would be constructed to USDA Forest Service standards. The water source for the recreation facilities would be required to meet State of Utah drinking water standards. Although a formal agreement has not been reached, it is anticipated that USDA Forest Service would administer the recreation facilities at the Narrows Reservoir under an operation agreement with SWCD and Reclamation. Title to the recreation facilities would remain in the name of the United States.

2.2.2.2.3 Fishery Measures

A total of 11 fishery mitigation measures have been included in the project to mitigate for adverse impacts. To the extent possible, an attempt was made to mitigate “in place” and “in kind.”

2.2.2.2.3.1 Restore Streamflow in Gooseberry Creek Tributaries.— Implementing this aquatic mitigation procedure would consist of altering the release of water from Fairview Lakes, which are owned and operated by CGIC. Presently, during the spring runoff period, water is stored in Fairview Lakes and released for irrigation use in the Fairview area. This release is a transbasin diversion of water to the San Pitch River drainage. With the historic operational pattern, the small unnamed tributaries to Gooseberry Creek located downstream from Fairview Lakes are dry several months each year. This

mitigation measure involves providing year-round releases, averaging about 2.6 cfs, from Fairview Lakes into two of these tributaries to Gooseberry Creek. This amounts to a 1.3-cfs average flow per channel. The total annual amount of water that is released from Fairview Lakes would not be changed. However, the flow would be dispersed during the entire year rather than the present 18- to 20-week discharge period, resulting in a higher water level in the lakes for more of the irrigation season.

Water released from Fairview Lakes during the year would be captured and stored in Narrows Reservoir. Upon notification by the CGIC, the Fairview Lakes water in Narrow Reservoir would be released through the Narrows Tunnel to the San Pitch River drainage.

This mitigation measure would provide not only aquatic mitigation benefits to the Narrows Project but also both aesthetic and recreational benefits to Fairview Lakes. These benefits would be a result of CGIC being able to maintain the lakes at higher water levels during more of the prime summer recreational season.

SWCD would be responsible for entering into operating agreements necessary to implement these year-round releases. SWCD also would ensure that the releases were made according to environmental commitments. Approval of a loan under the SRPA would be contingent upon securing these agreements with CGIC and an endorsement of the environmental commitments by SWCD.

Implementing this mitigation measure would result in creating approximately 2.3 stream miles of spawning and rearing habitat for cutthroat trout.

2.2.2.2.3.2 Provide Minimum Flows Below Narrows Dam.—The project plan calls for a 1.0-cfs minimum year-round release from Narrows Reservoir to Gooseberry Creek. That flow, combined with flows from springs located immediately below the dam, would be expected to produce a streamflow of at least 1.5 cfs at the Gooseberry Campground. If the flow at the campground is less than the expected 1.5 cfs, then up to an additional 0.25 cfs would be released to help achieve that flow rate.

2.2.2.2.3.3 Provide a Multiple-Level Intake at Narrows Dam.—A multiple-level intake would be provided at Narrows Dam to regulate the temperature of water released to Gooseberry Creek. Each of the three intakes, planned at elevations 8,640; 8,660; and 8,680 feet, would be designed with a 10.0-cfs capacity.

2.2.2.2.3.4 Stabilize Streambanks Along Middle Gooseberry Creek.—This mitigation measure would involve modifying Gooseberry Creek channel between Lower Gooseberry Reservoir and Narrows Dam to provide better habitat with the reduced flows. It is expected that the channel eventually would narrow by itself due to the decreased flow. However, to expedite the process, certain manmade improvements would be made.

Two alternative methods of accomplishing this mitigation measure were considered. The first method, which was eliminated from consideration due to its more invasive approach, would involve using earthmoving equipment to place fill material within the existing high water line of the stream to narrow the channel.

The second and selected alternative method would involve a less intrusive approach, which would consist of installing a variety of fish habitat enhancement structures in the existing stream channel. These structures could include cover logs, depositional structures, organic riprap treatments, rock clusters, rock deflectors, and rock weirs.

Example sketches of several of these enhancement structures are shown in figures 2-4 to 2-7. The objectives of these various structures would be to provide new pool habitat, hiding cover, high flow refuge area, scour holes, and spawning habitat for trout as well as a minimum level of channel erosion control.

Prior to SWCD constructing these improvements, SWCD would coordinate with the USDA Forest Service, Service, USACE, Utah Division of Wildlife (UDWR), and Utah Division of Water Rights. A qualified fluvial geomorphologist would develop a detailed plan based on the second alternative described above. A 200-foot-wide right-of-way corridor also would be acquired where the stream runs through private land. Fencing also would be provided where needed to protect the stream from livestock. Middle Gooseberry Creek would be used as spawning and rearing habitat for cutthroat trout.

2.2.2.2.3.5 Provide Flushing Flows and Other Releases to Gooseberry Creek.—The project would provide releases from Narrows Reservoir to Gooseberry Creek in excess of the minimum 1.0-cfs release described above. These additional releases would be used to provide additional instream flows or to flush accumulated silt and fine sediments from the streambed to enhance spawning habitat. UDWR has expressed interest in using this water to provide additional inflow to Lower Gooseberry Reservoir during the critical winter period when DO levels in the reservoir are low. The project would provide an average of 300 acre-feet per year of additional water for release to Gooseberry Creek. This water, released from carryover storage in Narrows Reservoir, could be used for fish habitat or flushing flows. The annual volume of 300 acre-feet could be released each year in a single event, or the water could be stored in the reservoir for multiple years to provide a larger magnitude or longer duration flush. In cooperation with UDWR, SWCD would determine the timing and quantity of water to be released each year. Because this water would be released to Gooseberry Creek, it would not count against the 5,400-acre-foot maximum transbasin diversion.

2.2.2.2.3.6 Acquire and/or Improve Stream Segments.—This measure would involve improving fishery habitat and/or fencing 11.5 miles of stream in the Price River drainage. Most of these stream segments are on private land; and, therefore, approximately 206 acres of right-of-way, that is a corridor averaging approximately 200 feet wide, would need to be acquired. Fishery habitat improvements such as riparian plantings and some minor channel work would be performed. As part of the 11.5 miles of habitat improvement, about 2 miles of stream would be improved in conjunction with the wetland restoration; and 1 mile of stream would be improved by providing fencing in conjunction with acquiring 640 acres of wildlife habitat adjacent to the Price River below Scofield Reservoir. The various parcels of land would be contiguous with other public lands and would be managed in conjunction with those public lands. Memoranda of agreement (MOAs) would be required between the SWCD and the managing agencies.

Where appropriate, the corridor would be fenced with a four-strand, barbed wire fence, topped with a rail to protect the streambanks and riparian zone from damage caused by grazing. Where the adjacent land is used for grazing, selected stream access points for livestock watering or other alternative livestock watering means would be provided. Stream crossings also would be provided as needed. Table 2-3 lists stream segments that have been recommended for this measure and

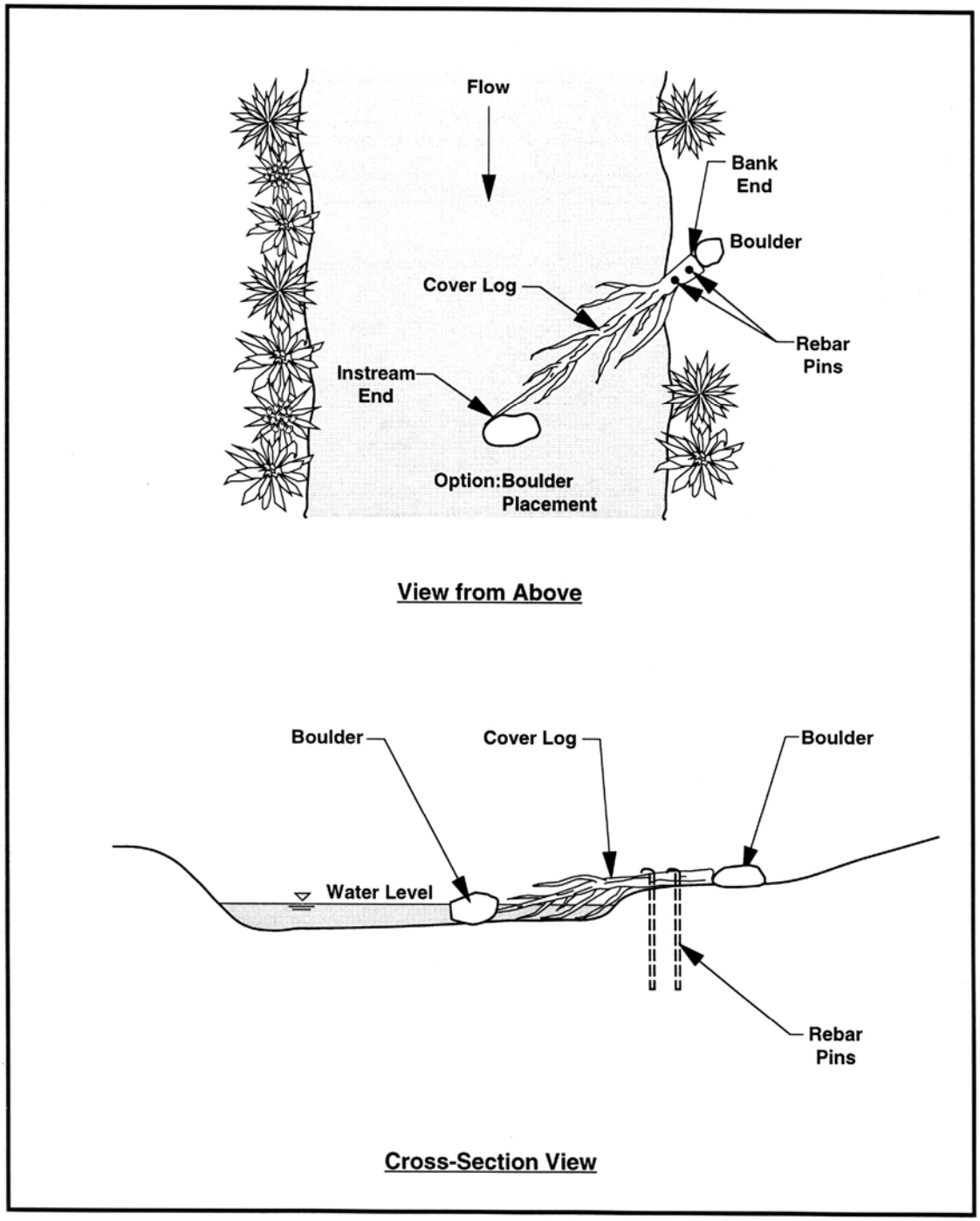


Figure 2-4.—Schematic of Cover Log Structure.

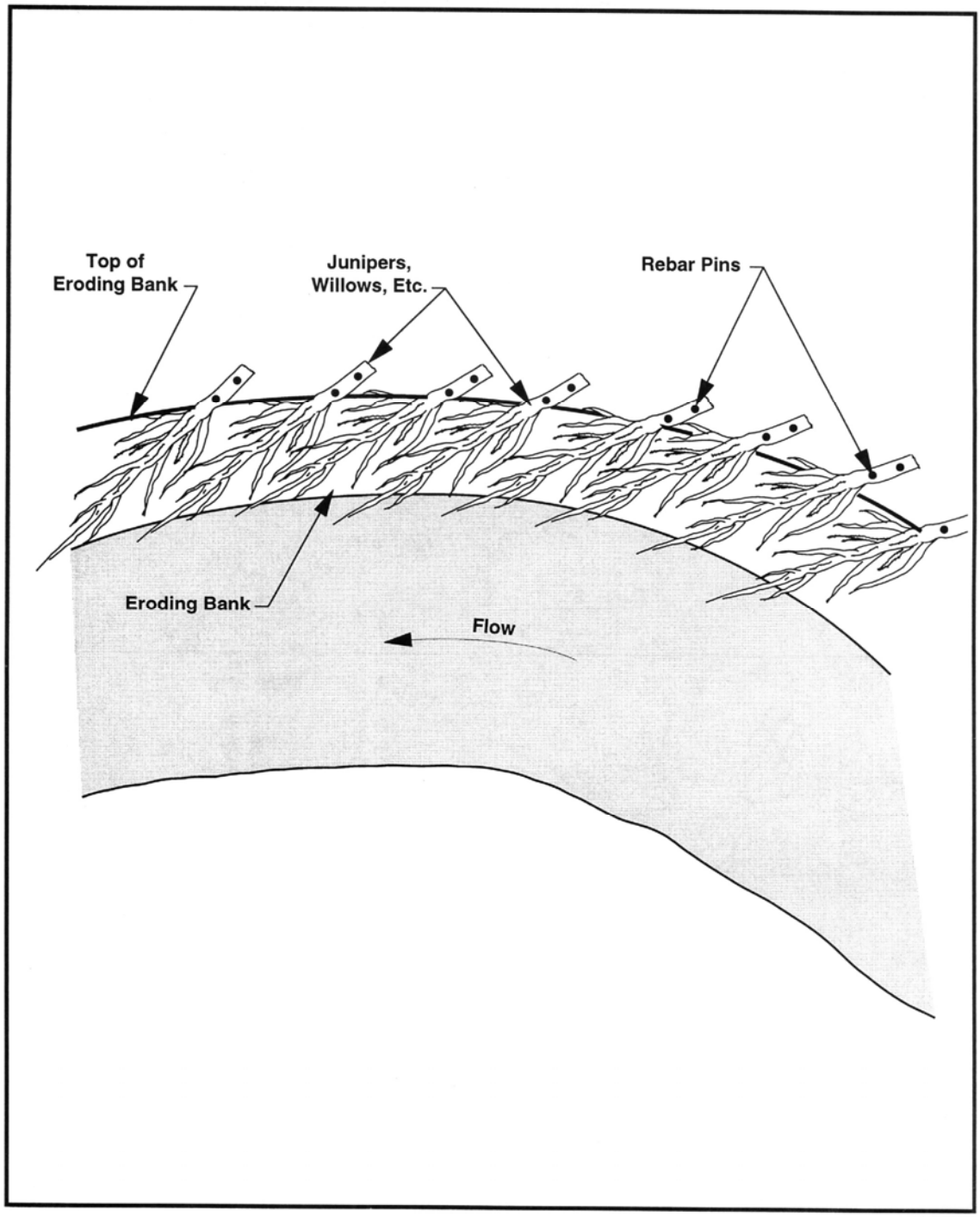


Figure 2-5.—Schematic of Organic Riprap.

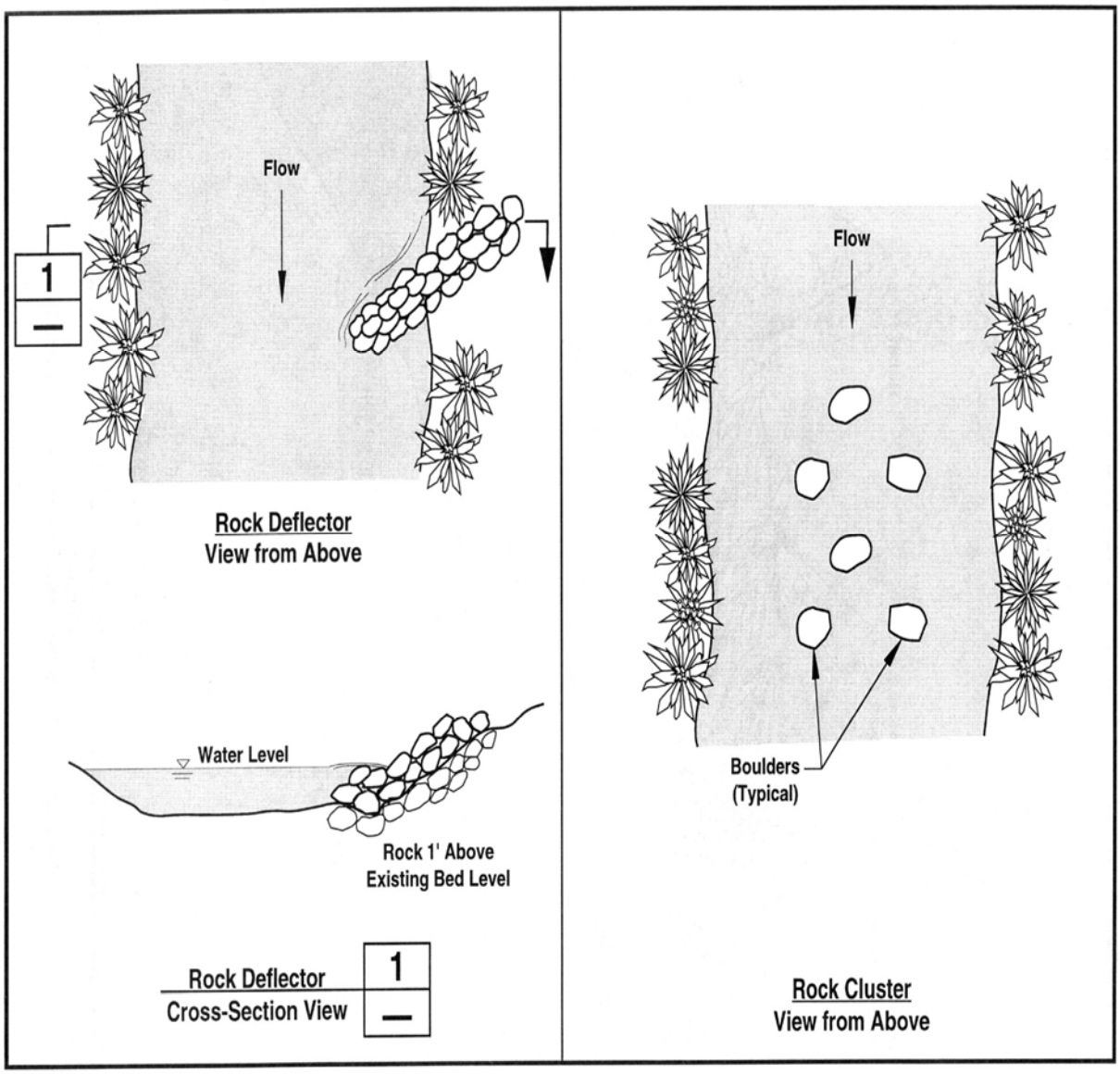


Figure 2-6.—Schematic of Rock Deflector and Rock Cluster.

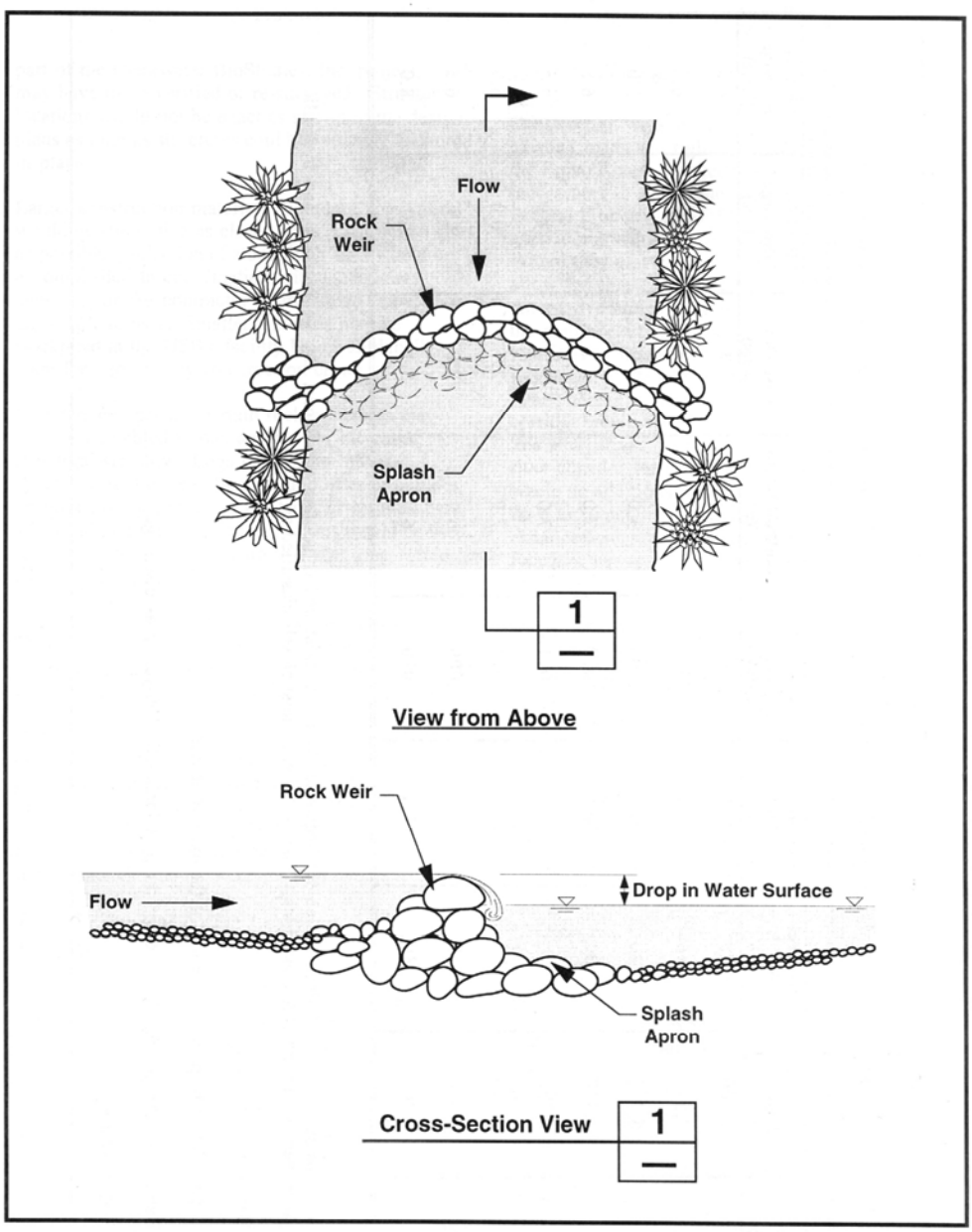


Figure 2-7.—Schematic of Rock Weir.

Table 2-3.—Stream Segments To Be Acquired and/or Improved for Fishery Habitat Proposed Action

Stream Reach	Length of Stream (miles)	Proposed Managing Agency
Price River Basin		
Mud Creek	4.0	UDWR
Winterquarters Creek	2.5	UDWR
Pondtown Creek	2.0	USDA Forest Service
Fish Creek above Scofield Reservoir	1.0	USDA Forest Service
Price River below Scofield Reservoir	2.0	UDWR

the proposed managing agencies. If necessary, additional parcels would be identified and evaluated to achieve the mitigation goal. The streams improved and protected under this measure would provide habitat for all life stages of cutthroat, rainbow, and/or brown trout. The improvements also would enhance wildlife habitat and water quality. A monitoring program would be established to ensure that the stream segments were acquired, improved, fenced, and maintained as planned.

2.2.2.2.3.7 Provide Winter Releases to Cottonwood Creek.—A release sufficient to provide a 2.0-cfs minimum flow at the confluence of Cottonwood Creek and Left Hand Fork would be made from Narrows Reservoir to Cottonwood Creek to increase the available fish habitat. Water released during the winter months would be stored in Wales Reservoir on a space-available basis. Wales Reservoir is a small reservoir that stores winter runoff from the Upper San Pitch River drainage, including Cottonwood Creek drainage.

2.2.2.2.3.8 Provide Summer Flows in Lower Cottonwood Creek.—Water would be released in lower Cottonwood Creek at the Cottonwood Canyon mouth to provide 2.0-cfs minimum instream flows at that location. This measure would provide year-round flows in the stream that would support fish habitat, create a fishery, and enhance the wetland and riparian corridor. In the past, this segment of stream historically has been dewatered during the irrigation season.

2.2.2.2.3.9 Construct Upper Cottonwood Creek Pipeline.—Upper Cottonwood Creek Pipeline would be constructed as described in the previous section 2.2.2.2.2.4.

2.2.2.2.3.10 Provide a Minimum 144-acre Conservation Pool in Narrows Reservoir.—A minimum pool with a surface area of 144 acres containing 2,500 acre-feet of water would be provided in Narrows Reservoir for fish habitat and propagation. This pool would not be drawn upon for project use. At minimum pool, the reservoir would have a maximum depth of 58 feet; and approximately 53 acres of the reservoir would be at least 20 feet deep.

2.2.2.2.3.11 Reduce External Phosphorus Loading to Scofield Reservoir.—This measure would help improve water quality in Scofield Reservoir by reducing phosphorus loading and would be implemented in conjunction with improving stream segments on tributary streams above Scofield Reservoir. About 9.5 miles of stream segments would be improved. The improvements would consist of bank stabilization, primarily through riparian plantings. Where grazing would occur, the stream segments would be fenced to protect them from potential impacts.

This measure would reduce the amount of sediment and animal waste and, hence, the amount of phosphorus flowing into the reservoir. Historically, fish kills have occurred in Scofield Reservoir due to poor water quality. Phosphorus has been identified as the limiting nutrient in the eutrophication of the reservoir. Phosphorus loading occurs from several factors, including inflow of

sediments that are naturally high in phosphorus and animal waste. In a report entitled *Scofield Reservoir Restoration Through Phosphorus Control*, the Utah Division of Water Quality concluded that:

> *"The most pragmatic and effective means to control the further eutrophication of Scofield Reservoir, or possibly to effect a moderate reversal of the eutrophication process, appears to be a reduction of the phosphorus load to the lake."*

SWCD would have primary responsibility for implementing all fishery measures described above. SWCD would be responsible for funding and acquiring all lands and rights-of-way and would fund and construct all improvements, such as fencing and stream channel improvements. SWCD would provide water from its water rights or enter into operating agreements for all instream flows described above. This work would be performed concurrently with construction of other project facilities such as the dam, tunnel rehabilitation, and pipelines. All lands and rights-of-way would be acquired, and initial construction of fishery measures would be completed prior to initial filling of the reservoir. SWCD would be responsible to fund all operation and maintenance (O&M) costs of mitigation facilities. SWCD would be responsible to enter into a MOA with UDWR and other appropriate agencies for all fishery measures. The MOA would define clearly the roles and responsibilities of SWCD, UDWR, and other parties for implementing, monitoring, and maintaining the fishery measures.

2.2.2.2.4 Wetlands Measures

Wetlands measures would be included in the project to mitigate unavoidable adverse impacts to wetlands that have been identified with the project. Four alternative wetland mitigation sites have been identified. The actual mitigation that is implemented could be from one alternative or a combination of alternatives. Proposed wetland mitigation areas are shown in figures 2-8, 2-9, and 2-10. A brief description of each alternative follows. Alternatives are listed in order of priority.

2.2.2.2.4.1 Enhance, Restore, and Create Wetlands Adjacent to Mud Creek Near Scofield Reservoir.—This measure includes the purchase of approximately 220 acres of private land adjacent to Mud Creek, south of Scofield Reservoir. The approximate elevation of this site is 7,700 feet. Some of this land consists of former wetlands damaged by cattle, and the remainder is upland habitat. Existing wetland portions would revert to their natural wetland condition by removing the cattle and allowing the vegetation to grow. The remaining wetlands would be created by other methods (e.g., construction).

To implement wetland mitigation at the Mud Creek site, a preliminary study of the site would use the following steps:

1. Perform wetland delineation mapping of the site to determine the location and quantity of existing wetlands.
2. Install piezometers to determine ground water levels.
3. Install a temporary check dam with a series of piezometers to determine the effectiveness of using check dams to raise ground water levels.
4. Excavate test pits to determine soil types and stratification of soils.
5. Design mitigation measures based on data collection.
6. Perform HEP analysis to quantify premitigation habitat.

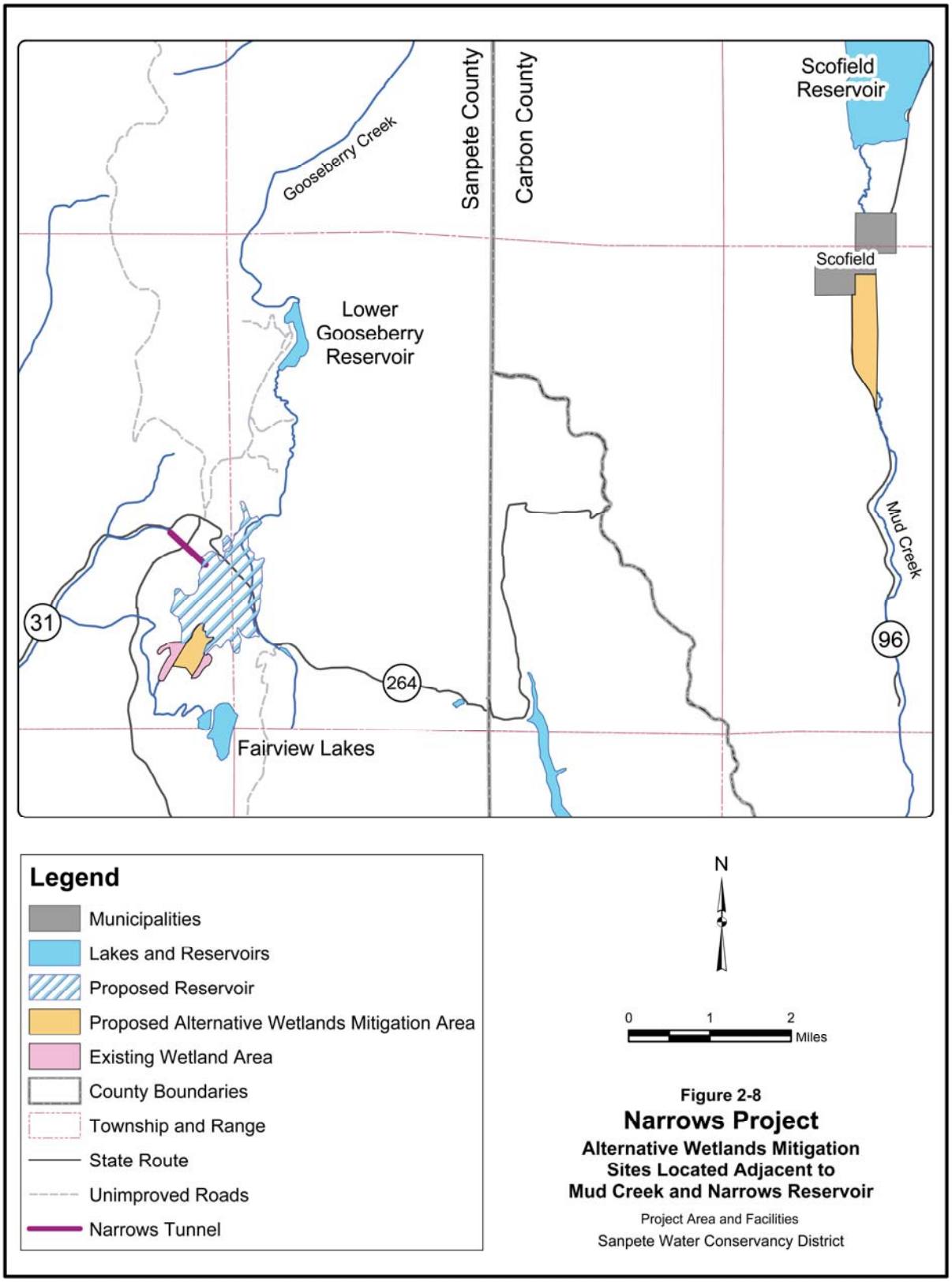
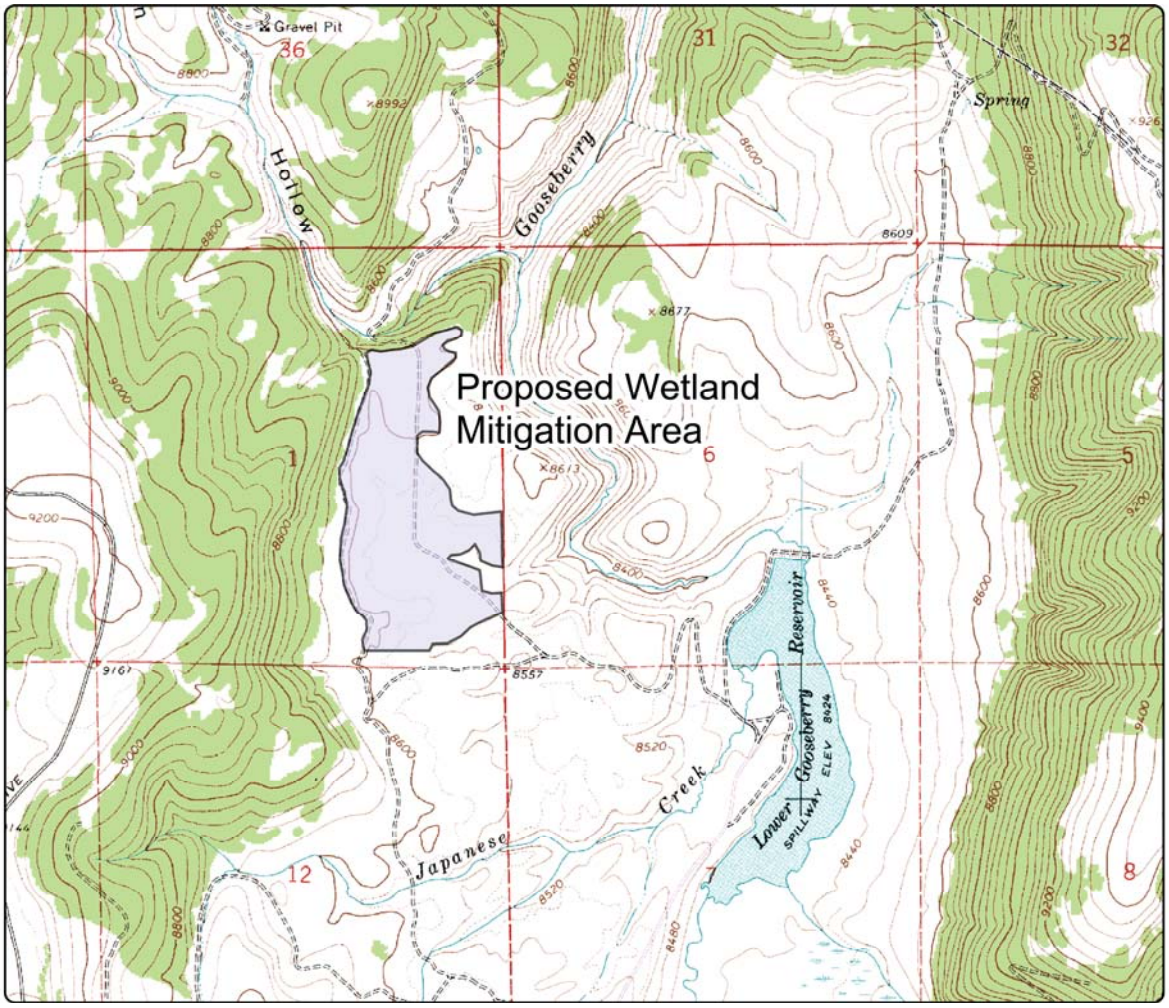


Figure 2-8.—Alternative Wetlands Mitigation Sites Located Adjacent to Mud Creek and Narrows Reservoir.



N

0 0.1 0.2 0.3 0.4 0.5
Miles

Figure 2-9

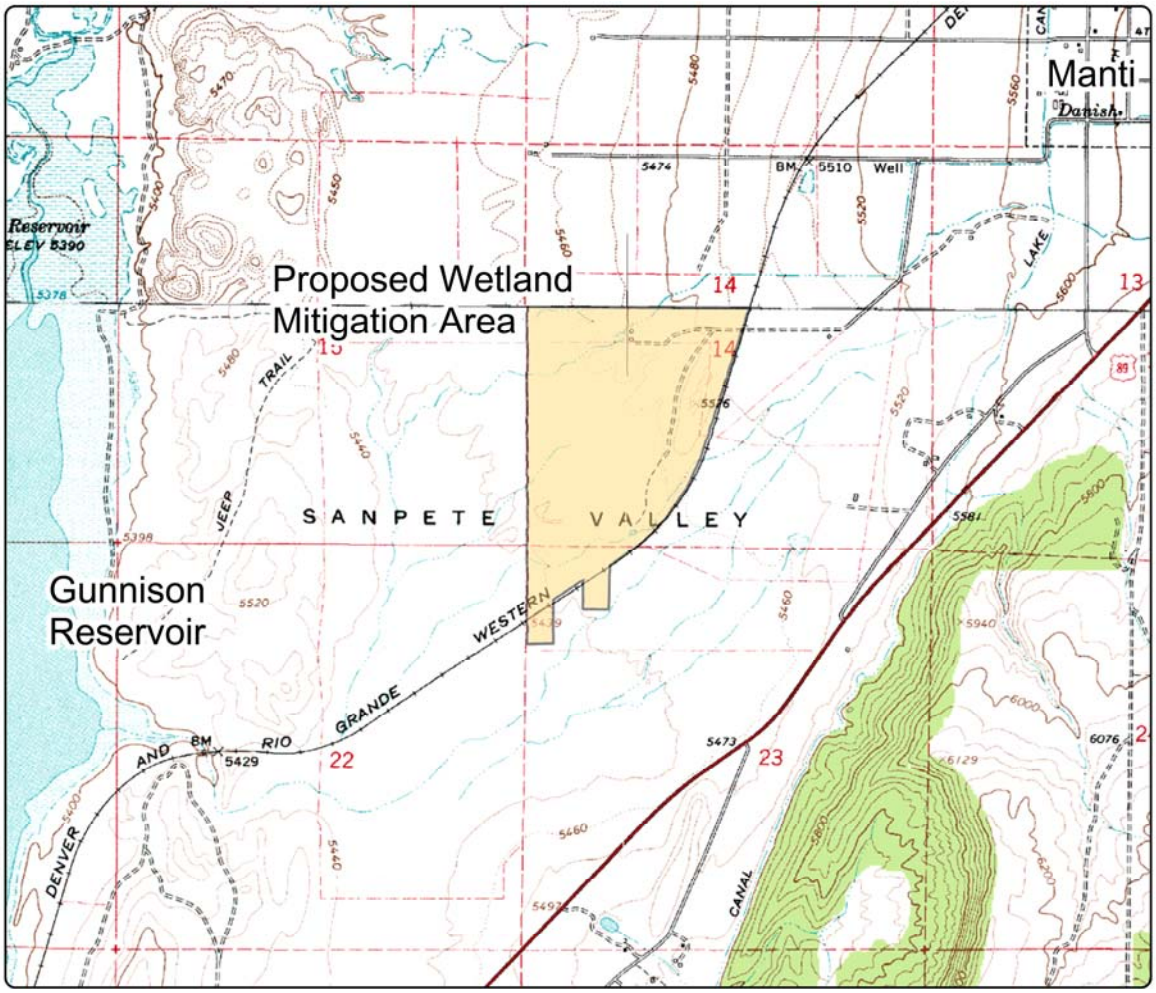
Narrows Project

Alternative Wetland Mitigation Area West of Lower Gooseberry Reservoir

Project Area and Facilities

Sanpete Water Conservancy District

Figure 2-9.—Alternative Wetland Mitigation Area West of Lower Gooseberry Reservoir.



N

0 0.25 0.5 Miles

Figure 2-10
Narrows Project
Alternative Wetland Mitigation Area
Manti Meadows
Sanpete Water Conservancy District

Figure 2-10.—Alternative Wetland Mitigation Area Manti Meadows.

The proposed design concept is to raise ground water levels by installing a series of check dams as explained in step 3. If the preliminary study shows that this is not a feasible option, reverse underdrains (buried perforated pipes) may be needed. This would expand the extent of saturated soils. Some minor recontouring may be required at this site. Also, wetland vegetation growth would be encouraged by transplanting suitable wetland species. All or a portion of the required mitigation could be performed at this site. The wetland area would be maintained by the SWCD under a MOA with UDWR (see figure 2-8).

2.2.2.2.4.2 Area West of Lower Gooseberry Reservoir.—This alternative would be developed near Lower Gooseberry Reservoir with an approximate elevation of 8,600 feet above msl. Approximately 120 acres of private land would be acquired west of the reservoir. The land currently is used for grazing sheep, and there are few existing wetlands. Water would be diverted from an existing diversion structure on Cabin Hollow, transported to the site through an existing open ditch, and would cause no additional adverse impacts to Cabin Hollow Creek.

The water planned for mitigation purposes is an existing diversion now used for pasture irrigation at the same site. The water would be diverted from the ditch at several locations and allowed to flow across the uplands and the surrounding wetlands. The existing wetlands on this site appear to have been created and maintained by the existing irrigation system.

Some earth work would need to be done to create small berms and swales that would create cells of wetlands. The area around the perimeter would be excavated somewhat deeper and to a 20-foot-minimum width and a wider width in some areas so that the edge of the swale is not abrupt but serpentine. This deeper area would allow willows and other shrubs to be planted to create a vegetation barrier to the interior wetlands. The area still would be available for grazing and wildlife use. However, sheep would be deterred from entering the wetland by perimeter swale, which would eliminate the need for fencing the area and would allow access for wildlife.

This wetland would be maintained by SWCD under a MOA with UDWR, USACE, and USDA Forest Service.

2.2.2.2.4.3 Enlarge and Create New Wetlands Adjacent to Narrows Reservoir.—This alternative would include enlarging existing wetland areas and creating new wetlands adjacent to Narrows Reservoir. Elevation of this site is approximately 8,800 feet above msl. At least 100 acres of new wetlands would be created adjacent to Narrows Reservoir by releasing water from Fairview Lakes to irrigate lands adjacent to existing wetlands. A new outlet from Fairview Lakes would be provided. The outlet would be designed to begin releasing water automatically once Fairview Lakes reached a certain level. The releases would stop as the water level receded in the fall. SWCD and CGIC jointly would develop a policy establishing how seasonal releases from Fairview Lakes would be coordinated to optimize system benefits. The water would be conveyed to and distributed within the wetland area by a system of open ditches. Some recontouring would be performed to ensure that the soils became saturated. All or a portion of the required wetland mitigation could be performed at this site alone. This wetland area would be maintained by SWCD under a MOA with UDWR and CGIC.

2.2.2.2.4.4 Manti Meadows.—Under this alternative, return flows from the Narrows Project in the San Pitch River drainage would be made available to UDWR to use at the Manti Meadows Waterfowl Management Area

located southwest of Manti. The elevation of this site is approximately 5,460 feet above msl. The water would be delivered by diverting Sixmile Creek water, which belongs to the Gunnison Irrigation Company and flows into Gunnison Reservoir, and delivering it to the Manti Meadows area through existing facilities belonging to the Manti Irrigation and Reservoir Company. Narrows Project return flows arising in the San Pitch River would be delivered to Gunnison Reservoir in exchange for the water delivered to Manti Meadows. The water would be used to create at least 100 acres of new wetlands and to improve wetland habitat values of existing wetlands in the area. Some excavation and ground re-contouring of existing uplands would be required to control drainage and encourage wetland development.

Wetland mitigation sites would provide similar functional value to that provided by the 100 acres of wetlands that would be inundated by the reservoir. Careful monitoring of the mitigation sites would be conducted to ensure that the value of the mitigation sites was similar in function and equal in value to the wetlands lost. The method to determine this would be using HEP analyses or equivalent for the sites and comparing habitat values. The wetland monitoring plan would need to be designed to be re-evaluated after 4 years and continued for as long as necessary to ensure that, at a minimum, a replacement of lost habitat values had occurred.

SWCD would have primary responsibility for implementing wetlands measures described above. SWCD would be responsible for funding and acquiring all lands and rights-of-way. SWCD would provide and transplant any plantings needed. SWCD would be responsible to ensure that all fences are in good repair and are maintained properly. SWCD also would be responsible to install and maintain any diversion and/or irrigation facilities. This work would be performed concurrently with construction of other project facilities such as the dam, tunnel rehabilitation, and pipelines. All lands and rights-of-way would be acquired, and initial construction of wetlands measures would be completed prior to initial filling of the reservoir. SWCD also would be responsible to fund the monitoring of the wetland mitigation. SWCD would be responsible to enter MOAs with UDWR, USACE, and other appropriate agencies for all wetlands measures. The MOAs would define clearly the roles and responsibilities of the SWCD, UDWR, USACE, and other parties for implementing and maintaining the wetland measures, including timeframes for future commitments such as fence maintenance. The MOAs would be required to be in place before the SRPA construction funds were dispersed.

2.2.2.2.5 Wildlife Measures

The wetlands measures previously described would offset any losses to wetland habitat caused by inundation. Impacts to upland habitat (mule deer and Brewer's sparrow habitat) would be mitigated by SWCD in the following ways:

- Acquisition of 150 acres of conservation easements adjacent to the Narrows Reservoir. These easements would impose restrictions on land use that would benefit impacted species. In addition, the conservation easements would provide a setback of about 500 feet on the west side of the reservoir for any new development or construction on private land adjacent to the reservoir.

- Acquisition of 640 acres of private land adjacent to the Price River below Scofield Reservoir. Wildlife values would be enhanced by providing 4 miles of fencing to protect the land from livestock grazing.

As with fishery mitigation, the goal of the wildlife mitigation would be to provide at least full mitigation for each impacted species.

As part of the conservation easements for the 150 acres adjacent to Narrows Reservoir, certain restrictions on the landowners' use of their lands would be needed. These restrictions would include prohibiting actions such as further construction of residential structures; commercial uses such as motels, cafes, hunting or fishing clubs, subdivisions, including the construction of sewers and septic tanks; livestock grazing; and storage or use of pesticides, herbicides, or chemical agents, either directly or indirectly lethal to wildlife. In addition, many of these lands would be made available to the general public for hunting, fishing, or other recreational uses without permit or fees charged by the landowners. Specific measures or restrictions would be developed individually as part of the easement negotiation process with each involved landowner.

As part of the wildlife mitigation plan, a monitoring program would be developed. Existing wildlife values on mitigation lands would be identified using the same models that were used to identify project impacts. These same models also would be used to measure the success of any wildlife mitigation programs. If the proposed mitigation programs are not as successful as anticipated, additional mitigation could be required. This procedure would apply to both wetland and upland wildlife habitat.

SWCD would have primary responsibility for implementing all wildlife measures described above. SWCD would be responsible for funding and acquiring all lands and easements. SWCD would provide native seed to supplement the USDA Forest Service-recommended seed mixture for the watershed and range improvement projects. SWCD would fund, construct, and maintain all improvements such as fencing. This work would be performed concurrently with construction of other project facilities such as the dam, tunnel rehabilitation, and pipelines. All lands and rights-of-way would be acquired, and initial construction of wildlife measures would be completed prior to initial filling of the reservoir. SWCD would also be responsible for funding the mitigation monitoring. SWCD would be responsible for entering into MOAs with UDWR, USDA Forest Service, and other appropriate agencies for all wildlife measures. The MOAs would clearly define the roles and responsibilities of SWCD, UDWR, USDA Forest Service, and other parties for implementing and maintaining the wildlife measures. All parties would be required to sign the MOAs before SRPA construction funds were dispersed.

2.2.2.2.6 Construction Materials

Locations of materials necessary for constructing Narrows Dam and Reservoir are shown in figure 2-3. Most of the embankment material for the Narrows Dam would be obtained from the reservoir basin. Rockfill material for upstream slope protection would be obtained from an existing quarry on Reclamation withdrawn land near SR-264. An alternative rockfill material quarry site is located on private land. Granular material for drains within the dam would be hauled from commercial pits in Sanpete Valley near Wales, Utah. Concrete for the outlet works, spillway, and other structures would be batched in Sanpete Valley and hauled to the damsite in transit mixers. Other materials such as pipe, steel gates and structures, electric motors, and operating and control equipment would be manufactured or processed outside the project area. The materials would be hauled to the construction sites by truck.

2.2.2.2.7 Lands for Project Features and Relocation

About 1,931 acres of land would be required for project features, wetland mitigation, fish and wildlife enhancement and mitigation, and material source areas. About 0.8 mile of SR-264 would be inundated by Narrows Reservoir, as described in section 2.2.2.2.2.6. The amounts of land by present ownership or administration and proposed project use are shown in table 2-4. There would be no relocation of persons, families, businesses, farms, or nonprofit organizations resulting from construction of the Narrows Project.

Approximately 225 acres of Reclamation withdrawn land would be used for project purposes. SWCD has acquired 366 acres of private lands for project uses from owners by perpetual easement or in fee. SWCD would purchase 1,340 additional acres of private and State School Trust lands for project needs.

The conservation area adjacent to the reservoir would be created through conservation easements. These lands would be administered by SWCD under a cooperative agreement with UDWR. To ensure proper management of easement lands needed to mitigate fish and wildlife losses attributed to the project, certain restrictions on the landowners' use of their

Table 2-4.—Proposed Action Right-of-Way Requirements for Project Features

Project Feature Type of Acquisition	Ownership or Administration		
	Private (acres)	Reclamation Withdrawal (acres)	Total (acres)
Narrows Dam and Reservoir	428	176	604
East Bench Pipeline			
Perpetual easement	51	0	51
Oak Creek Pipeline			
Perpetual easement	9	0	9
Upper Cottonwood Creek Pipeline	1.5	1.5	3
SR-264 relocation	0	34	34
Recreation area	0	12	12
Fishery mitigation			
Perpetual conservation easement	206	0	206
Wildlife mitigation			
Fee title purchase of fish and wildlife enhancement area	640	0	640
Perpetual conservation easement adjacent to reservoir	150	0	150
Wetlands mitigation			
Perpetual easement or fee title	220	0	220
Materials source area[1]	0	2	2
Total	1,705.5	225.5	1,931

[1] Embankment material for the dam would be obtained from the reservoir basin. Rockfill material for upstream slope protection would be obtained from an existing quarry located on withdrawn land. An alternative rockfill material quarry site may be located on private land.

lands would be needed. Specific measures or restrictions, including those to protect fish and wildlife values, would be developed by UDWR as part of the easement negotiation process with each involved landowner. If adequate easements cannot be secured, a fee-title acquisition of the lands would be made.

2.2.2.2.8 Access to Features

Construction access is fairly good for all project features. The proposed damsite is near an existing paved highway. This highway would be adequate for hauling materials and equipment to the site. Temporary haul roads would need to be constructed within the reservoir basin to move material from the borrow area to the damsite.

2.2.2.2.9 Construction Program

Construction of the Narrows Project would be under the supervision of SWCD with overall supervision furnished by Reclamation. All recreational facilities would be built by SWCD. Temporary construction offices would be located within the proposed reservoir basin.

2.2.2.2.10 Water Quality Protection Program

Several water quality permits must be obtained prior to construction of the project. The Clean Water Act of 1972 (Public Law 95-217), as amended in 1977, requires that Section 402 permits be obtained from the State or EPA for the discharge of any waste water or process water into a waterway. A Section 402 permit would be required for stormwater runoff during construction of the dam. In accordance with Section 404 of Public Law 95-217, permits must be obtained from USACE to discharge dredge and fill material below the normal high water level of streams, associated wetlands, and other water bodies as well as dam construction. A Section 404 permit would be required for construction of the project. SWCD has applied for that permit.

Approval by the Utah Division of Water Quality is required before installing any sanitary or industrial pollution control facilities, including turbidity control equipment. This approval also would be obtained before dewatering, diversion, and other such facilities could be constructed. In addition, a temporary waiver of the turbidity standard would be requested from the Utah Division of Water Quality during those periods of construction when it is physically impossible to provide turbidity control. A State Engineer's permit to alter a natural stream channel also would be requested for the proposed dam. Driving, fueling, and parking of heavy equipment would be controlled so as to avoid wetland and stream areas, precluding downstream sedimentation and other water quality impacts.

2.2.2.2.11 Public Safety

The final design of Narrows Dam would be based on additional and extensive geologic investigation and would include full consideration of such factors as seismic history, geology, induced seismicity from coal mining, and the dam's material composition. In addition, final design data and specifications for the dam would be reviewed by Reclamation and the State Engineer to ensure that it would be a safe and well-designed structure, fitting geological conditions of the site.

During construction, excavations would be mapped and studied to determine whether geologic conditions were the same as had been indicated from preliminary subsurface investigations. If actual geologic conditions were found to differ from what previously had been predicted, designs would be changed to accommodate the existing conditions. Also, geologists and inspectors

would report such hazardous conditions as potential slide or slump areas that might pose a danger to workers and equipment. All hazardous areas would be roped off and appropriate signs displayed to prevent accidents.

SWCD would develop a safety of dams program that would satisfy the State of Utah requirements. SWCD, with supervision by the State Engineer, would be responsible for monitoring structural performance and conducting safety inspections during construction and initial filling of the reservoir. Criteria would be developed and strictly followed for filling the reservoir and monitoring the safety of the dam. Marker buoys and float lines would be installed around spillway intake structures and other areas that might be hazardous to boaters. In accordance with State Engineer requirements, a standard operating procedure would be prepared to ensure that the dam was operated in a safe manner. In addition, an emergency action plan would be prepared and distributed to public safety officials. This plan would describe procedures to be followed if an emergency involved the dam.

2.2.2.3 Costs and Financing

The Proposed Action would cost approximately $40.3 million and would be funded by SWCD, the State of Utah, and a loan from the Federal Government. Of the $40.3-million cost, about $7.6 million would be allocated to fish and wildlife enhancement and recreation (table 2-5). These costs are nonreimbursable to the project sponsor. Total financing would be through provisions of the SPRA.

Table 2-5.—Narrows Project Cost Comparison of Storage Alternatives Evaluated in Detail[1]

	Proposed Action	Mid-Sized Reservoir Alternative	Small Reservoir Alternative
Narrows Dam and Reservoir	$ 12,292,000	$ 10,752,000	$ 9,212,000
Narrows Tunnel rehabilitation	4,021,000	4,021,000	4,021,000
Upper Cottonwood Creek Pipeline	677,000	677,000	677,000
Oak Creek Pipeline	341,000	341,000	341,000
East Bench Pipeline	7,997,000	7,997,000	7,997,000
Recreation area	1,065,000	937,000	801,000
Highway SR-264 relocation	3,292,000	3,292,000	3,292,000
Wetlands, wildlife, and fishery mitigation	4,274,000	4,274,000	4,147,000
Reclamation participation (EIS and planning)	950,000	950,000	950,000
SWCD's costs to date	2,818,000	2,818,000	2,818,000
Total construction cost	$37,727,000	$36,059,000	$34,256,000
Estimated interest during construction (IDC)	2,528,000	2,447,000	2,386,000
Total project costs	$40,255,000	$38,506,000	$36,642,000
Average annual water yield of project (acre-feet)	5,308	5,171	4,935
Capital cost per acre-foot of yield	$7,584	$7,447	$7,425

[1] Cost estimates have been indexed from July 2006 to 2008.

2.2.2.4 Project Administration

On completion of construction, the Narrows Project would be administered by SWCD. SWCD would have overall responsibility for administration and would contract with the water users for repayment of reimbursable project costs.

Although a formal agreement has not been reached, it is anticipated that the USDA Forest Service would administer the recreation facilities at the Narrows Reservoir under an operation agreement with SWCD and Reclamation.

A fishery management plan also would be developed, and a MOA would be agreed to between SWCD, USDA Forest Service, Reclamation, and UDWR. This plan would outline goals for fish species and angling opportunities that would be provided by the proposed reservoir and determine funding sources or contributions needed for reservoir fishery management. Any fish species released into the reservoir eventually could escape downstream. These species must not interfere with downstream fisheries. Species native to the Gooseberry drainage or that have already been introduced to this drainage would be acceptable for introduction into the proposed reservoir.

2.2.3 Mid-Sized Reservoir Alternative

This alternative would be similar to the Proposed Action except that the reservoir capacity would be limited to 12,450 acre-feet. Of that amount, 9,950 acre-feet would be active capacity, and 2,500 acre-feet would be inactive storage. The 110 feet high dam, with a crest length of 475 feet and crest width of 30 feet, would be in the same location as that for the Proposed Action (figure 2-11). Other features of the project would be the same as those for the Proposed Action and would include the construction of pipelines, rehabilitation of the existing Narrows Tunnel, relocation of SR-264, and provide recreation opportunities. Exceptions and differences between this alternative and the Proposed Action are described below.

2.2.3.1 Water Supply and Use

The average annual water supply under the Mid-Sized Reservoir Alternative would be reduced to 4,964 acre-feet because there would be less carryover storage. In years with average or above average precipitation, the full 5,400-acre-foot water right would be available. In 10 of 46 years studied, this alternative could not provide the full 5,400 acre-feet of water supply. However, in years with below average precipitation, the available water supply could be reduced by as much as 79% because of the reduced long-term carryover storage. This means less than 1,138 acre-feet of water could be available for transmountain diversion during those years when the water is needed most.

Of the average annual yield of 4,964 acre-feet, 855 acre-feet would be used for M&I purposes, and the remaining 4,109 acre-feet would be used for agriculture. As noted in section 1.4.2, there would be an estimated 15,250-acre-foot average annual shortage in the diversion demand assuming a portion of the nongrowing season precipitation was retained in the soil root zone to help meet early season water needs. On the average, the Mid-Sized Reservoir Alternative would reduce the average annual shortage to about 11,141 acre-feet per year or 21.6% of the diversion demand. With below average precipitation, the remaining shortage would be about 30,017 acre-feet per year or 58.1%. In either case, shortages still would be considerably greater than the 5% optimum shortage for irrigation projects.

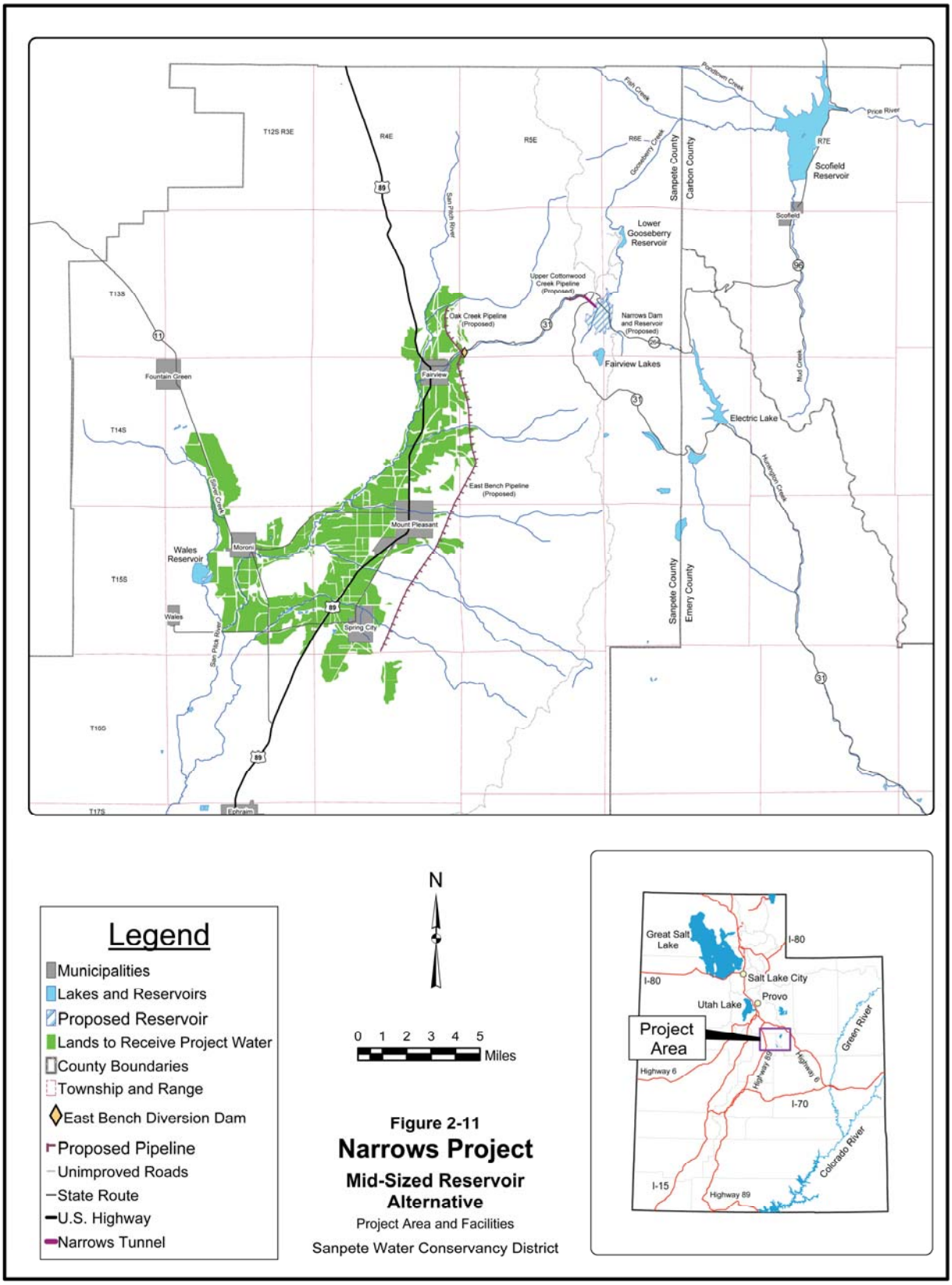


Figure 2-11.—Narrows Project, Mid-Sized Reservoir Alternative, Project Area and Facilities.

As with the Proposed Action, local water users would be expected to employ efficient water use practices or agree to implement them as a condition for receiving project water.

2.2.3.2 Construction Features and Project Operations

2.2.3.2.1 General

As in the Proposed Action, construction features of the Mid-Sized Reservoir Alternative would include one reservoir, three pipelines, rehabilitation of the existing Narrows Tunnel, the relocation of SR-264, and the relocation of some FDRs. Recreation facilities also would be provided at Narrows Reservoir. Design data for the construction features were presented earlier in table 2-2 for this alternative. The changes that would occur are depicted in table 2-2, and are described in more detail in section 2.2.3.2.2.

Specific fish and wildlife measures under the Mid-Sized Reservoir Alternative would remain the same as those stated under the Proposed Action.

Additionally, mitigation and enhancement of upland habitat would be the same as that described for the Proposed Action. New wetlands totaling about 81 acres would be created to mitigate for wetlands areas inundated by the reservoir rather than the 100 acres under the Proposed Action.

2.2.3.2.2 Design and Operation

2.2.3.2.2.1 Narrows Dam and Reservoir.— The design of Narrows Dam under the Mid-Sized Reservoir Alternative would be similar to that of the Proposed Action, but the height of the dam would be 10 feet lower. The embankment would contain an estimated total volume of 292,000 cubic yards of material.

Narrows Reservoir would still have two main outlets. A stream-level outlet would be constructed through the dam to provide downstream releases for fisheries and emergency evacuation of the reservoir. This outlet would have a 258-cfs capacity. The existing transmountain Narrows Tunnel, with a 60.0-cfs capacity, would serve as the other reservoir outlet and would accommodate releases through the mountain ridge for the transmountain diversion. The outlets would be designed and operated the same as in the Proposed Action.

The reservoir formed behind the dam would have a total capacity of 12,450 acre-feet and a water surface area of about 489 acres.

The reservoir's active capacity, or that portion of stored water that would be used to satisfy project water needs, would be 9,950 acre-feet. In all other respects, the Mid-Sized Reservoir would be designed and operated in the same manner as the Proposed Action.

2.2.3.2.2.2 Oak Creek Pipeline.—Under this alternative, this feature is identical to the same feature as that described in the Proposed Action.

2.2.3.2.2.3 East Bench Pipeline.—Under this alternative, this feature is identical to the same feature as that described in the Proposed Action.

2.2.3.2.2.4 Upper Cottonwood Creek Pipeline.—Under this alternative, this feature is identical to the same feature as that described in the Proposed Action.

2.2.3.2.2.5 Narrows Tunnel Rehabilitation.—Under this alternative, this feature is identical to the same feature as that described in the Proposed Action.

2.2.3.2.2.6 State Route-264 Relocation.— Under this alternative, this feature is identical to the same feature as that described in the Proposed Action.

2.2.3.2.2.7 Recreation Facilities.—For this alternative, public recreation facilities would be similar to those provided for in the Proposed Action. The facilities would include a boat ramp, boat slips, and a day-use area. The day-use area would include 8 picnic sites, restroom facilities, and a 50-unit campground. USDA Forest Service would participate in the recreation facility design, and the facilities would be constructed to their standards. USDA Forest Service would operate and maintain the facilities under agreement with SWCD and Reclamation. Title to the recreation facilities would remain in the name of the United States.

2.2.3.2.3 Fishery Measures

A total of 11 fishery measures have been included in the project to mitigate for adverse impacts that have been identified with the project. To the extent possible, an attempt was made to mitigate "in place" and "in kind." Under this alternative, these measures are identical to the same measures as those described in the Proposed Action.

2.2.3.2.4 Wetlands Measures

Wetlands measures would be included in the project to mitigate for unavoidable adverse impacts to wetlands that have been identified with the project. Four alternative wetland mitigation sites have been identified. The actual mitigation that is implemented could be from one alternative or a combination of alternatives. Proposed wetland mitigation areas have been shown previously in figures 2-8, 2-9, and 2-10. A complete description of each alternative was provided in the discussion of the Proposed Action. Modifications unique to the Mid-Sized Reservoir Alternative are discussed below.

2.2.3.2.4.1 Wetlands Adjacent to Mud Creek Near Scofield.—This measure would entail purchasing about 190 acres of private land adjacent to Mud Creek, south of the town of Scofield, rather than the 220 acres described in the Proposed Action.

2.2.3.2.4.2 Area West of Lower Gooseberry Reservoir.—Under this alternative, about 105 acres of private land west of Lower Gooseberry Reservoir would be acquired, rather than the 120 acres under the Proposed Action. This land would be treated in the same manner as in the Proposed Action.

2.2.3.2.4.3 New Wetlands Adjacent to Narrows Reservoir.—This alternative would be identical to that described in the Proposed Action, except that the target acreage for mitigation would be reduced from 100 to 81 acres.

2.2.3.2.4.4 Manti Meadows.—This alternative would be identical to that described in the Proposed Action, except that the target acreage for mitigation would be reduced from 100 to 81 acres.

Wetlands measures would be needed to provide similar wildlife values as those in the 81 acres of wetlands that would be inundated by the reservoir. Careful monitoring of the mitigation sites would be conducted to ensure that the value of the mitigation sites was at least equal to the value of the wetlands lost. This determination would be accomplished by performing HEP analyses of the sites and comparing habitat values.

SWCD would have primary responsibility for implementing the wetlands measures described above and would assume all other responsibilities associated therewith, as described in connection with the Proposed Action.

2.2.3.2.5 Wildlife Measures

The wetlands measures described above would offset any losses to wetland habitat caused by inundation. Impacts to upland

habitat (mule deer and Brewer's sparrow habitat) were described earlier in connection with the Proposed Action, and the mitigation measures discussed there also would be implemented under the Mid-Sized Reservoir Alternative.

2.2.3.2.6 Construction Materials

Locations of materials necessary for constructing Narrows Dam and Reservoir are shown in figure 2-11. In all other respects, the description of the construction materials is the same for this alternative as that described in connection with the Proposed Action.

2.2.3.2.7 Lands for Project Features and Relocation

About 1,516 acres of land would be required for project features, wetland mitigation, fish and wildlife enhancement and mitigation, and material source areas. The amounts of land by present ownership or administration and proposed project use for this alternative are shown in table 2-6.

2.2.3.2.8 Access to Features

Construction access would be the same as that described for the Proposed Action.

Table 2-6.—Mid-Sized Reservoir Alternative Right-of-Way Requirements for Project Features (Acres)

Project Feature Type of Acquisition	Ownership or Administration		
	Private	Reclamation Withdrawal	Total
Narrows Dam and Reservoir	338	151	489
East Bench Pipeline			
Perpetual easement	51	0	51
Oak Creek Pipeline			
Perpetual easement	9	0	9
Upper Cottonwood Creek Pipeline	1.5	1.5	3
SR-264 relocation	0	34	34
Recreation area	0	7	7
Fishery mitigation			
Perpetual conservation easement	206	0	206
Wildlife mitigation			
Fee title purchase of fish and wildlife enhancement area	385	0	385
Perpetual conservation easement adjacent to reservoir	150	0	150
Wetlands mitigation			
Perpetual easement or fee title	180	0	180
Materials source area[1]	0	2	2
Total	1,320.5	195.5	1,516

[1] Embankment material for the dam would be obtained from the reservoir basin. Rockfill material for upstream slope protection would be obtained from an existing quarry located on withdrawn land. An alternative rockfill material quarry site may be located on private land.

2.2.3.2.9 Construction Program

The construction program would be similar to that incorporated into the Proposed Action.

2.2.3.2.10 Water Quality Protection Program

The water quality protection program would be the same as that incorporated into the Proposed Action.

2.2.3.2.11 Public Safety

The public safety measures for this alternative would be the same as those incorporated into the Proposed Action.

2.2.3.3 Costs and Financing

The Mid-Sized Reservoir Alternative would cost about $38.5 million and would be funded by SWCD, the State of Utah, and a loan from the Federal Government (table 2-5). Of the $38.5-million cost, about $4.9 million would be for fish and wildlife enhancement and recreation. These costs are nonreimbursable to the project sponsors. Total financing would be through provisions of the SPRA. Because of a smaller storage capacity, the cost of project water would be approximately 31% higher than the Proposed Action.

2.2.3.4 Project Administration

Under the Mid-Sized Reservoir Alternative, project administration would be the same as that described for the Proposed Action.

2.2.4 Small Reservoir Alternative

This alternative would be similar to the Proposed Action except that the reservoir capacity would be limited to 7,900 acre-feet. Of that amount, 5,400 acre-feet would be active capacity, and 2,500 acre-feet would be inactive storage. The 100-feet-high dam, with a crest length of 425 feet and crest width of 30 feet, would be in the same location as that for the Proposed Action (figure 2-12). Other features of the project would be the same as those for the Proposed Action and would include the construction of pipelines, rehabilitation of the existing Narrows Tunnel, relocation of SR-264, and provide recreation opportunities. Exceptions and differences between this alternative and the Proposed Action are discussed below.

2.2.4.1 Water Supply and Use

The average annual water supply under the Small Reservoir Alternative would be reduced to 4,710 acre-feet because there would be less carryover storage. In years with average or above average precipitation, the full 5,400-acre-foot water right would be available. In 17 of 46 years studied, this alternative could not provide the full 5,400-acre-foot water supply. However, in years with below average precipitation, the available water supply could be reduced by as much as 74% because of the lack of long-term carryover storage. This means that less than 1,427 acre-feet of water could be available for transmountain diversion during those years when the water is most needed.

Of the average annual 4,710-acre-foot yield, 855 acre-feet would be used for M&I purposes; and the remaining 3,105 acre-feet would be used for agriculture. As noted in section 1.4.2, there would be an estimated 15,250-acre-foot average annual shortage in the diversion demand, assuming a portion of the nongrowing season precipitation was retained in the soil root zone to help meet early-season water needs. On the average, the Small Reservoir Alternative would reduce the average annual shortage to about 11,395 acre-feet per year or 22.1% of the diversion demand. With below average precipitation, the remaining shortage would amount to 29,728 acre-feet per year or 57.5%.

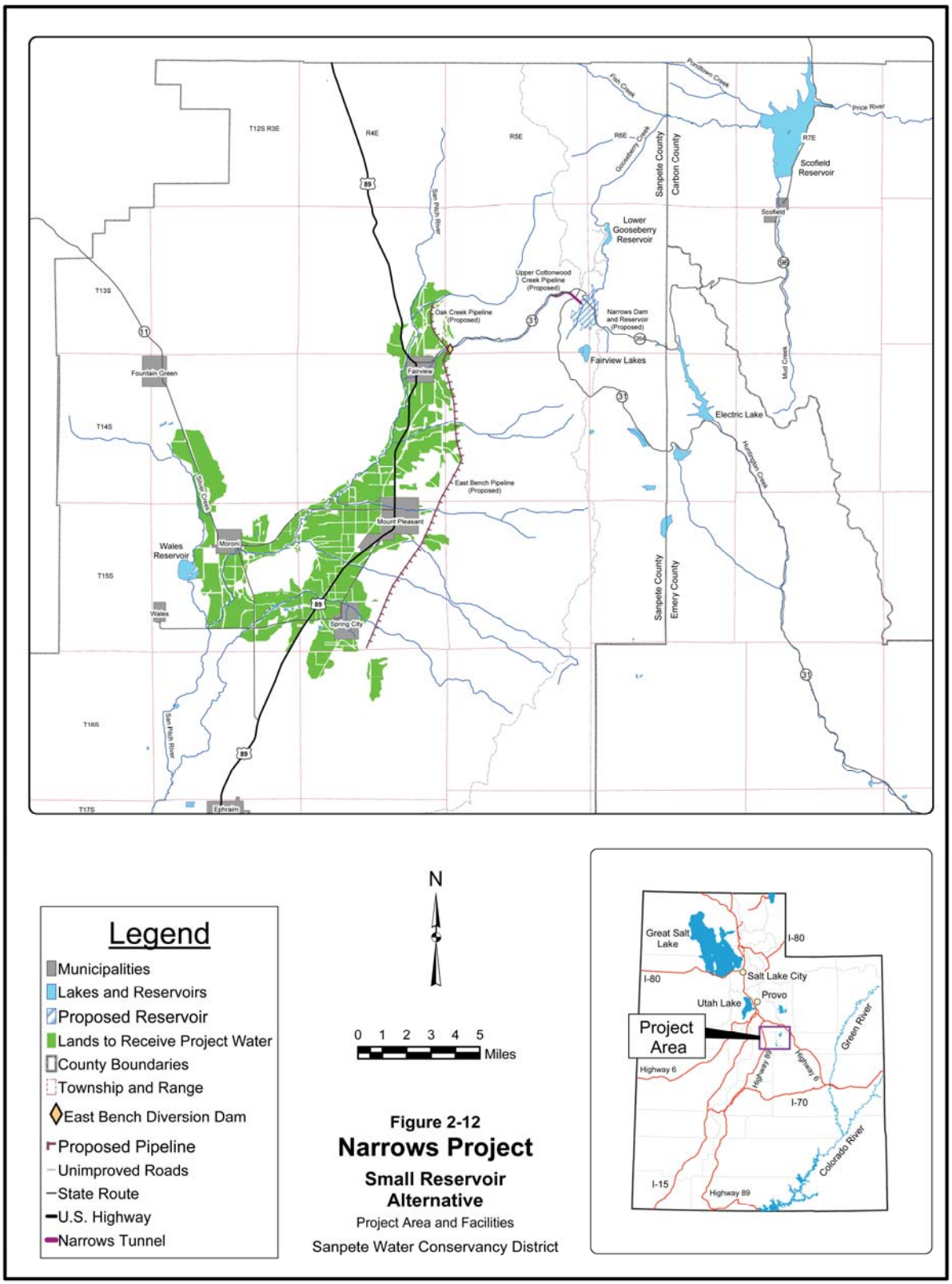


Figure 2-12.—Narrows Project, Small Reservoir Alternative, Project Area and Facilities.

In either case, shortages are still considerably greater than the 5% optimum shortage for irrigation projects.

As with the Proposed Action, local water users would be expected to employ efficient water use practices or agree to implement them as a condition for receiving project water.

2.2.4.2 Construction Features and Project Operations

2.2.4.2.1 General

As in the Proposed Action, construction features of the Small Reservoir Alternative would include one reservoir, three pipelines, rehabilitation of the existing Narrows Tunnel, the relocation of SR-264, and the relocation of some FDRs. Recreation facilities also would be provided at Narrows Reservoir. Design data for this alternative was presented earlier in table 2-2.

Of the 11 specific fish and wildlife measures included in the Proposed Action, 9 would be employed under the Small Reservoir Alternative. Those measures, some with modifications, include:

- Provide minimum flows of 1.0 cfs in Gooseberry Creek below Narrows Dam
- Provide a multiple-level outlet at Narrows Dam to regulate the temperature of releases to Gooseberry Creek from Narrows Reservoir
- Modify and/or stabilize streambanks and associated riparian zones along Middle Gooseberry Creek
- Acquire and/or improve stream segments to provide additional fish habitat
- Provide winter releases to Cottonwood Creek
- Provide summer flows in lower Cottonwood Creek
- Construct a pipeline in the upper Cottonwood Creek area to convey project water outside the stream channel
- Provide a minimum pool in Narrows Reservoir for fish
- Reduce external phosphorus loading to Scofield Reservoir

Because of the reduced reservoir capacity, there would not be enough storage to include the following measures that would be part of the Proposed Action:

- Provide year-round flows in two tributaries of Gooseberry Creek that are presently dewatered
- Provide an additional 300 acre-feet per year of releases from the Narrows Reservoir for channel maintenance and fish habitat

In lieu of providing year-round flows in the Gooseberry Creek tributaries, 1.8 miles of spawning and rearing habitat would be replaced. (This mitigation would require additional coordination with UDWR and the USDA Forest Service. If improvement of existing stream segments is used as the method of replacing the habitat, as much as 5.4 miles of stream may need to be improved.)

Mitigation and enhancement of upland habitat would be the same as that described for the Proposed Action. New wetlands totaling about 72 acres would be created to mitigate for wetlands areas inundated by the reservoir.

2.2.4.2.2 Design and Operation

2.2.4.2.2.1 Narrows Dam and Reservoir.— Under the Small Reservoir Alternative, the design of Narrows Dam would be similar to that of the Proposed Action; but the dam

would be 20 feet lower in height. The embankment would contain an estimated total volume of 220,000 cubic yards of material.

Narrows Reservoir would have two main outlets. A stream-level outlet would be constructed through the dam to provide downstream releases for fisheries and emergency evacuation of the reservoir. This outlet would have a 210-cfs capacity. The existing transmountain Narrows Tunnel, with a 60.0-cfs capacity, would serve as the other reservoir outlet and would accommodate releases through the mountain ridge for the transmountain diversion. The outlets would be designed and operated the same as in the Proposed Action.

The reservoir formed behind the dam would have a total capacity of 7,900 acre-feet and a water surface area of about 362 acres.

The reservoir's active capacity, or that portion of stored water that would be used to satisfy project water needs, would be 5,400 acre-feet. In all other respects, the Small Reservoir Alternative would be designed and operated in the same manner as under the Proposed Action.

2.2.4.2.2.2 Oak Creek Pipeline.—Under this alternative, this feature is identical to the same feature as described in the Proposed Action.

2.2.4.2.2.3 East Bench Pipeline.—Under this alternative, this feature is identical to the same feature as described in the Proposed Action.

2.2.4.2.2.4 Upper Cottonwood Creek Pipeline.—Under this alternative, this feature is identical to the same feature as described in the Proposed Action.

2.2.4.2.2.5 Narrows Tunnel Rehabilitation.—Under this alternative, this feature is identical to the same feature as described in the Proposed Action.

2.2.4.2.2.6 SR-264 Relocation.—Under this alternative, this feature is identical to the same feature as described in the Proposed Action.

2.2.4.2.2.7 Recreation Facilities.—For this alternative, public recreation facilities would be similar to those provided for in the Proposed Action. The facilities would include a boat ramp, boat slips, and a day-use area. The day-use area would include 6 picnic sites, restroom facilities, and a 40-unit campground. USDA Forest Service would participate in the recreation facility design, and the facilities would be constructed to their standards. USDA Forest Service would operate and maintain the facilities under agreement with SWCD and Reclamation. Title to the recreation facilities would remain in the name of the United States.

2.2.4.2.3 Fishery Measures

A total of nine fishery measures have been included in the project to mitigate for adverse impacts identified with this alternative for the project. These nine measures are the same as nine of the measures included as part of the Proposed Action. Two of the Proposed Action measures, however, would not be possible under the Small Reservoir Alternative. To the extent possible, an attempt was made to mitigate "in place" and "in kind." The two mitigation measures not included under this alternative are the restoration of streamflow in the Gooseberry Creek tributaries below Fairview Lakes and the provision for flushing flow releases to Gooseberry Creek below Narrows Reservoir. These two fishery mitigation measures could not be included due to the absence of capacity for carryover storage in the reservoir.

2.2.4.2.4 Wetlands Measures

Wetlands measures would be included in the project to mitigate for unavoidable adverse

impacts to wetlands that have been identified with the project. Four alternative wetland mitigation sites have been identified. The actual mitigation that is implemented could be from one alternative or a combination of alternatives. Proposed wetland mitigation areas have been shown previously in figures 2-8, 2-9, and 2-10. A complete description of each alternative was provided in the discussion of the Proposed Action. Modifications unique to the Small Reservoir Alternative are discussed below. Alternatives listed are in order of priority.

2.2.4.2.4.1 Wetlands Adjacent to Mud Creek Near Scofield.—This measure would entail purchasing about 160 acres of private land adjacent to Mud Creek, south of the town of Scofield, rather than the 220 acres described in the Proposed Action.

2.2.4.2.4.2 Area West of Lower Gooseberry Reservoir.—Under this alternative, about 86 acres of private land west of Lower Gooseberry Reservoir would be acquired rather than the 120 acres under the Proposed Action. This land would be treated in the same manner as in the Proposed Action.

2.2.4.2.4.3 New Wetlands Adjacent to Narrows Reservoir.—This alternative would be identical to that described in the Proposed Action, except that the target acreage for mitigation would be reduced from 100 to 72 acres.

2.2.4.2.4.4 Manti Meadows.—This alternative would be identical to that described in the Proposed Action, except that the target acreage for mitigation would be reduced from 100 to 72 acres.

The wetlands measures would need to include similar wildlife values as the 72 acres of wetlands that would be inundated by the reservoir. Careful monitoring of the mitigation sites would be conducted to ensure that the value of the mitigation sites is at least equal to the value of the wetlands lost. This determination would be accomplished by performing HEP analyses of the sites and comparing habitat values.

SWCD would have primary responsibility for implementing the wetlands measures described above and would assume all other responsibilities associated therewith and described in connection with the Proposed Action.

2.2.4.2.5 Wildlife Measures

The wetlands measures described above would offset any losses to wetland habitat caused by inundation. Impacts to upland habitat (mule deer and Brewer's sparrow habitat) were described earlier in connection with the Proposed Action, and the mitigation measures discussed there also would be implemented under the Small Reservoir Alternative.

2.2.4.2.6 Construction Materials

Locations of materials necessary for constructing Narrows Dam and Reservoir are shown in figure 2-12. In all other respects, the description of the construction materials is the same for this action as that described in connection with the Proposed Action.

2.2.4.2.7 Lands for Project Features and Relocation

About 1,345 acres of land would be required for project features, wetland mitigation, fish and wildlife enhancement and mitigation, and material source areas. The amounts of land by present ownership or administration and proposed project use for this alternative are shown in table 2-7.

2.2.4.2.8 Access to Features

Construction access would be the same as that described for the Proposed Action.

Table 2-7.—Small Reservoir Alternative Right-of-Way Requirements for Project Features (Acres)

Project Feature Type of Acquisition	Ownership or Administration		
	Private	Reclamation Withdrawal	Total
Narrows Dam and Reservoir	244	119	363
East Bench Pipeline			
Perpetual easement	51	0	51
Oak Creek Pipeline			
Perpetual easement	9	0	9
Upper Cottonwood Creek Pipeline	1.5	1.5	3
SR-264 relocation	0	34	34
Recreation area	0	7	7
Fishery mitigation			
Perpetual conservation easement	206	0	206
Wildlife mitigation			
Fee title purchase of fish and wildlife enhancement area	385	0	385
Perpetual conservation easement adjacent to reservoir	150	0	150
Wetlands mitigation			
Perpetual easement or fee title	135	0	135
Materials source area[1]	0	2	2
Total	1,181.5	163.5	1,345

[1] Embankment material for the dam would be obtained from the reservoir basin. Rockfill material for upstream slope protection would be obtained from an existing quarry located on withdrawn land. An alternative rockfill material quarry site may be located on private land.

2.2.4.2.9 Construction Program

The construction program would be similar to that incorporated into the Proposed Action.

2.2.4.2.10 Water Quality Protection Program

The water quality protection program would be the same as that incorporated into the Proposed Action.

2.2.4.2.11 Public Safety

The public safety measures for this alternative would be the same as those incorporated into the Proposed Action.

2.2.4.3 Costs and Financing

The Small Reservoir Alternative would cost about $36.6 million and would be funded by SWCD, the State of Utah, and a loan from the Federal Government (table 2-5). Of the $36.6-million cost, about $4.0 million is for fish and wildlife enhancement and recreation. These costs are nonreimbursable to the project sponsor. Total financing would be through provisions of the SPRA. Because of a smaller storage capacity, the cost of project water would be approximately 96% higher than the Proposed Action.

2.2.4.4 Project Administration

Under the Small Reservoir Alternative, project administration would be the same as that described for the Proposed Action.

2.3 ALTERNATIVES CONSIDERED AND ELIMINATED FROM THE STUDY

Several alternatives considered were determined to be nonviable. Those alternatives are summarized below.

2.3.1 Direct Diversion Without Reservoir

The Direct Diversion Without Reservoir Alternative was formulated to avoid impacts to wetlands in the Narrows Reservoir basin and does not require constructing a dam and reservoir. Water would be diverted from Gooseberry Creek according to water demands within the project service area to the extent it is available in the natural runoff pattern (figure 2-13). Key features and elements of this alternative include:

- A diversion structure and pumping plant on Gooseberry Creek located about 1,000 feet downstream from the SR-264 highway crossing of Gooseberry Creek
- An electrical transmission line
- A 1,000-foot-long discharge pipeline
- An open canal about 0.8 mile long
- Narrows Tunnel rehabilitation
- Upper Cottonwood Creek Pipeline
- Oak Creek Pipeline
- East Bench Pipeline

A hydrologic operation study indicates that an average of 1,373 acre-feet per year could be diverted from Gooseberry Creek to Cottonwood Creek. This analysis is based on 1960–92 flow records and takes into consideration the maximum annual transbasin diversion of 5,400 acre-feet, the 1.0-cfs minimum streamflow requirement at the Narrows damsite, and the demand for supplemental irrigation water. The majority of flow on Gooseberry Creek occurs in May and June. However, the demand for supplemental irrigation water generally occurs in July, August, and September. Therefore, the high flows of May and June would not be diverted because there would be no place to store the water to use later in the irrigation season. During low flow periods, natural flows in Gooseberry Creek would not be great enough to meet the 1.0-cfs minimum streamflow in Cottonwood Creek. Similarly, the project could not provide water as needed in the late irrigation season.

The total cost of the Direct Diversion Without Storage Alternative would be about $12.1 million. Since this alternative would provide neither recreation nor fish and wildlife benefits, there would be no grants available for those purposes; and the total project cost would be borne by the water users. In addition to capital costs, an annual pumping cost of about $7,200 would be incurred.

2.3.1.1 Reasons Eliminated from Further Consideration

Direct diversion does not supply irrigation water when it is needed during the mid- and late-summer months.

During low flow periods, this alternative cannot provide the 1.0-cfs minimum streamflow in Gooseberry Creek at the Narrows damsite as required by the project water rights.

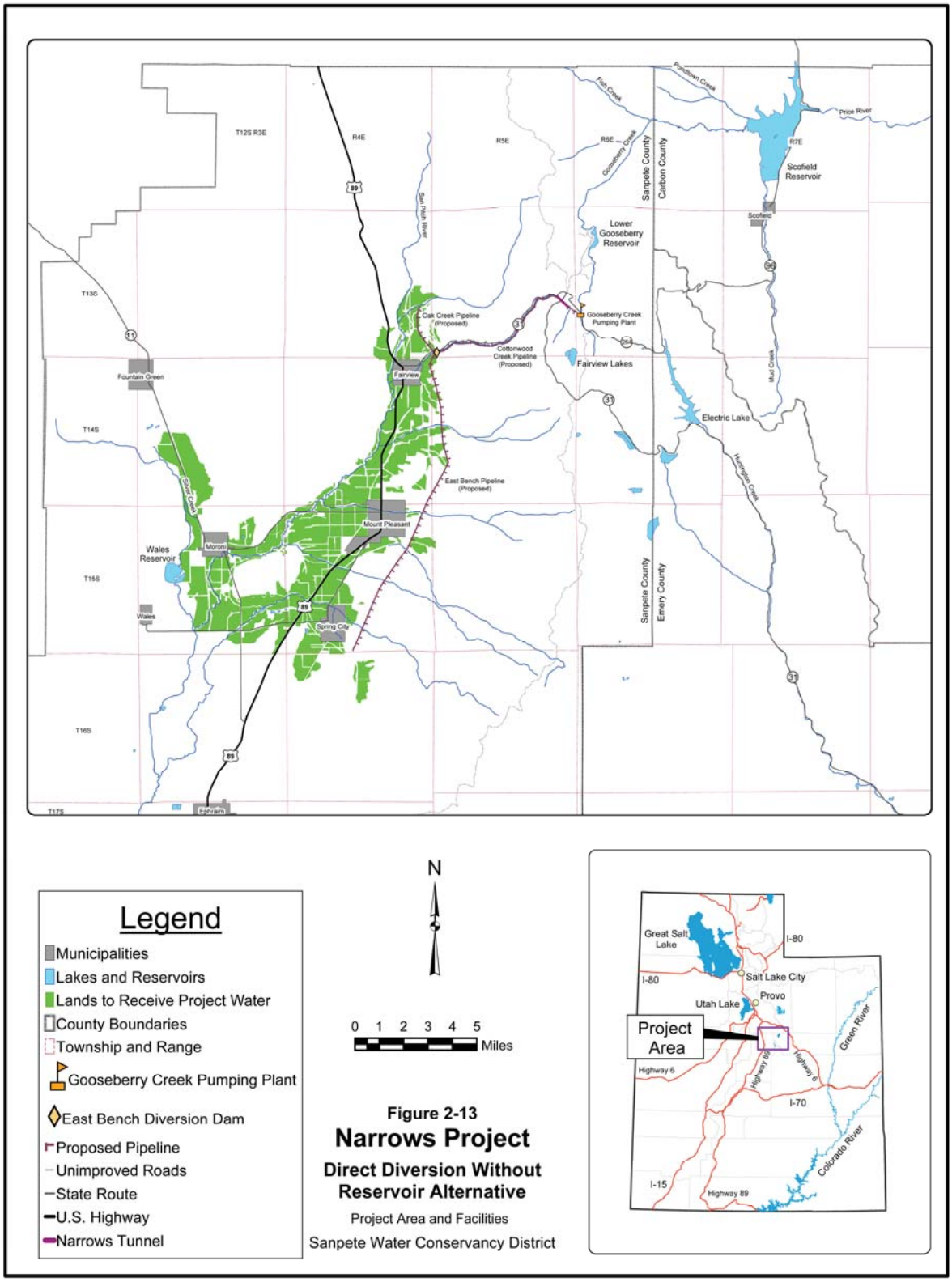


Figure 2-13.—Narrows Project, Direct Diversion Without Reservoir Alternative.

Because this alternative would provide neither recreation nor fish and wildlife benefits, there would be no grants available for those purposes that would offset some of the project costs. The total cost would be borne by the water users. The capital cost per acre-foot of water yield to the water users would be about 2.5 times that of the Proposed Action.

2.3.2 Direct Diversion with Reservoir in Sanpete Valley

This alternative would include the same facilities in Gooseberry Creek as the Direct Diversion Without Reservoir Alternative, but a storage reservoir would be provided at a lower elevation in Sanpete Valley. The storage would allow the water to be delivered at times during the irrigation season when it is needed (figure 2-14).

A hydrologic operation study indicates that an average of 4,671 acre-feet per year could be diverted from Gooseberry Creek to Cottonwood Creek. This analysis is based on 1960–92 flow records and takes into consideration the maximum annual transbasin diversion of 5,400 acre-feet and the 1.0-cfs minimum streamflow requirement at the Narrows damsite. The majority of the divertible flow occurs in May and June. This flow would be added to the usual spring peak flows in Cottonwood Creek and could result in considerable degradation of the stream channel. During low flow periods, natural flows in Gooseberry Creek would not be great enough to meet the 1.0-cfs minimum streamflow in Gooseberry Creek or to provide the 2.0-cfs minimum year-round flow in Cottonwood Creek, as required by the 1984 Compromise Agreement.

To avoid severe degradation of the stream channel, the flow would need to be conveyed through a pipeline (the Cottonwood Creek Pipeline) for the entire length of the canyon. Proper placement of the pipeline is critical because a total of 104 landslides, most of which are active, have been mapped in the canyon. The topography of the canyon suggests that the most likely location for the pipeline would be within the existing highway alignment. However, due to the landslides, the highway has continual stability problems; and repairs are needed on an annual basis. The instability would present continual safety and maintenance problems for the high-pressure pipeline. The terminus of the Cottonwood Creek Pipeline would require a control/energy dissipation structure.

To identify the best damsite available, a reconnaissance-level study was performed in which all potentially practicable reservoir sites within the project area were identified (see appendix B). Preliminary estimates of storage capacity, dam height, and dam length were made. A total of 10 damsites were included in this evaluation. Of these damsites, a site located near Milburn appeared to be the most feasible. This determination was made based on the amount of embankment material required to construct the dam versus the volume of water that could be stored. The other damsites were eliminated because they were either technically or economically infeasible. The reservoir basin at the Milburn site contains about 60 acres of high quality wetlands, including willow thickets, cattails, and sedges that would be impacted.

In addition to the dam, the Oak Creek Pipeline would need to be enlarged to deliver water from the reservoir to the project area. A pumping plant also would be needed to lift the water into the pipeline. Key features and elements of this alternative include the following:

- A diversion structure and pumping plant on Gooseberry Creek located about 1,000 feet downstream from the SR-264 highway crossing of Gooseberry Creek.

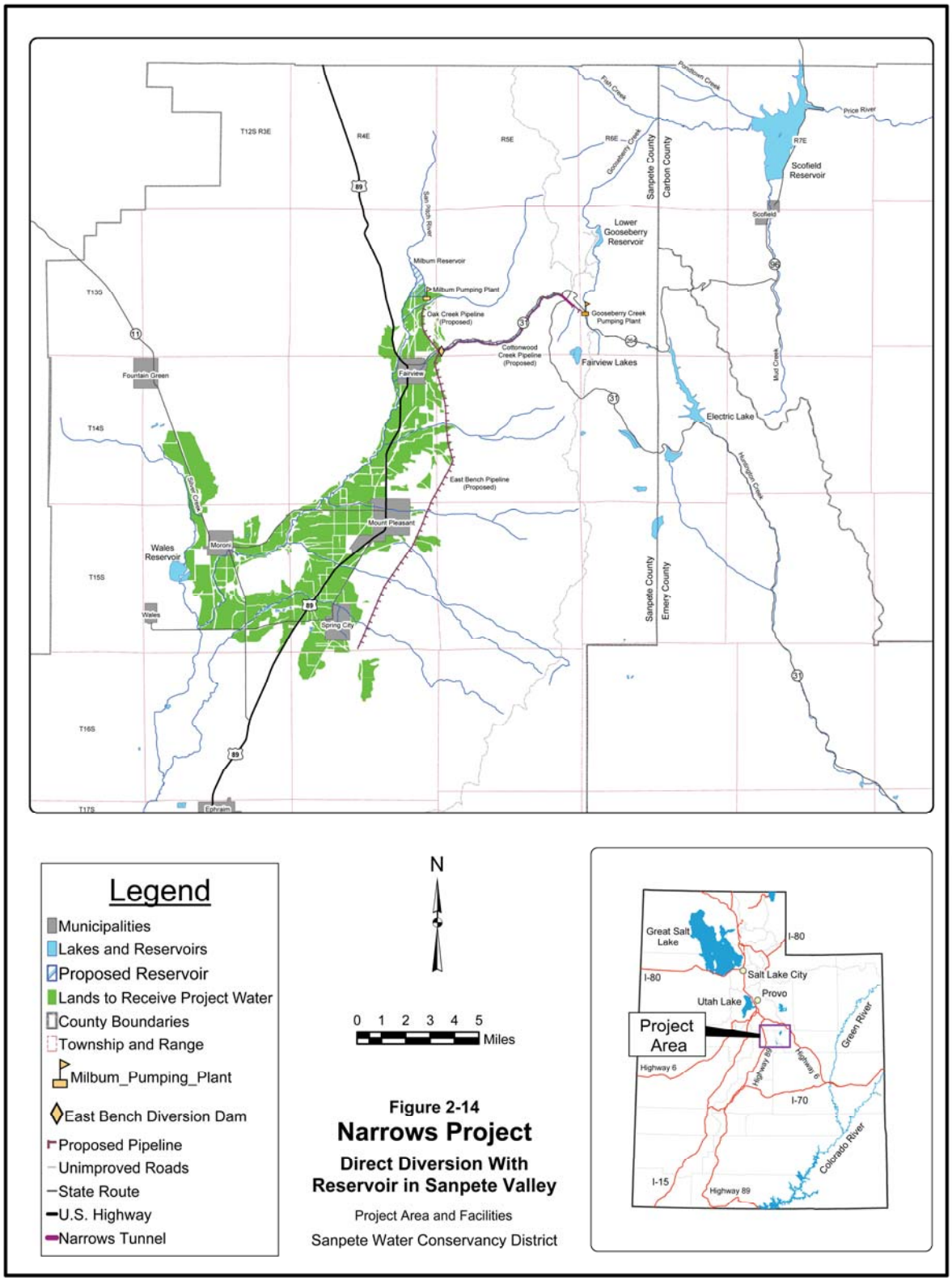


Figure 2-14.—Narrows Project, Direct Diversion with Reservoir in Sanpete Valley.

- An electrical transmission line.
- A 1,000-foot-long discharge pipeline.
- An open canal about 0.8 mile long.
- Narrows Tunnel rehabilitation.
- Cottonwood Creek Pipeline.
- Milburn dam and reservoir (5,400-acre-foot capacity). The dam would have a maximum height of 64 feet and a crest length of 2,185 feet.
- A pumping plant near Milburn dam.
- An enlarged Oak Creek Pipeline.
- East Bench Pipeline.

Total project cost would be about $50 million or about $18.4 million higher than the Proposed Action. However, this alternative does not have any carryover storage and would not provide recreation or fish and wildlife benefits. As a result, it would not be eligible for State or Federal grants for these purposes. All costs would be allocated to and repaid by the local water users. Costs allocated to the water users would be about 2.8 times those under the Proposed Action while the yield would be about 13% less than the Proposed Action. In addition, annual O&M costs would be increased by about $155,000 per year to provide for pumping power at two locations.

2.3.2.1 Reasons Eliminated from Further Consideration

The proposal is financially infeasible. With the substantially higher initial cost and higher annual costs, the sponsor lacks resources to meet SRPA cost-sharing requirements. In addition, annual costs exceed the sponsor's repayment capacity.

The feasibility of constructing the Cottonwood Creek Pipeline is highly doubtful due to the geologic instability of the canyon. The safety concerns and maintenance problems posed by this instability would be unacceptable.

Total cost of this plan is about 1.9 times the cost of the Proposed Action and produces about 13% less water than the Proposed Action.

The water right for this plan is questionable. During low flow periods, natural flow in Gooseberry Creek is insufficient to maintain the 1.0-cfs minimum streamflow required to establish and maintain the water right, as provided in the 1984 Compromise Agreement.

This proposal would still inundate about 60 acres of high quality wetlands.

2.3.3 Conservation Without Development of Other Water Supplies

Instead of developing new water supplies, implementing conservation measures has been suggested to extend existing water supplies. Under this alternative, the Narrows Dam and Reservoir would not be constructed. Without the dam construction, there would be no need to relocate SR-264; and there would be no recreational facilities constructed at the reservoir site. The East Bench, Oak Creek, and Upper Cottonwood Creek Pipelines would not be built. The existing Narrows Tunnel would have to be rehabilitated at some future date. If the tunnel were to collapse, Cottonwood Creek Irrigation Company would have to acquire some type of emergency funding to repair it.

Irrigators in the project area have already implemented extensive efficiency improvements (conservation measures) to extend their scarce water supplies. Approximately 60% of the irrigated land within the project area is irrigated with

sprinklers. About 75% of the land is served by improved conveyance facilities such as pipelines and lined canals and ditches. Based upon these conditions, the diversion requirement was computed to be an average of about 62,900 acre-feet per year for the 15,420 acres of project-eligible lands (see section 1.4.2). With average annual water supplies of 34,200 acre-feet per year, this would leave a shortage of about 28,700 acre-feet per year.

Because of this shortage, certain individuals and canal companies were planning to install, or were currently installing, a variety of efficiency improvements on much of the unimproved portions of project lands. These improvements would be expected to be in place by the projected date of completion for the proposed Narrows Project. These improvements would consist mainly of additional pipe delivery and sprinkler irrigation systems. Land leveling is often used as a technique to improve onfarm efficiency; however, due to the topography and shallow depth of soil, land leveling is generally not practical or economically feasible in the project area. Drip irrigation systems, which are highly efficient, are not considered practical for the alfalfa/grain rotation crops that are grown in the project area. With completion of these improvements, most of the cost-effective measures would have been implemented. There still could be limited opportunities for some localized improvements.

As a result of these efficiency improvements, diversion demands would be expected to be reduced from an average of 62,900 to about 51,700 acre-feet per year. This would be an average reduction in diversion demand of about 11,200 acre-feet per year. (In previous documents, this reduction has been reported to be 8,000 acre-feet per year but now has been revised based upon updated crop consumptive use data.) Even with these improvements in place, remaining shortages would be estimated at about 15,250 acre-feet per year. With this amount of shortage, significant soil moisture deficits would continue to seriously impact crop growth and production.

It should be noted that the 11,200-acre-foot reduction in diversion demand is not new water. New water would become available only if demands could be reduced below available supplies. In this case, efficiency improvements would make more use of the existing water supply available to the plants by reducing the amount of water lost to the plants because of evaporation, seepage, and spills from the carriage system; deep percolation through the root zone; and runoff from the ends of the fields. There would be two consequences of implementing efficiency improvements:

1. More of the existing water supplies would become available to support plant growth and development. Here, an additional 3,500 acre-feet per year of existing water supplies would be available to the plants.

2. Conversely, 3,500 acre-feet per year, less the amount previously lost by evaporation, no longer would be available as return flows to support wetlands, aquatic habitat, and downstream users.

As mentioned previously, most of the remaining cost-effective efficiency improvements would be implemented within a relatively short timeframe independent of the Narrows Project or any other organized program. In essence, their implementation would be a component of the No Action Alternative and would not satisfy the need for additional supplemental water.

2.3.3.1 Reasons Eliminated from Further Consideration

This is an ongoing activity that is a component of the No Action Alternative, the Proposed Action, and any other alternative that might be considered.

Implementing efficiency improvements does not adequately satisfy the need for additional supplemental irrigation water.

Efficiency improvements do not provide significant relief for water shortages during the late irrigation season when supplemental water is needed the most.

With implementing the planned efficiency improvements, the opportunity for additional large-scale conservation programs is nonexistent.

2.3.4 Mammoth Damsite Alternative

Several alternative damsite locations were evaluated and studied during the early stages of project planning. Because of the topography of many of these alternative damsites and technical difficulties relating to dam length and height and storage capacity, only two of the sites were further evaluated. The first of these is the damsite contemplated in the original Gooseberry Project.

The original Gooseberry Project trans-mountain diversion plan contemplated a reservoir site generally located in the south half of section 6 and part of sections 7 and 18, T. 13 S., R. 6 E., Salt Lake Base and Meridian, commonly referred to as the Mammoth reservoir site (figure 2-15). Through direct diversions and storage in the Mammoth reservoir, the original project plan contemplated a transmountain diversion of up to 30,000 acre-feet of water per year.

Through public reviews, the Service, among others, requested moving the Gooseberry damsite from the proposed Mammoth site to the proposed Narrows site to protect fishery values. In 1984, UDWR made a similar request and specifically requested the exclusion of Cabin Hollow Creek from the Gooseberry Project. Next, using Brooks Canyon Creek water became impractical because the existing wetlands are dependent upon its water supply. The amount of water available from this source did not justify the impact on the wetlands.

In 1984, Reclamation, SWCD, the Price River Water Users Association, and the Carbon Water Conservancy District entered into a Compromise Agreement that set forth conditions upon which water rights for both the Scofield Project and the Narrows Project would be established. The 1984 Compromise Agreement established priorities, quantities of flow, storage capacities, location of storage facilities, and points of diversion for these projects. The agreement recognized the above environmental concerns and expressly excluded the Mammoth damsite as a location for project storage facilities. The 1984 Compromise Agreement was a resolution of many years of disagreement between Carbon and Sanpete water interests over the Gooseberry Project. In 1985, the Utah State Engineer approved both the Narrows portion and the Scofield portion of the Gooseberry Project Plan water rights. Both approvals were expressly made subject to terms of the 1984 Compromise Agreement. Thus, no water right is now or likely would be approved in the future for a project constructed at the Mammoth damsite without amendment to the compromise agreement and approval of associated water right changes.

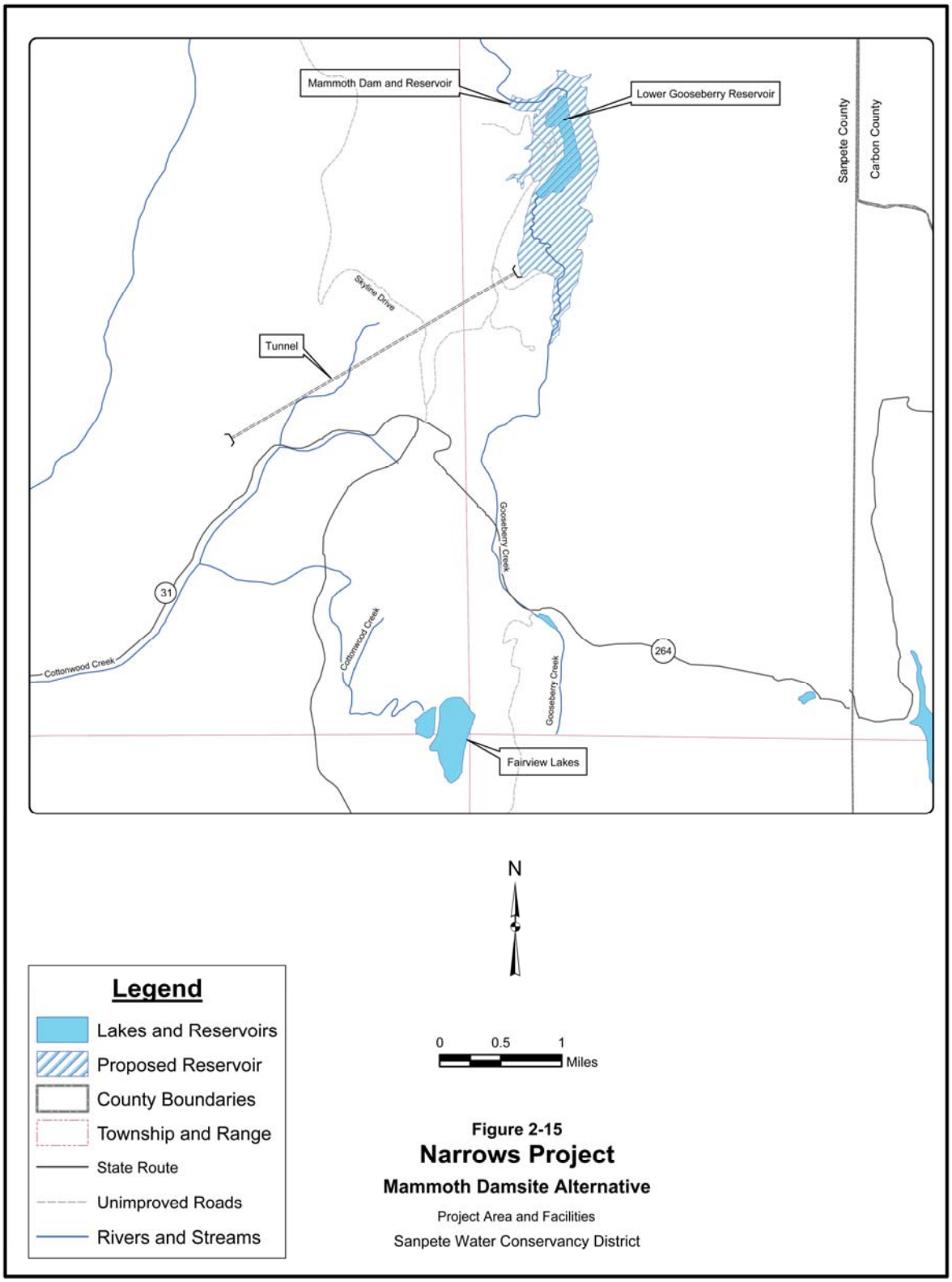


Figure 2-15.—Narrows Project Mammoth Damsite Alternative.

2.3.4.1 Reasons Eliminated from Further Consideration

The Mammoth damsite was specifically eliminated from consideration during negotiations leading to the 1984 Compromise Agreement because the environmental impacts of a project constructed at that location were unacceptable to the Service and UDWR.

The alternative is technically infeasible. The sponsor cannot secure the water rights necessary to establish project water supplies as required by SRPA.

2.3.5 Valley Damsite Alternative

Several alternative damsite locations were evaluated and studied. Because of the topography of many of these alternative damsites and technical difficulties relating to dam length and height as well as storage capacity, only two of the sites were further evaluated. The Valley damsite is the second of the two sites evaluated.

An alternative damsite for the Narrows Dam was evaluated and presented at the public scoping meetings. That dam would be located in the valley upstream of the Narrows damsite (figure 2-16). The dam, having a crest length of about 5,000 feet, would be located upstream of SR-264. The reservoir, with a 4,500-acre-foot capacity, would produce an annual average yield of about 4,376 acre-feet. This alternative would produce only about 82% of the yield of the Proposed Action. The dam and reservoir would be located off stream, so a diversion structure and feeder canal would be required to convey flows from Gooseberry Creek into the reservoir. The rehabilitated Narrows Tunnel would be required to convey project water transmountain into Cottonwood Creek. The East Bench and Oak Creek Pipelines would deliver water to the users. Total estimated cost of this alternative is about $31.1 million.

The reservoir would not have sufficient capacity for any carryover storage. Without the carryover storage, this alternative would not produce any recreation or fish and wildlife benefits; and the alternative would, therefore, be ineligible for grants for these purposes. The applicant would be responsible for the entire cost of the alternative. The lack of eligibility for grants increases the capital cost per acre-foot of yield attributed to the applicant to about 2.1 times the capital cost per acre-foot of yield of the Proposed Action. Based upon SRPA's financial feasibility requirements, the applicant would be eligible for a loan of about $16,900,000 and would be required to provide $7,200,000 in local funds toward project construction. The loan would be repaid in 30 years with annual payments of about $563,000.

In 1984, Reclamation, SWCD, the Price River Water Users Association, and the Carbon Water Conservancy District entered into a Compromise Agreement that set forth conditions upon which water rights for both the Scofield Project and the Narrows Project would be established. The 1984 Compromise Agreement established priorities, quantities of flow, storage capacities, location of storage facilities, and points of diversion for these projects. In 1985, the Utah State Engineer approved both the Narrows portion and the Scofield portion of the Gooseberry Project Plan water rights. Both approvals were expressly made subject to terms of the 1984 Compromise Agreement. This alternative does not conform to the terms of the 1984 Compromise Agreement as to location, storage capacity, or point of diversion. This alternative would not be eligible for an approved water right unless terms of the 1984 Compromise Agreement and the approved water rights were modified.

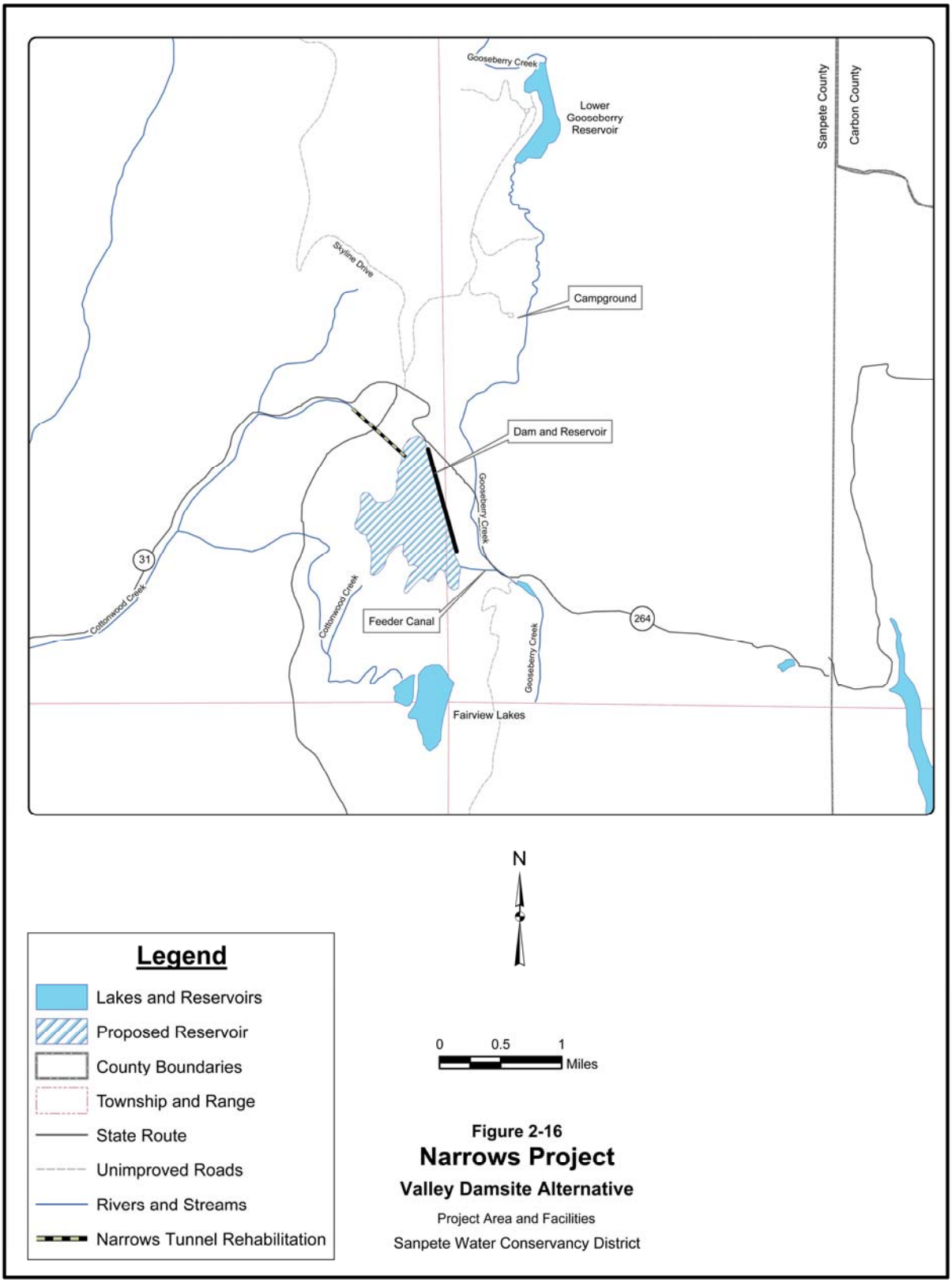


Figure 2-16.—Narrows Project Valley Damsite Alternative.

2.3.5.1 Reasons Eliminated from Further Consideration

The annual cost per acre-foot of yield exceeds the Proposed Action by about 2.1 times, whereas this alternative produces about 18% less yield than the Proposed Action. In addition, the required local cost share exceeds the locally available funds, and the annual repayment exceeds the local repayment capacity.

The average annual yield would be about 18% less than the Proposed Action; whereas, the absence of any carryover storage would mean that this shortage would be felt most severely in an extended drought and would, in that sense, provide virtually no water when it is most needed.

Water rights for this alternative are questionable. Lacking modification to the 1984 Compromise Agreement, the applicant would not be able to secure the water rights necessary to establish project water supplies as required by SRPA. Without an approved water right, the alternative would be technically infeasible and ineligible for SRPA funding. Under Utah law, a change of water right cannot be filed on an approved application to appropriate; a change application can be filed only on a certificated water right, which only can be acquired after the applied-for application has taken place and the water thereunder placed to beneficial use. Moving to another site, such as the Valley damsite, would require abandonment of the existing approved application and establishment of a new one, with a much junior priority date and associated complications relating to the downstream rights on Gooseberry Creek and Scofield Reservoir.

The overall financially feasibility is questionable. Without SRPA funding, the applicant lacks financial resources necessary to construct the project. Other lending institutions likely also would refuse to provide funding if a valid water right could not be established.

The average annual cost of water for this alternative is about 2.1 times greater than the Proposed Action, and this alternative does not eliminate most of the impacts to wetlands and Gooseberry Creek that are objectionable aspects of the Proposed Action

2.3.6 Skyline Mine Alternative

Under this alternative, ground water would be developed in the Flat Canyon area, located east of the proposed Narrows Reservoir basin, by drilling deep wells and pumping the ground water from bedrock. This plan originally was developed and proposed by Canyon Fuel Company, the owner of the Skyline Coal Mine.

On August 16, 2001, coal miners in central Utah's Skyline Mine inadvertently tapped into a saturated sandstone formation. As a result, 4,700 gallons per minute of water began flowing into the mine. The coal company, in turn, spent $6 million on pipe and pumping equipment to remove the water from the mine and drain it into Scofield Reservoir. Additional wells were drilled near Electric Lake and were pumped into the Huntington Creek drainage.

Early investigations performed by the mine identified the water as potentially being a new, potentially unappropriated source from a prehistoric aquifer. The mine developed a theory that if the water was a new source, development of this source would not interfere with any existing water rights—therefore, this ground water could be developed as a new source of water supply. The idea was that the mine would help pay the capital cost of the project if the surrounding counties (Carbon, Emery, and Sanpete) would pay the cost of pumping the water and then use it for a temporary water

supply. The mine would, in turn, benefit by having the ground water levels adjacent to the mine lowered, which would make it economical for Canyon Fuel to mine the remainder of the coal deposit. Some individuals suggested that the water supply developed by this project could be an alternative to the Narrows Project.

However, before the logistics of this alternative could be coordinated among Carbon, Emery, and Sanpete Counties, Utah Power claimed ownership of the water. Utah Power asserted that since the miners had tapped into the aquifer, Electric Lake, owned by Utah Power, began losing 700 acre-feet of water per month.

In discussions with mine officials, Utah Power, water users, and county officials, the State Engineer gave his opinion that it would be difficult, if not impossible, to prove that the water pumped from the mine is unappropriated.

Recently, Canyon Fuel has abandoned the Flat Canyon portion of the mine where the ground water was encountered and has expanded its operations to the north. It has sealed off that portion of the mine and does not have plans to resume mining operations in the Flat Canyon area.

2.3.6.1 Reasons Eliminated from Further Consideration

Preliminary studies performed by Canyon Fuel showed that water developed by the project would be very expensive, even with Canyon Fuel's assistance with capital costs. The project would be cost prohibitive without Canyon Fuel's participation.

The source of the water and the impact on existing water rights has not been established. The State Engineer maintains the position that all water in the area is fully appropriated; without a water right, this alternative is not feasible.

Since it would have provided only a temporary water supply, Sanpete County never considered this project to be a viable alternative.

2.3.7 Year-round Release with Ground Water Exchange and Pumping Alternative

The purpose and intent of this alternative is to avoid impacts to Cottonwood Creek by making releases from the Narrows Reservoir on a year-round basis. Year-round releases would eliminate the need for much higher releases during the latter part of the irrigation season. Water would be released through the Narrows Tunnel and would flow down Cottonwood Creek to the San Pitch River and be stored in Gunnison Reservoir. This water would be exchanged with ground water pumped from wells during the irrigation season.

Under the Ground Water Exchange Alternative, a total of about 50.0 cfs would be required to satisfy project demands. Based on typical hydraulic transmissivity of the alluvial material in the northern Sanpete Valley aquifers, it is estimated that properly engineered wells could produce only about 2.0 to 3.0 cfs each. At this capacity, about 20 wells would be required to deliver the water to the various irrigation companies within the project area. These wells would be located strategically near the existing distribution systems. Under this alternative, the Narrows Reservoir and Tunnel would still be needed. The Upper Cottonwood, East Bench, and Oak Creek Pipelines would be eliminated.

Ground water occurs in northern Sanpete Valley in the unconsolidated alluvial fill

under water table (unconfined) and artesian (confined) conditions. Depth to water ranges from 10 feet in the center of the valley to about 88 feet near the alluvial slopes at the base of the Wasatch Plateau. The hydraulic transmissivity ranges from less than 1,000 square feet per day (ft^2/day) to about 20,000 ft^2/day. Formations with the lowest transmissivity generally are located in the center of the valley. Typical well depths range from about 50 to 500 feet. There are about 55 pumped wells and about 185 flowing wells in the entire Sanpete Valley. Most of the ground water currently is being used for irrigation.

As noted, in addition to the Narrows Reservoir and Tunnel, approximately 20 wells would be required to produce a total capacity of 50.0 cfs. These would be 20-inch-diameter rotary-drilled wells. Because they would be drilled in unconsolidated alluvial fill, the wells would need to be fully cased and screened with gravel packing. The wells would cost about $6.5 million at a cost of approximately $325,000 per well. O&M costs for pumping would be about $52 per acre-foot or $281,000 per year to deliver 5,400 acre-feet. The total estimated cost of this alternative is about $26,632,000 or about 0.85 times the cost of the Proposed Action. However, with the added cost of pumping, the average annual cost for water is about 1.07 times the cost for the Proposed Action.

As noted above, the productivity of the aquifer as reflected by the range in transmissivity varies considerably from location to location throughout the valley. This suggests some risk associated with the site selection and the associated uncertainty as to whether the required flow could be developed with the 20 wells for the estimated cost. In addition, the 20 new, high-capacity wells coupled with the relatively large number of existing wells and low transmissivity in parts of the valley suggest that the potential for interference with other wells would be significant.

Change applications would need to be approved by the State Engineer to exchange the imported water from the Narrows Project to the new wells. Historically, the State Engineer has been reluctant to approve change applications or new applications where there is a possibility of significant interference with existing wells. With the high potential for interference, it is unlikely that extensive changes as proposed by this alternative would be approved by the State Engineer.

An additional alternative configuration would be to implement this alternative without constructing the Narrows Dam and Reservoir, diverting approximately 4,671 acre-feet of water. This configuration is simply a variation of the Year-Round Release Alternative and would suffer from the same deficiencies. Therefore, this configuration has been eliminated from further study for the same reasons as the Year-Round Release with the Ground Water Exchange and Pumping Alternative.

2.3.7.1 Reasons Eliminated from Further Consideration

Technical feasibility of the alternative is uncertain. The range of transmissivity of the aquifer formation introduces significant risk and suggests that more than 20 wells might be required to produce the 50.0-cfs capacity. The potential for obtaining an approved change application is equally uncertain because of the potential for significant interference with existing wells.

The alternative is financially infeasible. Annual costs far exceed the sponsor's repayment capacity and other available resources as needed to maintain eligibility for SRPA funding. Similarly, water right

uncertainties also cloud eligibility for SRPA funding. As with other alternatives, SRPA funding is essential to maintain financial feasibility.

Even though the average annual cost of water for this alternative is about 1.75 times greater than the Proposed Action, this alternative does not eliminate most of the impacts to wetlands and Gooseberry Creek that are aspects of the Proposed Action.

2.3.8 New Ground Water Development

Some suggestions received in scoping meetings proposed developing local ground water sources in lieu of constructing the Narrows Dam and Reservoir. Under this alternative, there would be no need for the Narrows Dam and Reservoir or the pipelines included in the Proposed Action. However, the Narrows Tunnel eventually would need rehabilitation. A total well capacity of about 50.0 cfs would be required to supply project needs. As discussed in the previous alternative, about 20 wells with a capacity of 2.0 to 3.0 cfs would be required. Total cost of the wells would be about $6,500,000; and annual pumping costs would be about $281,000.

This alternative would require approval by the State Engineer. However, the State Engineer considers the ground water aquifer in north Sanpete County to be fully appropriated. Further development of ground water in the area without import would impact existing water rights in downstream locations. In a November 5, 1997, policy memorandum entitled Water Rights Policy, Sevier River Basin Areas 61, 63, 65, 66, 67, 68, and 69, the State Engineer published the following:

> *"As of March 19, 1997, the Sevier River Basin was closed to all new appropriations of ground water. . .. All new ground-water development will be based on the acquisition and changing of existing valid water rights from surface (including direct flow and reservoir storage) and underground sources."*

No new water is available for development of the magnitude required here. The only water that might be made available would be through purchasing existing water rights. Purchasing existing water rights is essentially the same as the proposal to retire irrigated lands, which is discussed subsequently.

2.3.8.1 Reason Eliminated from Further Consideration

This alternative is technically infeasible. No water supply exists for the proposal. Consequently, this alternative does not satisfy the project purpose and need.

2.3.9 New Surface Water Development in Sanpete County Alternative

Several suggestions have been made to expand the use of local streams to satisfy project needs. These suggestions include storing excess spring flows either in a new reservoir built in Sanpete County or using these flows to recharge the ground water basin for later use. Another version of this alternative would be for SWCD to purchase existing water rights to meet its needs. Under this alternative, there would be no need to construct the Narrows Dam and Reservoir or the pipelines included in the Proposed Action. However, the Narrows Tunnel eventually would need rehabilitation.

While it is true that there are excess flows in the local streams during the spring runoff, this water is not available for use in northern Sanpete County. On November 30, 1936, a final decree was entered by Judge LeRoy Cox adjudicating the water and water rights of the Sevier River system. Under the terms of the Cox Decree, all of the waters within the project area, located in the Sevier River drainage, are fully appropriated; and no additional local supplies are available for appropriation or development. Any water, either underground or surface water, in the project area is either fully appropriated by local water right owners or is necessary to satisfy the water rights of downstream appropriators. Thus, no new surface water is available for local development.

Even though the local surface water supplies are fully appropriated, the State Engineer would consider applications to transfer water rights and change points of diversion. To be approved, the change in points of diversion must not adversely impact third party water rights holders. With the complexity of water rights in the Sevier River Basin involving direct and return flows, the possibility of adverse impacts is substantial with almost any conceivable change in points of diversion.

The suggested purchase of water rights and transfer of points of diversion implies that certain irrigated lands would be removed from production with the transfer of the water right. This proposal is essentially the retirement of irrigated lands, which is discussed subsequently.

2.3.9.1 Reason Eliminated from Further Consideration

The alternative is technically infeasible. There is no adequate surface water supply for the project. Consequently, this alternative does not satisfy the project purpose and need.

2.3.10 Central Utah Project Water Alternative

Use of CUP water has been suggested to meet project needs. The CUP originally intended to deliver CUP water to southern Sanpete County, south of the city of Gunnison. It is suggested that this water be made available to northern Sanpete County by exchange or through a new pipeline constructed from the outlet of Syar Tunnel to northern Sanpete County. An exchange is not technically possible. No water could be retained in northern Sanpete County to be exchanged for CUP water. As a result, CUP water would need to be delivered directly from Syar Tunnel.

Under this proposal, 50 cfs of CUP water would be delivered from the outfall of Syar Tunnel through a series of pipes and tunnels using the available pressure head from Strawberry Reservoir. This 38.8-mile-long pipeline would start at Syar Tunnel and end at the mouth of Cottonwood Creek Canyon in Sanpete County. It would require three tunnels and pressure pipe with ratings as high as 750 pounds per square inch.

The hydraulics require a minimum of 48-inch-diameter pipe through the reach between the Syar Tunnel and the outfall of the third tunnel, a length of 116,600 feet. From this point on, the pipeline is reduced to a 36-inch-diameter pipe for an additional 88,300 feet. A total of 13,300 feet of tunnel would be required. Costs were developed using 1987 estimates for steel pipe and tunnels for the CUP and indexing them to April 1994. The total cost for the Syar-Cottonwood Pipeline is estimated to be $146,600,000. This includes the cost of the East Bench Pipeline that still would be required to deliver project water.

To be eligible for funding under terms of the SRPA, total project costs must be under $15 million indexed from 1956 to the present or about $50 million in today's dollars. The total cost of the Syar-Cottonwood Pipeline proposal exceeds the maximum limit by over 2.5 times and is more than 8 times that of the Proposed Action. Thus, the proposal would not be eligible for SRPA funding.

The Central Utah Project Completion Act, which authorized completion of the remaining features of the CUP, placed certain restrictions on delivery of project water. It restricted development of the CUP to the Wasatch Front area of central Utah if certain Utah counties withdrew from the CUP. Since passage of the CUPCA, Millard and Sevier Counties formally have withdrawn from the CUP. As a result, delivery of water to Sanpete County has been dropped from the CUP plan in compliance with the CUPCA.

2.3.10.1 Reasons Eliminated from Further Consideration

The plan is financially infeasible because the proposal does not qualify for SRPA funding, and no other major funding sources are available.

Costs exceed the estimated cost of the Proposed Action by more than eight times.

CUP water cannot be legally delivered to Sanpete County under present law.

2.3.11 Conservation Through Retirement of Irrigation

Retirement of irrigated lands is one method of reducing water shortages where local supplies are inadequate to meet all demands for irrigation water. In practice, certain irrigated lands are retired; and the water is transferred to other irrigated lands. The shortage on the active lands thereby is reduced by some corresponding increment. If storage is available, water originally allocated to the retired lands would be held until needed on the active lands. In the absence of storage, only the existing streamflow allocated to the retired lands would be available for diversion to the active lands. Where snowmelt is the major component of local supplies, flows diminish during the irrigation season. Thus, absent storage, water would be available only for transfer to the remaining active lands when it would normally be applied to the retired land. Since any land that might be considered for retirement is already water short during the mid- to late-summer, little additional water would be available when it is needed most.

It has been suggested that sufficient irrigated lands be retired to reduce the demand by 4,900 acre-feet per year, the amount of irrigation water that would be produced by the Proposed Action. Local water supplies amounting to about 1.78 acre-feet per acre are available in the late irrigation season to lands proposed for retirement. In order to make 4,900 acre-feet of water available to the active lands, about 2,760 acres of land would need to be retired. This represents about 18% of the 15,420 acres of project-eligible lands. Project-ineligible lands normally do not receive water during most of the water-short portion of the growing season, so there would be no advantage in retiring project-ineligible lands.

To achieve this benefit for the lands remaining in production, the lands (18%) removed from production would be taken out of production in their entirety. An 18% reduction of project-eligible farmland is contrary to one of the stated needs for the project. Agriculture is one of the major components of the economy of north Sanpete

County and is seriously impacted by persistent water shortages. Land retirement would not materially improve the overall water supply situation in the project area. It would improve only the water supply for selected farmland, and then only marginally.

It should be noted that the suggested land retirement still would not provide a full water supply to the remaining active lands. To put land retirement in perspective, consider how many acres of land must be retired to provide a full water supply to the remaining active lands. In a typical June when local supplies are still relatively abundant, available local water supplies could supply only the June demands on about 11,900 acres of project-eligible farmland—a reduction of about 3,500 acres from what is now farmed. The typical September demands are considerably lower, but local supplies have also dwindled to the point that they could provide a full water supply only to about 6,000 acres of land—a reduction of about 9,400 acres.

Reduced water shortages on active irrigated lands definitely would provide an incremental improvement in production and yield on those lands. The economic impact of land retirement is detrimental to the local economy and is politically unacceptable to local residents.

Major sources of funding for the proposed project would be from the SRPA and a State loan and grant. However, land retirement is a local land use issue that does not qualify as a water development feature under requirements of the SRPA loan program. Similarly, land retirement does not provide benefits that would be eligible for State funding. Without State and SRPA funding, local funds would be inadequate to retire 2,760 acres of irrigated farmland.

The concept of land retirement also presupposes that there are willing sellers and willing buyers of land, forbearance, or water rights. There seems to be little indication that local farmers are willing to forgo farming on 20% of their irrigated farmland. To the contrary, local farmers appear to be more willing to support the Proposed Action to improve the water supply for their irrigated lands.

The purchase of land or rights for retirement would have to be accomplished either by the project sponsor or by individual farmers. In either case, prospective purchasers most likely would not have the resources to make such extensive land purchases. Land and rights purchases are not eligible for funding under terms of the SRPA, and most banks would not accept idle, nonproductive land as collateral for a bank loan. Further, no buyers have announced any interest in making such purchases. Lacking willing sellers, there may be no equitable or acceptable means for determining which lands would be retired.

2.3.11.1 Reasons Eliminated from Further Consideration

This plan does not meet a stated need for supplemental water supplies to support existing farmland; rather, it proposes taking farmland out of production to reduce the need for supplemental water.

The plan does not qualify for SRPA and State funding. Without these sources of funds, the plan is financially infeasible.

Any water made available for late season irrigation under this proposal would be only that fraction of the water formerly used on retired lands during the late irrigation season; most of the water formerly used on these lands would flow past without being used locally.

2.3.12 Purchase of Sanpete County's Water Rights by Carbon County Water Interests

Scoping comments suggested that Carbon County water interests could purchase Sanpete's rights to Gooseberry Creek water. This would eliminate impacts to Carbon County that would occur as a result of constructing the Narrows Project and diverting Gooseberry Creek water. Since the inception of the Gooseberry Project, this alternative has been available to Carbon County water interests.

2.3.12.1 Reasons Eliminated from Further Consideration

The proposal does not provide any relief from the persistent water shortages that prompted northern Sanpete County water users to pursue developing additional water supplies.

The proposal is infeasible without the presence of both willing sellers and willing buyers.

This plan does not satisfy the stated project purpose and need.

2.3.13 Carbon County Proposed Recharge Alternative

In September 2006, Carbon County proposed an alternative for review consisting of diverting transbasin water through a rehabilitated Narrows Tunnel and down Cottonwood Creek to a proposed ground water recharge aquifer at the mouth of the canyon. The alternative also would include construction of production wells and a delivery system. Following coordination with the Utah State Engineer to verify feasibility of the alternative from a water rights perspective, Sanpete County agreed to an analysis of the alternative overseen by the Central Utah Water Conservancy District. CH2MHill, under contract to the CUWCD, analyzed this alternative and included it in the June 2008 draft update to the *Sanpete County Master Plan*, which was distributed for public review and comment, including a public meeting on June 26, 2008, hosted by CUWCD in Orem, Utah. Following consideration of comments received on the draft plan, the final *Update to the Sanpete County Master Plan* was published in August 2008.

2.3.13.1 Reasons Eliminated from Further Consideration

As indicated on page 20 of the August 2008 *Update to the Master Plan*, this alternative would meet the purpose of and the need for the project, but it is not a feasible option for several reasons:

- It is unlikely that an aquifer with a capacity to hold over 4,000 acre-feet of water could be found in northern Sanpete County.
- Direct diversion of flows would require extensive construction of diversion dams and canals within the reservoir basin, potentially negating the avoidance of impacts by not building the proposed reservoir.
- Water would have to be treated to drinking water standards before injection; or alternately, a large infiltration pond and settling basin, equivalent to a small reservoir, would be required to hold water diverted during spring runoff.

- The nature and location of available aquifers and apparent separation of bedrock and shallow aquifers poses technical problems due to the requirement to inject and remove water from the same aquifer.
- High drawdown from the proposed high capacity wells could affect adjacent wells and water rights

2.4 COMPARISON OF ALTERNATIVES

Table 2-8 compares the closely examined alternatives against the issues associated with the Proposed Action that are outlined in chapter 1. The scientific and analytical basis for these comparisons can be found in chapter 3.

Table 2-8.—Comparison of the Narrows Project Alternatives and the Project Issues

Issues	No Action		Proposed Action		Mid-Sized Reservoir		Small Reservoir	
THREATENED AND ENDANGERED								
Acre-feet depletion from Colorado River system	0		5,491 acre-feet		5,124 acre-feet		4,703 acre-feet	
WILDLIFE	Species	Without Mitigation (with Mitigation)	Species	Without Mitigation (with Mitigation)	Species	Without Mitigation (with Mitigation)	Species	Without Mitigation (with Mitigation)
Change in habitat units for the following species: mule deer, Brewer's sparrow, beaver, Richardson vole, yellow warbler	Mule deer Brewer's sparrow Beaver Richardson vole Yellow warbler	0 (0) 0 (0) 0 (0) 0 (0) 0 (0)	Mule deer Brewer's sparrow Beaver Richardson vole Yellow warbler	-135 (0) -477 (0) -13 (0) -63 (0) -26 (0)	Mule deer Brewer's sparrow Beaver Richardson vole Yellow warbler	-109 (0) -386 (0) -11 (0) -57 (0) -24 (0)	Mule deer Brewer's sparrow Beaver Richardson vole Yellow warbler	-78 (0) -263 (0) -9 (0) -45 (0) -19 (0)
WATER RESOURCES								
Acre-feet of depletion to the Price River drainage	0		5,491 acre-feet		5,124 acre-feet		4,703 acre-feet	
Acre-feet of water available to San Pitch River drainage	0		5,136 acre-feet		4,964 acre-feet		4,710 acre-feet	
FISHERIES								
Instream								
Change in weighted usable area in fish habitat as measured by instream flow incremental methodology for the following life stages:	Preproject		Postproject (Percent Change)		Postproject (Percent Change)		Pos-project (Percent Change)	
▪ Adult	11,932.32		10,958.04	(-8.17)	10,958.04	(-8.17)	10,958.04	(-8.17)
▪ Juvenile	2,623.93		2,312.67	(-11.86)	2,312.87	(-11.86)	2,312.87	(-11.86)
▪ Spawning	69.14		69.91	(+1.11)	69.91	(+1.11)	69.91	(+1.11)
▪ Fry	427.44		373.25	(-12.68)	373.25	(-12.68)	373.25	(-12.68)
Reservoir								
Change in surface area in Scofield Reservoir (average)	0		-290		-284		-258	

Table 2-8.—Comparison of the Narrows Project Alternatives and the Project Issues (Continued)

Issues	No Action	Proposed Action	Mid-Sized Reservoir	Small Reservoir
WATER QUALITY				
Change in Scofield Reservoir Trophic State Index	0	+3.5	+3.5	+3.5
Change in average phosphorus level in Scofield Reservoir based on external phosphorus loading (milligrams per liter)[]	0	0.0026	≈0	≈0
WETLANDS				
Acres of wetlands lost	0 acres (without mitigation) 0 acres (with mitigation)	100 acres (without mitigation) 0 acres (with mitigation)	81 acres (without mitigation) 0 acres (with mitigation)	72 acres (without mitigation) 0 acres (with mitigation)
RIPARIAN AND AQUATIC HABITATS				
Miles of stream lost due to inundation of the reservoir	0	5.3 miles	4.8 miles	4.8 miles
Number of miles of stream affected by flow:				
▪ Increase in flow	0	4.9 miles	4.9 miles	4.9 miles
▪ Decrease in flow	0	16.1 miles	16.1 miles	16.1 miles
RECREATION AND VISUAL				
Change in projected fisherman days in Scofield	0	-6,800	-6,400	-5,800
Increase in developed recreation visitor days at Narrows (including fishing)	0	+46,400	+37,600	+27,800
Increase in dispersed recreation visitor days at Narrows (including fishing)	0	+910	+740	+560
Change in visual quality objective	Partial retention	Partial retention	Partial retention	Partial retention
CULTURAL RESOURCES				
Sites inundated or otherwise impacted	0	3	3	3
SOCIAL AND ECONOMIC				
Number of jobs (Carbon, Sanpete) created during construction	0	50-100	50-100	50-100
Change in farm income	0	11% increase	10% increase	10% increase
Change in available water supply				
▪ Sanpete County	0	+5,318 acre-feet	+5,157 acre-feet	+4,935 acre-feet
▪ Carbon County	0	-439 acre-feet	-457 acre-feet	-457 acre-feet

Table 2-8.—Comparison of the Narrows Project Alternatives and the Project Issues (Continued)

Issues	No Action	Proposed Action	Mid-Sized Reservoir	Small Reservoir
LAND MANAGEMENT/ROW/MINERAL LEASING				
Change in number of AUMs of forage	0	-240 AUMs	-203 AUMs	-166 AUMs
Acres of mineable coal reserves not available for mining	0	0	0	0
PUBLIC SAFETY				
Percent change in the volume of traffic in the project area	0	19% increase	15% increase	11% increase
AIR QUALITY[1]				
Number of days project will exceed National Ambient Air Quality Standards for PM_{10}	0	0	0	0
SLOPES AND CHANNEL STABILITY				
Exceed 50-year channel-forming discharge	0	0	0	0
Lateral and vertical degradation	0	0	0	0
GEOLOGIC HAZARDS				
Known geologic hazards within vicinity of dam and reservoir	3	3	3	3
SOILS				
Acres of new soil disturbance	0	668 acres	547 acres	426 acres
Change in sediment loads in Gooseberry Creek	0	-400 tons	-400 tons	-400 tons
TRACE ELEMENTS				
Increase in levels of select trace elements in ground water	0	0	0	0
INDIAN TRUST ASSETS				
Number of Indian trust assets affected	None	None	None	None
ENVIRONMENTAL JUSTICE				
Number of minority communities disproportionately affected by the Narrows Project	None	None	None	None

[1] Particulate matter of 10 microns in diameter or smaller.

CHAPTER 3

Affected Environment/Predicted Effects

3.0 INTRODUCTION

This chapter discusses the affected environment and predicted effects that would result from the construction, operation, and maintenance of the project features associated with the Proposed Action and alternatives of the Narrows Project. The affected environment discussions describe existing conditions for resources within the project area. The impact analyses focus on potential direct, indirect, total, and cumulative impacts on these resources. Potentially significant impacts, together with criteria developed at the beginning of this study for assessing the significance of potential impacts, are identified. Resource specialists reviewed all data and results of the March 1998 DEIS analysis and updated where appropriate in the SDEIS. Mitigation measures that would reduce or avoid certain adverse impacts or would compensate for some unavoidable adverse impacts also are identified. The final section of this chapter describes the irreversible and irretrievable commitment of resources associated with the Proposed Action.

3.1 THREATENED AND ENDANGERED SPECIES

3.1.1 Affected Environment

No plant species currently receiving protection under the Endangered Species Act are known to exist in the project area.

A biological assessment of potential effects on endangered, threatened, and candidate wildlife and fish species was conducted in October 1991 (three amendments—July 1994, March 1997, and February 1999) for the Narrows Project in accordance with Section 7(c) of the Endangered Species Act of 1973 (appendix C). Federally listed or otherwise protected species addressed in the assessment included: bald eagle (*Haliaeetus luecocephalus*); Colorado pikeminnow, (*Ptychocheilus lucius*); bonytail chub (*Gila elegans*); humpback chub (*Gila cypha*); and razorback sucker (*Xyrauchen texanus*).

The bald eagle, now delisted by the Service, was listed as an endangered species in 1967. Historically, the bald eagle was a resident of Utah but currently occurs primarily as a winter visitant. Of the 10 known historic nest sites (4 sites currently occupied), none are in the vicinity of the proposed Narrows Project.

The Colorado pikeminnow evolved as the main predator in the Colorado River system. Larval pikeminnow measuring less than 40 millimeters (mm) subsist on diets of plankton and macroinvertebrates; pikeminnow between 40 and 80 mm begin to become piscivorus (fish eating); and those measuring more than 80 mm are entirely piscivorus. Fish less than 80 mm are considered larval or young-of-the-year (YOY) fish. The Colorado pikeminnow is the largest cyprinid fish (minnow family) native to North America and, during the predevelopment period, may have grown as large as 6 feet in length and weighed nearly 100 pounds. The Colorado pikeminnow currently occupies about 1,000 river miles in the Colorado River system and is presently found only in the Upper Colorado River Basin above Glen Canyon Dam. Since 1995, as many as 20 adult pikeminnow, 1 in breeding condition, have been caught in the Price River and individually marked. It is

currently unknown whether Colorado pikeminnow use the Price River year round. Colorado pikeminnow have been located in the Price River from April to October. Their known range in the Price River extends from the confluence with the Green River upstream almost 90 miles to the Farnham Diversion near Wellington. Further study is needed to determine the pikeminnow's seasonal use of the Price River and to identify the extent to which pikeminnow use the Price River.

Little is known about the biological requirements of the bonytail chub, as the species greatly declined in numbers in the Upper Colorado River Basin shortly after 1960. Bonytail are considered extremely rare or functionally extirpated from the Upper Colorado River Basin. Occasional captures of *Gila* individuals show bonytail characteristics; however, no known populations exist.

The humpback chub generally does not make migrational movements in the Upper Colorado River and tends to reside throughout the year within a limited reach of river. The species is found in narrow, deep canyon areas and is relatively restricted in distribution, seldom leaving its canyon habitat. None have been found in the Price River.

Historically, the razorback sucker was abundant throughout the Colorado River Basin. At present, the only concentrations occur in the Green River in the upper basin and Lake Mojave in the lower basin. Catch-effort estimates suggest that adult razorback suckers are rarer than other native suckers and the endangered Colorado pikeminnow. An immediate goal for razorback sucker recovery is to prevent the species' extinction in the wild. A draft recovery plan has been developed for the razorback sucker.

The Service wrote to Reclamation, identifying the southwestern willow flycatcher (SWWF) as an additional endangered species present at a site known as Fish Creek, in the proximity of the Narrows Project, and advised Reclamation that an amendment to the biological assessment would be necessary. An amended biological assessment was submitted to the Service on February 5, 1999. A final *Recovery Plan for the Southwestern Willow Flycatcher* was prepared by Region 2 of the Service and signed August 30, 2002.

Based on recent information, the Service "believes that the willow flycatcher found at the Fish Creek site is not the endangered subspecies, the southwestern willow flycatcher." No discussion was offered specifically in reference to the endangered subspecies, *E. t. extimus* from the Service. To date, the following information was used to identify the subspecies:

- The willow flycatcher subspecies inhabiting the riparian corridor in the proposed Narrows Project proximity is located at the extreme northern boundary of *E. t. extimus* but within the range of *E. t. adastus*, an unlisted species. Experts suggest that the central part of the State of Utah is more likely an area of intergradation between *E. t. extimus* and *E. t. adastus* (Behle, 1985).
- Research data confirms that this willow flycatcher population is not likely the endangered *E. t. extimus* subspecies but is more likely to be *E. t. adastus* (Eben Paxton et al., 2008). In 2000, Eben Paxton finalized a thesis covering this work entitled "Molecular Genetic Structuring and Demographic History of the Willow Flycatcher."
- Vocalization analysis has determined the population to be *E. t. adastus* (personal communication, Dr. Jim Sedgwick, spring 1999). However, these results have yet to be published or peer reviewed.

3.1.1.1 Conservation Species

The scientific name of the Columbia spotted frog, as it is now known, has been changed to *Rana luteiventris* based on recent genetic analyses conducted by Green et al. (1977). The distinct population that occurs in the San Pitch drainage is part of what is known as the Wasatch Front population. A conservation agreement was signed by Reclamation as well as others. Subsequently, on April 2, 1998, the Service removed the Wasatch Front population from the candidate species list. The San Pitch drainage site, located near Fairview, was surveyed for spotted frog in 1991–92 and again in 1997. In 1991–92, the estimated number of breeding individuals in the population was 108; while in 1997, the estimate was 48 individuals.

Specifically within the project boundaries, two spotted frogs were found near Oak Creek at the northern terminus of the proposed water delivery pipeline. Reclamation and the project applicant will cooperate in implementing the measures prescribed in the *Spotted Frog Conservation Agreement and Strategy*.

A *Conservation and Management Plan for Three Fish Species in Utah* was published September 2006. This document was developed to prevent the Federal listing of three Utah State sensitive species. These are roundtail chub (Gila robusta), bluehead sucker (Catostomus discobolus), and flannelmouth sucker (Catostomus latipinnis).

These species historically occupied the Price River. Roundtail chub have been extirpated from the river. Bluehead sucker and flennelmouth sucker exist in the river below the Farnham Diversion Dam, which acts as a barrier to upstream fish migration. This diversion is located approximately 3 miles southeast of Wellington, Utah, in Carbon County.

3.1.2 Methodology and Impact Indicators

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

The importance of the Green River (and its tributaries) to rare and endangered fish was established by the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin and recognized by many biologists as noted in the recovery plans for each of the species. The Service has identified water, physical habitat, and biological environment as the primary constituent elements of critical habitat. This includes a quantity of water of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species.

Important habitat requirements for the SWWF include space for individual and population growth; food, water, air, light, minerals, or other nutritional or physiological needs; cover or shelter; sites for breeding, reproduction, and rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical or ecological distribution of the species.

The impact indicator for this issue is acre-feet of water depleted from the Colorado River system. This indicator is critical for the Colorado endangered fish species and is a key habitat requirement for the SWWF.

3.1.3 Predicted Effects

3.1.3.1 No Action Alternative

There would be no endangerment to the bald eagle, Colorado pikeminnow, bonytail chub, humpback chub, razorback sucker, or the SWWF under the No Action Alternative. Contributions to the Recovery Program would not be required.

3.1.3.2 Proposed Action Alternative

Project impacts to threatened or endangered species were evaluated by Reclamation in a biological assessment and submitted to the Service. Subsequently, the Service issued a final biological opinion on August 24, 2000, (appendix C) that found that the proposed project would have no effect upon the bald eagle, which was subsequently delisted in 2007. The Service believes that the willow flycatcher found at the Fish Creek site is not the endangered subspecies; therefore, no discussion was offered specifically in reference to the SWWF. The Service concluded, however, that the project and associated depletion of water from the Colorado River system may affect the four endangered Colorado River fishes. While the opinion concluded that the proposed project may affect the four endangered fishes, it also stated that the project is not likely to jeopardize their continued existence, provided measures are implemented to offset project impacts (i.e., payment of a one-time financial contribution by SWCD to the RIP). The current depletion charge is $18.29 per acre-foot (2009 figure); and when multiplied by the project's 5,597-acre-foot average, annual depletion of flows to the Colorado River system amounts to a financial contribution of $102,369 to the RIP. The Service will notify SWCD of the current depletion charge by September 1 each year. On July 13, 1995, SWCD made a partial payment of $7,063, 10 percent of the total depletion charge as identified in the January 9, 1995, Biological Opinion.

Reliance on the RIP to serve as the reasonable and prudent alternative for project impacts is dependent upon sufficient progress toward recovery being made by the RIP. In the event sufficient progress is not made by the RIP, re-initiation of consultation would be required. Payment of the depletion charge would be made by SWCD prior to beginning construction.

Initially, the Service issued a biological opinion in March 1992. Consultation was re-initiated in 1994 as a result of the Service's designation of critical habitat for the four endangered Colorado River fishes and again in 1995 after new information arose about the presence of Colorado pikeminnow in the Price River. The Service issued a biological opinion in January 1995, an amended biological opinion in October 1995, a biological opinion on December 13, 1999, and the final biological opinion on August 24, 2000, which addresses project impacts to designated critical habitat and the Price River. As an element of the reasonable and prudent alternative to the Narrows proposal, the Recovery Program was directed under the 2000 biological opinion to fund a study to determine seasonal endangered fish use in the Price River and develop recommendations for year-round instream flow requirements in the Price River for Colorado pikeminnow. The Recovery Program has completed field investigations to address this element of the reasonable and prudent alternative and is planning to release a summary of flow requirements for internal committee review and approval during autumn 2009.

Because the project would result in a depletion of water to the Price River and reduced spills from Scofield Reservoir, there is, at this time, some uncertainty about what effect the project would have on the timing,

duration, and magnitude of flows in the portion of the Price River used by Colorado pikeminnow. Further study of the extent to which pikeminnow use the Price River and other tributaries is needed before conclusions can be made regarding the importance of Price River flows in recovery. If flow recommendations are approved and implemented, further study may be necessary to assess response of endangered fish over a range of hydrologic conditions.

Reduced flows to Fish Creek, as a result of the Narrows Project, may affect SWWF through reduction in availability of tall, thick stands of willows and reduction of standing water and saturated soils, both typical components of their breeding habitat.

During the critical growing season, seedling establishment of willows can be reduced or eliminated from a riparian system if flows are reduced to such an extent that gravel bars and other likely seed nursery sites are no longer wetted. Seedling establishment is the primary means of willow regeneration and, at the proposed project elevation and latitude, occurs in early July through late August. The average annual depletion to Fish Creek is 18%. Depletions are highest in May (18%), June (24%), July (13%), August (16%), and September (17%). Stage changes of the above levels, because they occur during the growing season, are large enough to potentially cause severe impediment of willow seedling establishment.

As stated earlier, there is no Service-designated or proposed critical habitat for the SWWF in Utah; therefore, there is no adverse modification of existing or proposed critical habitat.

3.1.3.3 Mid-Sized Reservoir Alternative

There would be a 5,298-acre-foot-per-year depletion to the Colorado River, which could affect the Colorado pikeminnow, bonytail chub, humpback chub, and razorback sucker.

Incidental take of Colorado pikeminnow, humpback chub, bonytail chub, or razorback sucker is not anticipated under this alternative, nor would it be authorized.

It was assumed that the same criteria applied to the Proposed Action to offset project depletion impacts could be applied proportionately to the Mid-Sized Reservoir Alternative. This would result in a one-time contribution of $96,900 (5,298 acre-feet multiplied by 2009 depletion charge of $18.29) to the Recovery Program. Other conservation measures described for the Proposed Action also would be implemented under this alternative.

Under the provisions of the Endangered Species Act, there would be no irreversible impacts to endangered species as a result of implementing the Mid-Sized Reservoir Alternative. In the event sufficient progress is not achieved under the RIP, re-initiation of consultation would be required to discuss additional conservation measures.

The impacts to the SWWF under the Mid-Sized Reservoir Alternative would be the same as those under the Proposed Action.

3.1.3.4 Small Reservoir Alternative

There would be a 4,841-acre-foot-per-year depletion to the Colorado River that could affect the Colorado pikeminnow, bonytail chub, humpback chub, and razorback sucker.

Incidental take of Colorado pikeminnow, humpback chub, bonytail chub, or razorback sucker is not anticipated under this alternative, nor would it be authorized.

It was assumed that the same criteria applied to the Proposed Action to offset project depletion impacts could appropriately be applied to the Small Reservoir Alternative.

This would result in a one-time contribution of $88,542 (4,841 acre-feet multiplied by 2009 depletion charge of $18.29) to the Recovery Program. Other conservation measures described for the Proposed Action also would be implemented under this alternative.

Under provisions of the Endangered Species Act, there would be no irreversible impacts to endangered species as a result of implementing the Small Reservoir Alternative. In the event sufficient progress was not achieved under the RIP, re-initiation of consultation would be required to discuss additional conservation measures.

The impacts to the SWWF under the Small Reservoir Alternative would be the same as with the Proposed Action but proportionately reduced.

3.1.4 Conservation Species Impacts

The spotted frog is not a federally listed species. However, potential project impacts to the species have been considered. A survey of historic spring and wetland habitat along the San Pitch River was conducted, and spotted frogs were found to be present within the project area. Increased flows in the San Pitch River associated with any of the construction alternatives of the project could benefit the springs and wetlands that comprise spotted frog habitat along the San Pitch River by increasing water quantity. On the other hand, if spotted frog habitat receives return flows from irrigation, habitat quality could be diminished by virtue of the conservation measures. If a construction alternative is implemented, the net effect of the project, together with the conservation measures, would likely be a slight net reduction dispersed over a large area.

Three fish species, including roundtail chub, bluehead sucker, and flannelmouth sucker, are Utah State-listed sensitive species. Although roundtail chub historically inhabited the Price River, they have been extirpated from the system. The bluehead sucker and the flannelmouth sucker exist in the Price River below the Farnham Diversion Dam, which is approximately 3 miles southeast of Wellington, Utah. This structure effectively eliminates upstream fish migration. Reaches of the Price River below this structure are a significant distance from the Proposed Narrows Dam. Effects to flows associated with this project would be attenuated to the point of insignificance as measured at the Farnham Diversion Dam. Therefore, the proposed project would have no effect on these fish species.

3.2 WILDLIFE

3.2.1 Affected Environment

The wildlife species found in the general project area are common in the Great Basin Desert valleys and Rocky Mountain Range. There are about 364 species of terrestrial vertebrates that may inhabit the project area. Approximately 88 bird species and 33 mammal species may use the habitats that would be disturbed by the proposed project.

3.2.2 Methodology and Impact Indicators

The method used to evaluate the project is known as the Habitat Evaluation Procedure—a “species habitat” approach to impact assessment and habitat quality. The program uses selected species as indicators to evaluate habitat for a host of other species, assuming that these indicator (evaluation) species are functioning units of part of an ecosystem. Impacts to a particular indicator species assume that there also would be impacts to the group of the species it represents.

Habitat Suitability Indices (HSI) were ascertained for each evaluation (indicator) species. These indices range from 0.0 to 1.0 with each increment of change identical to the next. An HSI value is linearly related to the carrying capacity of the species. An HSI of "1.0" would represent the optimum habitat for the particular evaluation species, whereas "0.0" would represent habitat that is unsuitable.

Evaluation species chosen to assess the impacts to habitat of the proposed project included: mule deer, beaver, Richardson vole, yellow warbler, and Brewer's sparrow. The Brewer's sparrow was used because of the vegetative community it represented, not for the species. It was determined that the Brewer's sparrow would reflect summer range needs for deer, elk, and other species as well as the sparrow. These wildlife species and the communities that they utilize are described below.

- **Mule Deer –** Deer are of great public interest in the area and are plentiful in the reservoir area. The project area provides excellent summer range, and areas surrounding the reservoir basin and aspen forest are critical in summer because of fawning.
- **Beaver –** The beaver is able to use a wide variety of wetlands habitat and is found at two different locations within the proposed reservoir basin.
- **Richardson Vole –** The vole utilizes much of the wetland habitat in the area. These voles live primarily in moist areas with high densities of grasses and sedges.
- **Yellow Warbler –** The yellow warbler also utilizes the wetland habitats in the area but does not use the same grassy habitat as the vole. The warbler occurs in the deciduous shrub/scrub wetlands and also is found in high abundance at the reservoir site.
- **Brewer's Sparrow –** This sparrow nests and forages in the sagebrush, and this allows the evaluation to take the shrub habitat into consideration.

The impact indicator for vegetation and wildlife is the change in habitat units for the indicator species listed above. Habitat units are based on the quantity and quality of the various vegetation types used as habitat for the species.

3.2.3 Predicted Effects

3.2.3.1 No Action Alternative

The baseline conditions within the reservoir basin are summarized under the No Action Alternative in table 3-1. Wildlife habitat conditions are expected to remain the same as baseline conditions if the project were not constructed and if there were no other future developments. Because there are no impacts, no mitigation would be provided.

3.2.3.2 Proposed Action Alternative

Table 3-1 summarizes the impacts to wildlife habitat that would result from construction of the Proposed Action. In an assumed worst-case situation where the most habitat would be lost at one time, it would take the reservoir 2 years to fill to capacity. The *1994 Fish and Wildlife Coordination Act Report* evaluates the impacts of the proposed Narrows Project on fish and wildlife resources and recommends appropriate mitigation (see appendix D).

In addition to the 604 acres of habitat inundated by the reservoir, there would be an additional 32 acres lost due to SR-264 relocation, of associated forest development roads, and of the recreation area construction.

Table 3-1.—Comparison of Wildlife Habitat Losses Within Narrows Reservoir Basin (Without Mitigation)

Species	Cover Type(s)[1]	No Action Alternative			Proposed Action			Mid-Sized Reservoir Alternative			Small Reservoir Alternative		
		Acres	HSI[2]	HU[3]	Acres	HSI[2]	HU[3]	Acres	HSI[2]	HU[3]	Acres	HSI[2]	HU[3]
Mule deer	PEM, PSS, USHE	0	0.23	0	587	0.23	135	475	0.23	109	341	0.23	78
Beaver	PEM, PSS	0	0.13	0	100	.013	13	81	0.13	11	72	0.13	9
Richardson vole	PEM	0	1.00	0	63	1.00	63	51	1.00	51	45	1.00	45
Yellow warbler	PSS	0	0.70	0	37	0.70	26	30	0.70	24	27	0.70	19
Brewer's sparrow	USHE	0	0.98	0	487	0.98	477	394	0.98	386	269	0.98	264

[1] PEM = Palustrine emergent wetland cover (herbaceous wetlands); PSS = palustrine scrub/shrub cover (shrubby wetlands); and USHE = shrub cover (Vasey sagebrush; silver sagebrush).

[2] A HSI of "1.0" represents the optimum habitat; whereas "0.0" represents unsuitable habitat.

[3] Habitat Unit = Habitat availability.

These areas are primarily mule deer and Brewer's sparrow habitat.

Temporary impacts would result from construction of the Upper Cottonwood Creek, Oak Creek, and East Bench Pipelines and from development of the rockfill material source area. These areas would be recontoured, covered with topsoil, and revegetated with native plant species after construction. Implementing the fishery and wildlife mitigation measures would increase the amount of wildlife habitat affected by the Proposed Action to a total of about 1,931 acres of land. Species benefitting by the mitigation measures would include mule deer, beaver, Richardson vole, yellow warbler, and Brewer's sparrow.

Analyses were performed comparing the habitat units available with and without the proposed project. As mentioned previously, if the Narrows Dam were constructed, a mitigation plan would be implemented to compensate for wetlands and upland communities impacted by reservoir inundation.

Alternative wetland mitigation measures for the Proposed Action were described in chapter 2. The proposed wetland mitigation areas are in kind, and a detailed mitigation plan would be developed in conjunction with the Clean Water Act Section 404 permitting process. In determining the exact acreage to be provided, careful monitoring of the mitigation sites would be conducted to ensure that the value of the mitigation sites is at least equal to the value of the wetlands lost. This determination would be accomplished by performing HEP analyses of the sites and comparing habitat values. Because plants require time to become fully established, it is anticipated to take 6 years from the time construction is initiated to achieve the desired wildlife habitat for the wetland mitigation.

To accommodate the loss of habitat for mule deer and Brewer's sparrow if the Narrows Reservoir were constructed, additional mitigation measures would be implemented. Impacts to upland game (mule deer and Brewer's sparrow habitat and the host of species that they represent) would be mitigated in the following ways:

- Acquisition of conservation easements around Narrows Reservoir. The conservation easements would be in the name of the United States. These easements would include restrictions on land use that would benefit impacted species. This measure would serve to protect wildlife values adjacent to the

reservoir and minimize impacts that would occur if the land were developed.

- Acquisition of private or State School Trust land adjacent to the Price River below Scofield Reservoir. Wildlife values would be enhanced by fencing the land to protect it from livestock grazing. The primary objective of this measure would be to protect mule deer habitat. The lower Fish Creek acquisition would protect both summer and winter range, depending on which side of the canyon is acquired. South facing slopes provide winter range in early winter and mild winters. The area would provide riparian and fishery habitat. The wetland mitigation area near Scofield Reservoir also would provide habitat for mule deer.

A wildlife mitigation program has been designed to provide at least full mitigation for each impacted species.

A monitoring program would be implemented on a yearly basis using qualitative and quantitative sampling methods to monitor the progress of the mitigation plans. At the end of the predicted time, when it is assumed that full mitigation should be achieved, the areas would be sampled using the same techniques that were used to gather the baseline information. Statistical comparisons would be made. If full mitigation standards are not achieved, steps would be taken to ensure that the goals are eventually met.

Because the wetland and upland wildlife mitigation measures are intended to provide full mitigation for project impacts, there would be no residual impacts.

3.2.3.3 Mid-Sized Reservoir Alternative

Table 3-1 summarizes the impacts to wildlife habitat that would result under the Mid-Sized Reservoir Alternative. Permanent impacts caused by SR-264 relocation and construction of the recreation area would be the same as with the Proposed Action. Temporary impacts due to construction of pipelines and development of material source areas also would be the same.

Implementing the wildlife mitigation measures would increase the amount of wildlife habitat on about 1,680 acres of land. Benefited species would include mule deer, beaver, Richardson vole, yellow warbler, and Brewer's sparrow.

Under the Mid-Sized Reservoir Alternative, wetland and upland wildlife habitat mitigation measures would be similar to those described under the Proposed Action, except that the amount of acreage would be smaller, as described in chapter 2. The proposed wetland mitigation areas are in kind, and a detailed mitigation plan would be developed and designed in conjunction with the Section 404 permitting process.

Because the wetland and upland wildlife mitigation measures are intended to provide full mitigation for project impacts, there would be no residual impacts.

3.2.3.4 Small Reservoir Alternative

Table 3-1 summarizes the impacts to wildlife habitat that would result under the Small Reservoir Alternative. Permanent impacts caused by SR-264 relocation and construction of the recreation area would be the same as with the Proposed Action. Temporary impacts due to construction of pipelines and development of material source areas also would be the same.

Implementing the wildlife mitigation measures would increase the amount of wildlife habitat on about 1,510 acres of land. Benefited species would include mule deer, beaver, Richardson vole, yellow warbler, and Brewer's sparrow.

Under the Small Reservoir Alternative, wetland and upland wildlife habitat mitigation measures would be similar to those described under the Proposed Action, except that the amount of acreage would be smaller, as described in chapter 2. The proposed wetland mitigation areas are in kind, and a detailed mitigation plan would be developed and designed in conjunction with the Section 404 permitting process.

Because the wetland and upland wildlife mitigation measures are intended to provide full mitigation for project impacts, there would be no residual impacts.

3.3 WATER RESOURCES

3.3.1 Affected Environment

Gooseberry Creek and its three unnamed tributaries are located high in the Price River drainage. This tributary of Fish Creek flows directly into Scofield Reservoir (see the location map at the front of this document). Other tributaries to Scofield Reservoir include Mud Creek and Pondtown Creek. The Price River, which flows out of Scofield Reservoir, is a tributary of the Green River—a tributary of the Colorado River. These three rivers are all located in the Colorado River Basin.

Cottonwood Creek, located in the San Pitch River Basin, is located on the opposite side of the divide from Gooseberry Creek.

Cottonwood Creek and the San Pitch River are located in the Sevier River subbasin of the Great Basin.

Typical of Wasatch Mountain streams, flows in these creeks are greatest in the spring, when snowmelt runoff is peaking. Peak flows during May and June are estimated to range from 15 to over 100 cfs in Upper Gooseberry Creek near the proposed damsite. The flow declines considerably in late summer and reaches a minimum in late fall or winter. Late-season flows are estimated to be 1.5 to 5 cfs in Upper Gooseberry Creek.

The average annual natural runoff volume of Upper Gooseberry Creek, near the proposed damsite, is 9,032 acre-feet. Of this amount, an average of 1,815 acre-feet presently is stored in Fairview Lakes and diverted transmountain to Cottonwood Creek through the Narrows Tunnel. The remaining water continues down Gooseberry Creek to Fish Creek. An average of 35,800 acre-feet per year enters Scofield Reservoir from Fish Creek. The total annual inflow to Scofield Reservoir from all tributaries averages 57,500 acre-feet. The average total contents of Scofield Reservoir are about 42,360 acre-feet. All of these values are for the 1960–2002 hydrologic period.

The Price River below Scofield Reservoir, referred to as lower Fish Creek, has a wide range of flows that vary according to downstream water demands and hydrologic conditions. Releases consist of direct flow right bypasses and Scofield Reservoir storage deliveries for Scofield Project users. Spills occur when the reservoir is full and water flows over the spillway or when releases are made in excess of downstream demands. These total releases and spills have averaged 51,815 acre-feet for 1960–2002 but historically have varied from 13,762 to 154,475 acre-feet. Low flow conditions generally occur from November through March. There are no minimum flow requirements in the Price River, and it is not unusual for the flow below the dam to be completely shut off during winter months. Peak flows below the dam occur in wet years when the reservoir spills. While normal dam releases in June are about 150 cfs, the total releases with these spills have ranged up to more than 1,100 cfs. Since spills are in excess of downstream consumptive use requirements, they usually increase river

flows throughout the lower Price River to the confluence with the Green River. From 1960–2002, the reservoir filled and spilled 17 times. This indicates that, on the average, the reservoir historically has spilled about every 2 to 3 years.

About 25 miles downstream from Scofield Reservoir near the small community of Heiner, the average annual flow of the Price River is about 81,000 acre-feet based on 1935–81 data. Within 5 miles of Heiner, numerous diversions from the river occur. The largest diversion is the head of the Carbon and Price Wellington Canals, located about 1.5 miles south of Spring Glen. Except during high water conditions when the flow of the river exceeds the capacity of the canals, the river is essentially dry below this diversion. In addition to irrigation water, winter flows also are diverted for stock watering.

Irrigation return flows in this area discharge back to the river, and the flow of the river increases after passing through the Price-Wellington area. Near its confluence with the Green River, the average annual flow of the river is 94,929 acre-feet, based on 1960–92 records. The stream gauging station on the Price River at Woodside was discontinued in September 1992 and renewed in July 2000.

As mentioned previously, Cottonwood Creek, located in the San Pitch River Basin, has typical flow conditions as compared with other streams in the area with one noted exception. After spring runoff flows subside in late May or early June, natural flows are supplemented with releases from Fairview Lakes. These releases are made through an existing transmountain tunnel. Flows from Fairview Lakes are used by the Cottonwood-Gooseberry Irrigation Company (CGIC) as a source of supplemental irrigation water in the Fairview area. These supplemental releases generally occur in July and August. The historic average annual flow volumes at the tunnel outlet and the mouth of Cottonwood Creek have been 2,055 and 8,600 acre-feet, respectively.

3.3.2 Methodology and Impact Indicators

Impacts to water resources were determined by using six distinct and detailed operation studies, which simulate streamflows and reservoir operations under historical, future without project, and project conditions. All studies are based on hydrologic data from 1960–2002. While these operation studies originally were prepared by Franson Noble Engineering, contractors for the loan applicants, they have been reviewed carefully and revised by Reclamation. These revisions primarily involved reconciling the State of Utah, U.S. Geologic Survey, and Reclamation flow data below Scofield Dam using daily flow records. Operation studies then were rerun, and output graphs and tables were revised. These operation studies are briefly described as follows:

- **Scofield Reservoir Historical Operation Study –** This study simulates the historical operation of Scofield Reservoir and is used to calculate ungauged inflow to the reservoir.
- **Scofield Reservoir Demand Study –** This study was performed to segregate the outflow from Scofield Reservoir to separate the releases for downstream demands from the spills and operational releases (releases made in anticipation of a large spill or releases not needed for downstream demands). The study also segregates the bypass of direct flow water rights from releases from storage.
- **Future Without Project Operation Study –** This study shows the flows of Gooseberry and Fish Creeks and the Price

River below Scofield Dam and the operation of Scofield Reservoir under the future without Narrows Project conditions. These conditions are the same as the No Action Alternative. Demands identified in the Scofield Reservoir Dam and Study are used to operate Scofield Reservoir. Controlled releases from storage are limited to the 30,000-acre-foot water right, which does not include bypasses for direct flow rights.

- **Future with Narrows Project Operation Study –** This study shows the flows of Gooseberry and Fish Creeks and the Price River below Scofield Dam and the operation of Scofield Reservoir under the Proposed Action. Transmountain releases to Cottonwood Creek also are modeled.
- **Mid-Sized Reservoir Alternative Operation Study –** This study is similar to the Future with Narrows Project Operation Study, except that it is based on the Mid-Sized Reservoir Alternative instead of the Proposed Action.
- **Small Reservoir Alternative Operation Study –** This study is similar to the Future with Narrows Project Operation Study, except that it is based on the Small Reservoir Alternative instead of the Proposed Action.

Impact indicators for water resources were previously identified in chapter 1, including the following:

- Acre-feet of depletion to the Price River drainage
- Acre-feet of water available to the San Pitch River drainage

3.3.3 Predicted Effects

3.3.3.1 No Action Alternative

Under the No Action Alternative, streamflows would remain as they are. There would be no depletion of water from the Price River drainage. Water supplies would remain at present levels; however, water shortages in northern Sanpete County would be reduced by about 11,200 acre-feet per year with continued implementation of water conservation measures.

There would be no streamflow mitigation measures under the No Action Alternative because there would be no project-induced impacts.

There would be no residual impacts to water resources under the No Action Alternative.

3.3.3.2 Proposed Action Alternative

Operation of the Narrows Project would affect streamflows in Gooseberry Creek, Fish Creek, Price River, Green River, Colorado River, Cottonwood Creek, and about 3 miles of the San Pitch River. Table 3-2 provides a comparison of average monthly streamflows under the four project alternatives evaluated. Monthly streamflow data were used to develop this table because reliable daily streamflow data were not available.

Impacts to Lower Gooseberry Creek and Fish Creek would occur primarily during the spring snowmelt period as water is stored in Narrows Reservoir for release later in the summer. Impacts to Lower Gooseberry Reservoir would consist of reduced inflow. However, the effect would be negligible because the reservoir is not operated as a storage reservoir. As a result, the outflow would be reduced in the same proportion as the inflow would be reduced. Impacts to Scofield Reservoir would be in the form of reduced inflows, resulting in a lowering of

Table 3-2.—Average Monthly Streamflow Comparison (cfs)

Month	Proposed Action			Mid-Sized Reservoir Alternative			Small Reservoir Alternative			No Action Alternative		
	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)
Gooseberry Creek at Proposed Narrows Damsite												
October	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.2	5.3	1.7
November	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.6	3.9	1.5
December	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.6	4.6	0.8
January	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.4	2.6	1.0
February	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	2.6	1.2
March	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	2.8	1.2
April	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.9	5.8	5.4
May	5.9	81.0	5.9	5.9	84.1	5.9	1.0	88.2	1.0	49.8	106.0	17.9
June	8.4	100.5	1.0	28.1	101.3	1.0	38.7	102.3	1.0	67.8	105.0	6.9
July	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	7.9	15.3	3.3
August	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.4	6.7	1.6
September	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.5	4.8	1.0
Gooseberry Creek Below Lower Gooseberry Reservoir												
October	2.9	5.8	2.4	2.9	5.8	2.4	2.9	5.8	2.4	4.1	10.2	3.0
November	3.1	5.9	2.2	3.1	5.8	2.2	3.1	5.9	2.2	3.8	8.8	2.7
December	3.2	5.4	2.1	3.2	5.4	2.1	3.2	5.4	2.1	3.8	9.0	1.9
January	3.6	6.2	2.1	3.5	6.2	2.1	3.6	6.2	2.1	4.0	7.8	2.1
February	3.7	6.1	2.2	3.7	6.1	2.2	3.7	6.1	2.2	4.1	7.6	2.4
March	3.7	5.2	2.3	3.7	5.2	2.3	3.7	5.2	2.3	4.2	7.0	2.6
April	4.6	6.4	6.5	4.6	6.4	6.5	4.6	6.4	6.5	7.5	11.2	10.9
May	38.2	174.3	0.8	38.2	177.4	0.8	33.3	181.4	0.9	82.1	199.3	12.9
June	32.7	157.4	3.9	52.4	158.2	3.9	63.0	159.2	3.9	92.1	162.0	9.8
July	5.9	9.9	1.5	5.9	9.9	1.5	5.9	9.9	1.5	12.8	24.1	3.8
August	5.6	4.9	1.4	5.6	4.9	1.3	5.6	4.9	1.3	10.0	10.7	2.0
September	3.9	3.6	1.9	3.9	3.6	1.9	3.9	3.6	1.9	6.4	7.4	1.9
Fish Creek Above Scofield Reservoir												
October	9.4	18.9	7.6	9.4	18.9	7.6	9.4	18.9	7.6	10.6	23.3	8.2
November	9.5	17.3	7.9	9.5	17.3	7.9	9.5	17.3	7.9	10.2	20.2	8.4
December	8.4	15.6	7.5	8.4	15.6	7.5	8.4	15.6	7.5	9.1	19.2	7.3
January	9.1	16.3	5.5	9.1	16.3	5.5	9.1	16.3	5.5	9.5	17.9	5.6
February	10.6	19.0	5.3	10.6	19	5.3	10.6	19.0	5.3	11.1	20.6	5.5
March	14.1	17.3	5.4	14.1	17.2	5.4	14.1	17.3	5.4	14.6	19.1	5.7
April	17.8	43.7	24.5	17.8	43.6	24.5	17.8	43.7	24.5	20.7	48.5	29.0
May	211.7	616.3	11.4	211.7	619.4	11.4	206.8	623.4	6.5	255.6	641.3	23.5
June	171.4	361.3	8.5	191.1	362.1	8.5	201.7	363.1	8.5	230.8	365.8	14.4
July	29.6	51.4	4.6	29.6	51.3	4.6	29.6	51.4	4.6	36.5	65.7	6.8
August	17.6	21.6	3.5	17.5	21.6	3.5	17.6	21.6	3.5	22.0	27.4	4.1
September	12.2	17.3	3.5	12.2	17.2	3.5	12.2	17.3	3.5	14.7	21.0	3.5

Table 3-2.—Average Monthly Streamflow Comparison (cfs) (continued)

Month	Proposed Action			Mid-Sized Reservoir Alternative			Small Reservoir Alternative			No Action Alternative		
	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)
Price River Below Scofield Dam												
October	49.5	204.0	26.9	49.4	210.4	26.9	49.5	204.0	26.9	49.5	204.0	26.9
November	13.8	15.0	11.4	13.8	15.0	11.4	13.8	15.0	11.4	13.8	15.0	11.4
December	15.0	0.0	9.1	15.0	0.0	9.1	15.0	0.0	9.1	15.0	0.0	9.1
January	5.4	0.0	8.0	5.4	0.0	8.0	5.4	0.0	8.0	5.4	0.0	8.0
February	5.5	0.0	7.1	5.5	0.0	7.1	5.5	0.0	7.1	5.5	0.0	7.1
March	5.1	15.0	5.8	5.1	15.0	5.8	5.1	15.0	5.8	5.1	15.0	5.8
April	4.7	74.4	27.7	4.7	74.3	27.7	4.7	74.4	27.7	4.7	74.4	27.7
May	0.0	646.2	111.6	0.0	648.2	111.6	0.0	653.3	111.6	59.2	733.5	111.6
June	186.0	941.3	52.6	211.3	940.4	52.6	211.7	943.1	52.6	316.1	945.8	52.6
July	212.7	278.8	63.2	212.3	278.3	63.2	212.7	278.8	63.2	212.7	278.8	63.2
August	94.0	126.2	39.1	93.9	126.0	39.1	94.0	126.2	39.1	94.0	126.2	39.1
September	177.5	132.4	22.0	177.2	132.2	17.6	177.5	132.4	22.0	177.5	132.4	22.0
Price River at Confluence of White River												
October	50.9	207.4	27.5	50.9	207.4	27.5	50.9	207.4	27.5	50.9	207.4	27.5
November	14.8	17.8	12.1	14.8	17.8	12.1	14.8	17.8	12.1	14.8	17.8	12.1
December	17.1	2.4	9.2	17.1	2.4	9.2	17.1	2.4	9.2	17.1	2.4	9.2
January	7.1	2.0	8.0	7.1	2.0	8.0	7.1	2.0	8.0	7.1	2.0	8.0
February	7.1	2.8	7.1	7.1	2.8	7.1	7.1	2.8	7.1	7.1	2.8	7.1
March	7.1	18.7	5.9	7.1	18.7	5.9	7.1	18.7	5.9	7.1	18.7	5.9
April	9.3	86.2	30.0	9.3	86.2	30.0	9.3	86.2	30.0	9.3	86.2	30.0
May	33.4	730.6	113.0	33.4	730.6	113.2	33.4	730.6	113.0	92.5	817.7	113.0
June	214.3	970.5	52.7	240.0	970.5	52.8	240.0	970.5	52.7	344.2	975.1	52.7
July	218.9	289.1	63.2	218.9	289.1	63.3	218.9	289.1	63.2	218.9	289.1	63.2
August	97.5	131.3	39.1	97.5	131.3	36.4	97.5	131.3	36.4	97.5	131.3	39.1
September	179.2	135.7	22.0	179.2	135.7	4.5	179.2	135.7	8.9	179.2	135.7	22.0
Price River at Woodside												
October	45.4	399.1	39.4	45.4	399.1	39.4	45.4	399.1	39.4	45.4	399.1	39.4
November	38.8	112.2	31.7	38.8	112.2	31.7	38.8	112.2	31.7	38.8	112.2	31.7
December	46.0	96.5	34.2	46.0	96.5	34.2	46.0	96.5	34.2	46.0	96.5	34.2
January	33.0	69.4	20.0	33.0	69.4	20.0	33.0	69.4	20.0	33.0	69.4	20.0
February	47.5	71.8	20.0	47.5	71.8	20.0	47.5	71.8	20.0	47.5	71.8	20.0
March	71.8	35.0	26.8	71.8	35.0	26.8	71.8	35.0	26.8	71.8	35.0	26.8
April	109.5	396.2	16.8	109.5	396.2	16.8	109.5	396.2	16.8	109.5	396.2	16.8
May	269.6	1,568.0	21.6	269.6	1,568.0	21.8	269.6	1,568.0	21.6	328.7	1,655.2	21.6
June	333.0	1,054.0	3.8	358.7	1,054.0	3.9	358.7	1,054.0	3.8	463.0	1,058.5	3.8
July	105.3	271.3	120.2	105.3	271.3	120.3	105.3	271.3	120.2	105.3	271.3	120.2
August	295.2	276.4	32.3	295.2	276.4	29.6	295.2	276.4	29.6	295.2	276.4	29.6
September	71.2	192.0	21.0	71.2	192.0	3.5	71.2	192.0	7.9	71.2	192.0	8.4

Table 3-2.—Average Monthly Streamflow Comparison (cfs) (continued)

Month	Proposed Action			Mid-Sized Reservoir Alternative			Small Reservoir Alternative			No Action Alternative		
	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)
Fairview Tunnel at Outlet												
October	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0
November	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0
December	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0
January	2.0	2.0	2.0	2.0	2.0	1.2	2.0	2.0	2.0	0.0	0.0	0.0
February	2.0	2.0	2.0	2.0	2.0	0.2	2.0	2.0	1.2	0.0	0.0	0.0
March	2.0	2.0	2.0	2.0	2.0	0.2	2.0	2.0	0.2	0.0	0.0	0.0
April	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
May	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
June	4.0	11.8	8.8	0.2	0.2	0.2	0.2	0.2	0.2	3.7	11.6	8.6
July	45.3	45.0	43.4	30.6	32.6	43.0	30.6	32.6	25.5	14.7	12.3	0.3
August	43.5	45.5	33.1	30.1	29.2	18.2	30.1	29.2	0.0	13.3	16.3	0.2
September	17.3	24.9	0.2	15.8	14.6	0.0	15.8	14.6	0.0	1.6	10.3	0.1
Cottonwood Creek at Mouth of Canyon												
October	3.3	5.1	3.1	3.3	5.1	3.1	3.3	5.1	3.1	1.3	3.1	1.1
November	3.6	5.0	3.3	3.6	5.0	3.3	3.6	5.0	3.3	1.6	3.0	1.3
December	3.4	4.8	3.2	3.4	4.8	3.2	3.4	4.8	3.2	1.4	2.8	1.2
January	3.4	4.7	3.0	3.4	4.7	2.2	3.4	4.7	3.0	1.4	2.7	1.0
February	3.6	4.6	3.2	3.6	4.6	2.2	3.6	4.6	2.4	1.6	2.6	1.2
March	4.0	4.7	3.3	4.0	4.7	1.5	4.0	4.7	1.5	2.0	2.7	1.3
April	3.7	8.1	3.2	3.7	8.1	3.2	3.7	8.1	3.2	3.7	8.1	3.2
May	45.0	117.1	4.9	44.8	117.1	4.9	44.8	117.1	4.9	45.0	117.1	4.9
June	46.7	63.5	12.8	42.9	51.9	4.2	42.9	51.8	4.2	46.4	63.2	12.6
July	49.4	53.5	44.6	34.7	20.9	44.2	34.7	41.1	26.8	18.8	20.9	1.6
August	46.0	49.2	34.0	32.6	32.9	19.1	32.6	32.9	0.9	15.9	20.0	1.1
September	19.1	27.9	1.1	17.6	17.6	0.9	17.5	17.6	0.9	3.3	13.3	1.0
San Pitch River Below Cottonwood Creek Confluence[1]												
October	31	33	22	31	33	22	31	33	22	29	31	20
November	+2	+2	+2	+2	+2	+2	+2	+2	+2	n/a	n/a	n/a
December	+2	+2	+2	+2	+2	+2	+2	+2	+2	n/a	n/a	n/a
January	+2	+2	+2	+2	+2	+2	+2	+2	+3	n/a	n/a	n/a
February	+2	+2	+2	+2	+2	+2	+2	+2	+2	n/a	n/a	n/a
March	+2	+2	+2	+2	+2	+2	+2	+2	+0	n/a	n/a	n/a
April	49	63	58	49	63	58	49	63	58	49	63	58
May	73	113	51	73	113	51	73	113	51	73	113	51
June	80	109	32	76	97	23	76	97	23	80	109	32
July	79	98	25	64	65	25	64	86	25	79	98	25
August	74	88	24	61	72	24	61	72	24	74	88	24
September	73	80	23	72	70	23	71	70	23	73	80	23

[1] Based on historical diversion records. Streamflow records are not available at this location. Actual streamflows for wet year may have been higher than indicated by diversion records. No data for winter flows is available. November–March values indicate changes from No Action flows.

average reservoir storage. Impacts to regulated releases from Scofield Reservoir for Scofield Project use would occur only during multiple successive drought years, such as occurred in the early 1960s, 1990s, and 2000s. Impacts to the Price, Green, and Colorado Rivers would result primarily in reduced spills from Scofield Reservoir.

The impacts of the Narrows Project on water resources are most pronounced near the reservoir. About 1 mile of Upper Gooseberry Creek and 4.3 miles of small streams in the proposed reservoir basin would be inundated by the reservoir. In addition, annual flows in the middle 3 miles of Gooseberry Creek between Narrows Reservoir and inflow into Lower Gooseberry Reservoir would be reduced by about 74%. Under the Proposed Action, a 1.0-cfs minimum flow would be made from Narrows Reservoir to Gooseberry Creek to provide a 1.5-cfs minimum flow at the USDA Forest Service campground ⅛ mile downstream from the proposed damsite. If the 1.5-cfs flow at the campground is not met, up to an additional 0.25 cfs would be released from the reservoir to meet the required flow. Minimum streamflow releases from Narrows Reservoir would eliminate periodic dry stream channels in the Middle Gooseberry Creek segment. An average of 300 acre-feet per year also would be released for channel maintenance or other instream flow purposes.

Flows in Cottonwood Creek would increase during the irrigation season, with the import of project water through Narrows Tunnel. However, during the irrigation season, these flows would be less than peak flows that occur naturally during the spring snowmelt period. The Upper Cottonwood Creek Pipeline would convey these increased flows outside the stream channel between the tunnel outlet and the confluence with Left Hand Fork. About 300 feet below the Left Hand Fork confluence, the project flows would be discharged to the stream. At this point, the increase in average July and August flows from current conditions would be about 200%.

Depletions to the Price River drainage would average 5,597 acre-feet per year. This amount would consist of 5,227 acre-feet of transbasin diversions and 370 acre-feet of increased evaporation in the Price River Basin. When measured in Gooseberry Creek below Narrows Reservoir, the reduction in annual streamflow varies between 1,760 and 10,200 acre-feet, depending on the storage level of Narrows Reservoir and the magnitude of the streamflow into the reservoir. As shown in table 3-2, the greatest impact would occur during the spring snowmelt runoff period. Releases from Narrows Reservoir to Gooseberry Creek would remain at a minimum of 1.0 cfs; and when the reservoir is spilling or when flushing releases are made, the flow would be greater.

As a result of constructing Narrows Reservoir, the operation of Scofield Reservoir would be altered within the normal historic range. Scofield Reservoir would operate at a lower level with implementing the Proposed Action as shown in figure 3-1. Under project conditions, the average total contents of Scofield Reservoir would be reduced from about 42,360 acre-feet to about 31,500 acre-feet. Average reduction in storage releases to irrigators in the Price area would be about 753 acre-feet per year. Total depletions to the Price River drainage would average 5,597 acre-feet per year. Both the volume and frequency of spills from the reservoir would be reduced. With the No Action Alternative, the average reservoir surface area would be reduced from 2,370 acres to about 2,125 acres. This is about a 10% reduction or about 245 acres of the surface area of the No Action Alternative.

Since Scofield Reservoir would operate at a lower level, there is an increased potential for the reservoir to be drained to the bottom of its

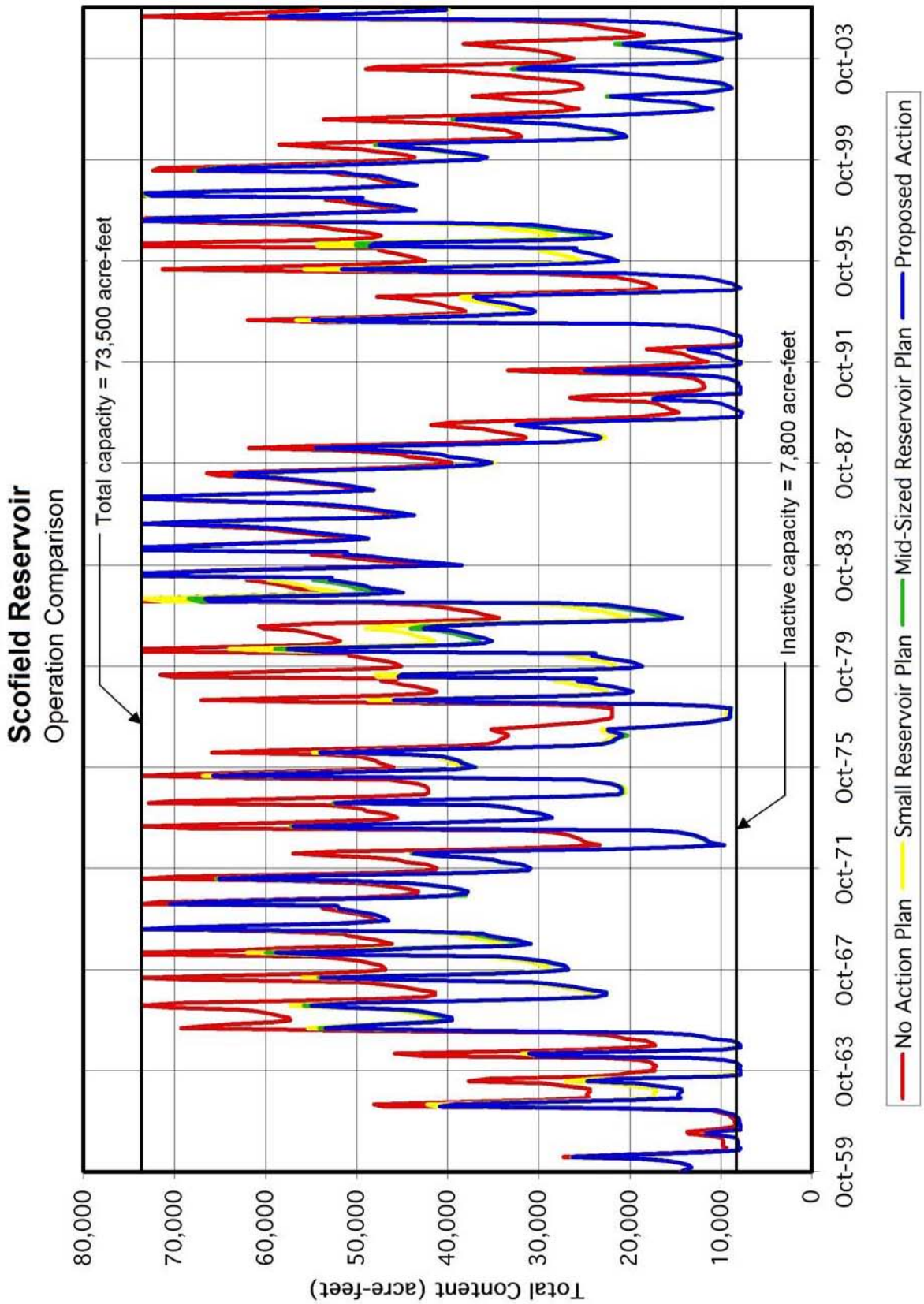


Figure 3-1.—Scofield Reservoir Operation Proposed Action.

active storage. The frequency of this occurrence increases from 3 times in 43 years for the No Action Alternative to 12 times in 43 years with the Proposed Action. An example of this type of problem occurred during 1992. The lowest water surface elevation at Scofield Reservoir that year was 7,587 feet with a reservoir active capacity of 1,102 acre-feet. A major concern was that the reduced water level would lower water temperature, causing ice to form on the lake. This caused the potential for a blockage at the site of the old dam near the middle of the reservoir, not allowing water to pass from the upstream portion of the reservoir to the dam. Channel improvements and an electrical system to prevent freezing around the outlet structures were put in place. Other measures also were put on standby in case reservoir levels dropped lower. The crises were finally averted by restricting reservoir releases, rationing irrigation water, eliminating the use of water for lawns and yards, and monitoring water tank levels downstream in Carbon County. While such drought periods are not frequent, they do have significant impacts and would occur more often with implementing the proposed project.

During most years, controlled releases from Scofield Reservoir to meet Scofield Project demands would remain unaltered. This was the case in 77% of the years in the model simulation. However, under prolonged drought conditions, irrigation releases from Scofield Reservoir would be reduced due to lack of water in the reservoir. These reductions occurred in 10 of the 43 simulated years. Reductions for the 1960–2002 period averaged about 753 acre-feet or about 3% of the historical release from storage; whereas during drought periods, the reductions were much larger, as in 1992, when reductions would have been 8,346 acre-feet or 20% of the average annual historical release from storage.

The Proposed Action would impact only storage releases. Direct flow rights would be unaffected by the project.

It should be noted, however, that the above reductions in storage releases are based on the 73,500-acre-foot Scofield Reservoir, which was enlarged specifically to accommodate the Gooseberry Project (Narrows Project). Without this enlargement and the associated water rights agreements, the usable capacity of Scofield Reservoir would have remained at 30,000 acre-feet. As part of the reservoir enlargement, 7,800 acre-feet of inactive capacity was added to provide a minimum pool for fish habitat. An additional 35,700 acre-feet of active capacity was included to facilitate developing the remainder of the Gooseberry Project Plan without impacting water supplies in Carbon County. In conjunction with the reservoir enlargement, the Carbon County water interests signed an agreement that they would operate the reservoir according to the Gooseberry Project Plan.

If the reservoir capacity had remained at 30,000 acre-feet without the Narrows Project, the storage releases would have been reduced by an average of 2,253 acre-feet as a result of these same drought cycles, which is about 5% of the average annual supply. These reductions would have occurred in 19 of the 43 years simulated, with the largest single-year reduction being over 15,809 acre-feet, about 60% of the average annual storage release. Therefore, the reductions in current Scofield Reservoir storage caused by the Narrows Project would be less, in fact, than the reductions that would have occurred without the enlargement of Scofield Reservoir and the associated water right agreements; Scofield Reservoir water users realize a significant net benefit from the Narrows Project.

Figure 3-2 provides a comparison of the operation of Scofield Reservoir under the No Action Alternative and a simulated operation of the reservoir had it not been enlarged to accommodate the Gooseberry Project Plan. Figure 3-2 also shows that there would be no minimum pool for fishery in Scofield Reservoir had it not been enlarged. Downstream from Wellington, where most of the significant diversions occur on the lower Price River, the effects of the Narrows Project would be much different from those predicted near the Narrows Reservoir. In this stretch of river, Scofield Reservoir controls about 35% of the annual flow. High spring flows characteristic of unregulated hydrographs are contributed by undammed tributaries downstream from Scofield Dam, but spills from Scofield Dam are still the controlling factor in high spring flows.

Flow reductions in the Price River and the Colorado River downstream due to the Narrows Project would occur primarily as a result of decreased spills out of Scofield Reservoir. These effects are illustrated in figure 3-3, which displays average monthly flows of the Price River at Woodside under the No Action Alternative and the Proposed Action. This figure is based on data from 1960–92. The gauge on the Price River at Woodside was discontinued in September 1992 and renewed in July 2000. The frequency of spills decreases from 42 to 12% in the years simulated. As seen in figure 3-3, spills in very large runoff years, such as 1983–86, would not be greatly affected; rather, it is the spills in moderate runoff years that would be affected most.

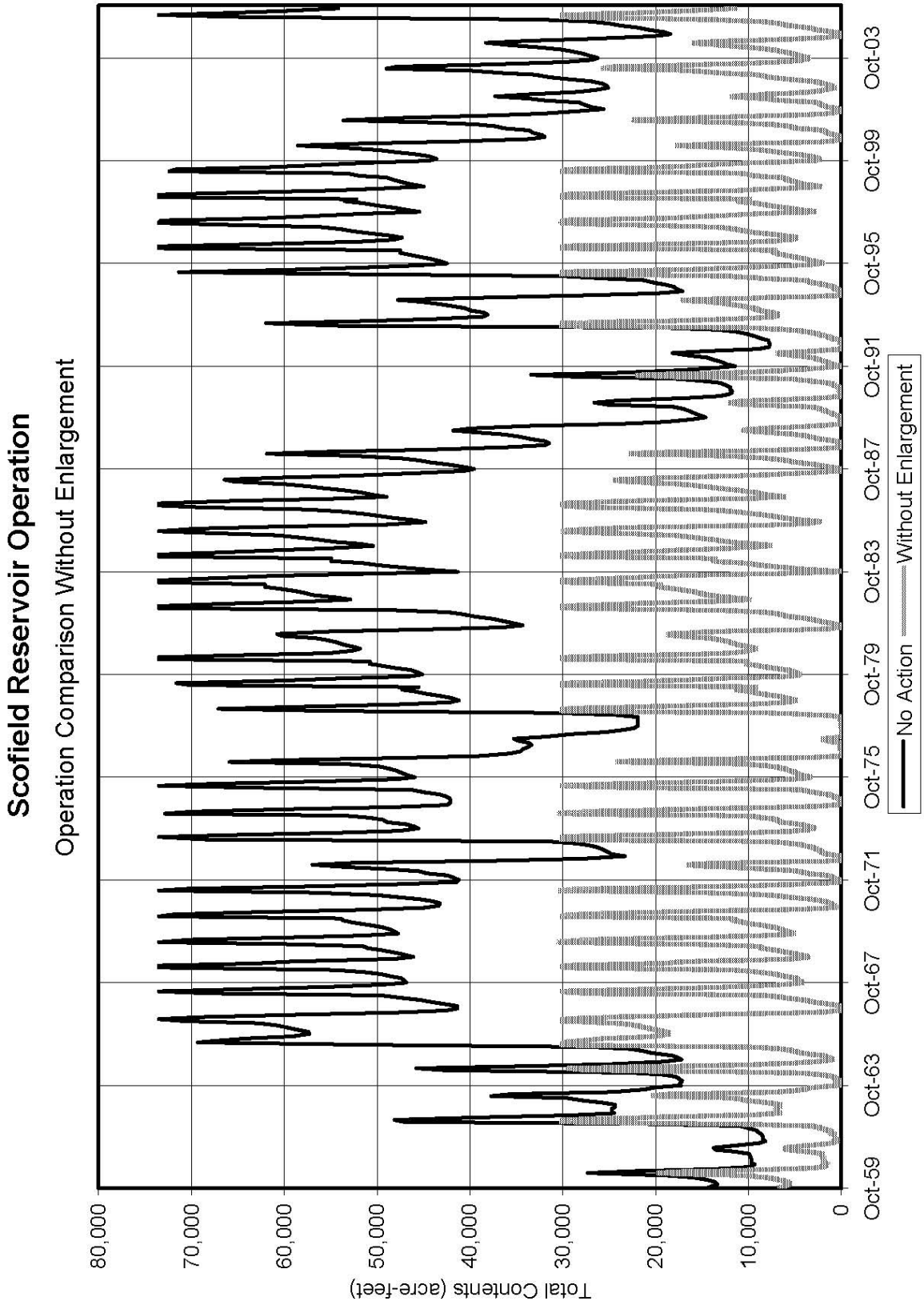
Releases through the Narrows Tunnel would increase under the Proposed Action. In comparison to the natural base flow and the existing channel capacity in Cottonwood Creek, the percent increase in flow due to project releases is reduced as the flow travels downstream. Most of the project water that would be released to Cottonwood Creek during the irrigation season would be diverted by an existing diversion structure near the mouth of Fairview Canyon for use along the east bench area of northern Sanpete Valley. Winter releases would be stored in Wales Reservoir, to the extent of available storage capacity, and would be used on project lands closer to the San Pitch River.

About 1,820 acre-feet of additional return flow to the San Pitch River would result from the Narrows Project, entering the river at various locations between Fairview and Chester and most likely then would be re-diverted from the river by other downstream water users within a short distance after entering the river. The river would continue to be dry-dammed at several locations during irrigation season.

Construction of the Upper Cottonwood Creek Pipeline would convey project releases outside the creek and would prevent degradation of the stream channel. Winter flows of 2.0 cfs in the upper reach of Cottonwood Creek and summer flows of 2.0 cfs in the lower reach of Cottonwood Creek also would be provided.

Under the Proposed Action, water supplies in the San Pitch River Basin would increase by an average of 5,227 acre-feet per year due to releases from Narrows Reservoir. Irrigation water shortages would be reduced to about 10,878 acre-feet per year or about 21.1% of the diversion demand.

In summary, the residual impacts (after mitigation) of the Proposed Action include the inundation of 1.0 mile of Gooseberry Creek and 4.3 miles of unnamed tributaries. Flows in Gooseberry Creek below Narrows Reservoir, Fish Creek, and the Price River would be reduced as shown in table 3-2. The flow in Cottonwood Creek below the confluence with Left Hand Fork would be



Graph based on monthly data.

Figure 3-2.—Scofield Reservoir Operation Comparison Without Enlargement.

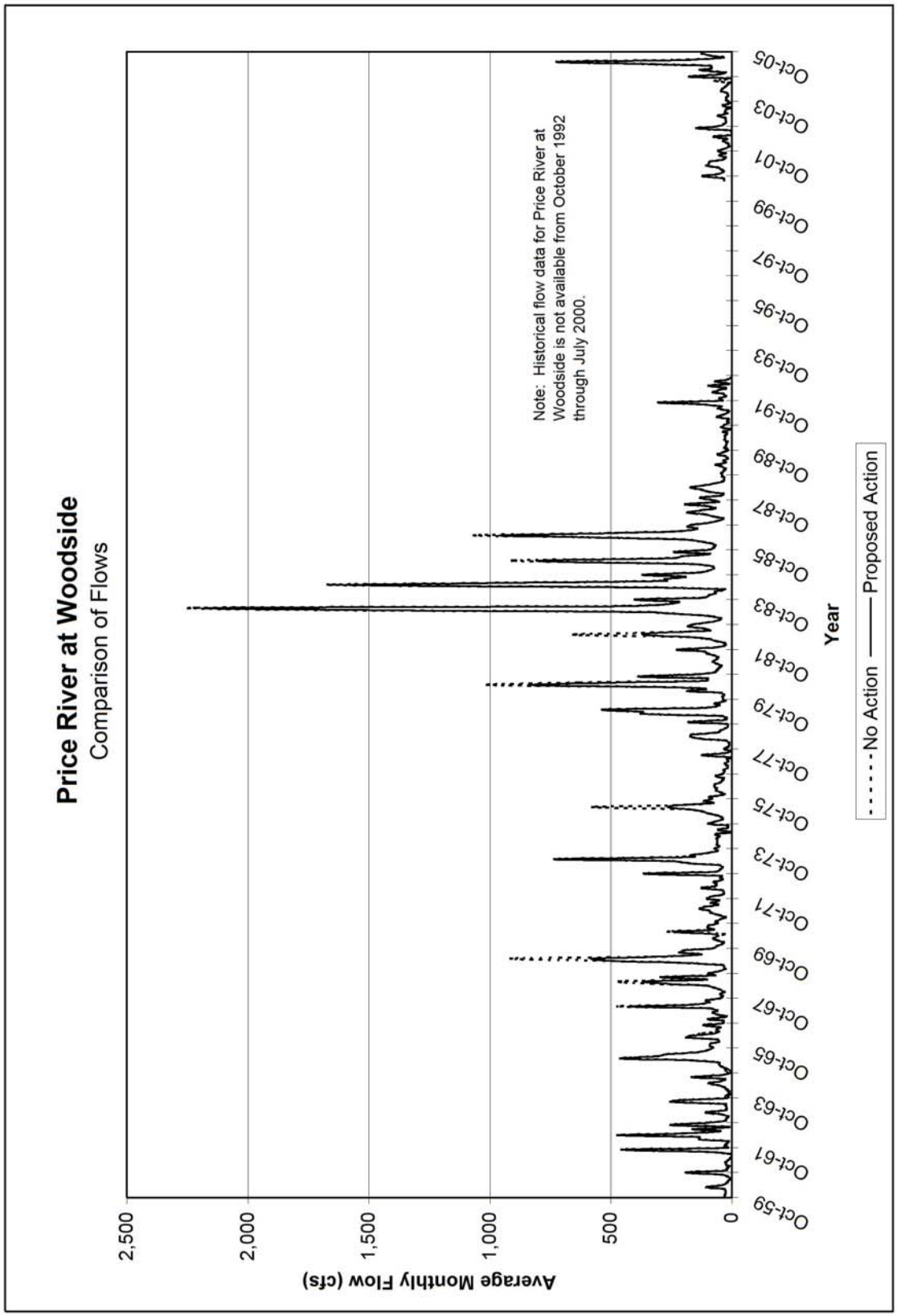


Figure 3-3.—Scofield Reservoir Operation Comparison, Price River at Woodside.

increased during the nonrunoff portions of the irrigation season. Scofield Reservoir would operate at a lower level in most years, and reductions in storage releases to irrigators in the Price area would occur only after several successive years of drought and would average about 753 acre-feet per year. However, on the average, these reductions would be about 1,500 acre-feet less than the reductions that would have occurred if Scofield Reservoir had not been enlarged to accommodate the Gooseberry Project (Narrows Project).

3.3.3.3 Mid-Sized Reservoir

The impacts to water resources under the Mid-Sized Reservoir Alternative would be similar to those resulting from construction of the Proposed Action. About 1 mile of Upper Gooseberry Creek and 4.0 miles of small streams in the proposed reservoir basin would be inundated. Because Narrows Reservoir would be smaller, it would spill more often, causing higher flows in certain years in Gooseberry and Fish Creeks in May and June. Because of the smaller reservoir, in drought years, there would not be enough water stored to meet the maximum transbasin diversion of 5,400 acre-feet. The long-term, average transbasin diversion to the San Pitch River drainage would be 5,095 acre-feet. During those years, the flow in Cottonwood Creek would be lower, and project shortages would be greater. These differences in streamflows are shown in table 3-2.

As shown in figure 3-1, Scofield Reservoir Operation Comparison, Scofield Reservoir would operate at a slightly higher level than it would under the Proposed Action. The average contents would consist of about 32,084 acre-feet. Average reductions in storage releases to irrigators in the Price area would be about 753 acre-feet per year. Total depletions to the Price River drainage would average 5,298 acre-feet per year, rather than the 5,597 acre-feet under the Proposed Action.

Streamflow mitigation measures under the Mid-Sized Reservoir Alternative would be the same as those described for the Proposed Action.

Under the Mid-Sized Reservoir Alternative, water supplies in the San Pitch River Basin would increase by an average of 5,095 acre-feet per year due to releases from Narrows Reservoir. Irrigation water shortages would be reduced to about 11,027 acre-feet per year or about 21.2% of the diversion demand.

In summary, the residual impacts of the Mid-Sized Reservoir Alternative would be similar to those of the Proposed Action, except that slightly fewer miles of stream would be inundated, and Scofield Reservoir would operate at a slightly higher level. Annual reductions in storage releases to irrigators in the Price area would occur only after several successive drought years and would average 753 acre-feet per year.

3.3.3.4 Small Reservoir Alternative

The impacts to water resources under the Small Reservoir Alternative would be similar to those resulting from construction of the Proposed Action. About 1 mile of Upper Gooseberry Creek and 3.8 miles of small streams in the proposed reservoir basin would be inundated. Because Narrows Reservoir would be smaller, it would spill more often, causing higher flows in certain years in Gooseberry and Fish Creeks in May and June. Because of the smaller reservoir, in drought years, there would not be enough water stored to meet the maximum transbasin diversion of 5,400 acre-feet. The long-term average transbasin diversion to the San Pitch River drainage would be 4,815 acre-feet. During those years, the flow in Cottonwood Creek would be lower, and project shortages

would be greater. These differences in streamflows are shown in table 3-2.

As shown in figure 3-1, Scofield Reservoir Operation Comparison, Scofield Reservoir would operate at a slightly higher level than under the Proposed Action. The average contents would be about 33,049 acre-feet. Average reductions in storage releases to irrigators in the Price area would be about 732 acre-feet per year, rather than 753 in the Proposed Action. Total depletions to the Price River drainage would average 4,841 acre-feet per year as compared to 5,597 acre-feet under the Proposed Action and 5,298 acre-feet under the Mid-Sized Alternative.

Streamflow mitigation measures under the Small Reservoir Alternative would be the same as those described for the Proposed Action, with the exception that no year-round flows would be provided in the tributaries to Gooseberry Creek above the proposed Narrows Reservoir site, and no flushing flows would be provided to Gooseberry Creek.

Under the Small Reservoir Alternative, water supplies in the San Pitch River Basin would increase by an average of 4,815 acre-feet per year due to releases from the proposed Narrows Reservoir. Irrigation water shortages would be reduced to about 11,290 acre-feet per year or about 21.8% of the diversion demand.

The residual impacts of the Small Reservoir Alternative would be similar to those of the Proposed Action, except that slightly fewer miles of stream would be inundated, and Scofield Reservoir would operate at a slightly higher level. Annual reductions in storage releases to irrigators in the Price area would occur only after several successive drought years and would average about 21 acre-feet less than under the Proposed Action (i.e., 732 acre-feet, rather than 753 acre-feet as in the Proposed Action).

3.4 FISHERIES

3.4.1 Affected Environment

Most of the Narrows Project alternatives have the potential to affect aquatic resources in Gooseberry Creek, Fish Creek, three unnamed headwater tributaries to Gooseberry Creek, Cottonwood Creek, Lower Gooseberry Reservoir, Fairview Lakes, and Scofield Reservoir (see the location map). Cottonwood Creek is in the San Pitch River Basin, whereas all of the others are in the Price River drainage. Cottonwood Creek flows into the San Pitch River downstream from Fairview, Utah; but the San Pitch River, within the project area, does not support a sport fishery because of low summer flows.

Flows in Gooseberry Creek, its unnamed tributaries, and Cottonwood Creek presently are affected by the operation of Fairview Lakes, which store water during spring runoff. Water from the lakes is delivered during the irrigation season via one of the unnamed tributary streams and a canal to the Narrows Tunnel that discharges into Cottonwood Creek. The released water then is diverted for irrigation in Sanpete County.

Lower Gooseberry Creek and Fish Creek downstream from the confluence with Gooseberry Creek also are affected by the operation and limited regulation offered by Fairview Lakes. If the project is approved, an operating agreement would have to be negotiated between SWCD and CGIC to regulate seasonal releases from Fairview Lakes in connection with downstream discharges from the Narrows Reservoir.

Aquatic resources vary considerably between the different reservoirs and stream segments that could be affected by the Narrows Project. Fish habitat study reaches are shown in figure 3-4. A summary of aquatic resources present in the different stream segments and

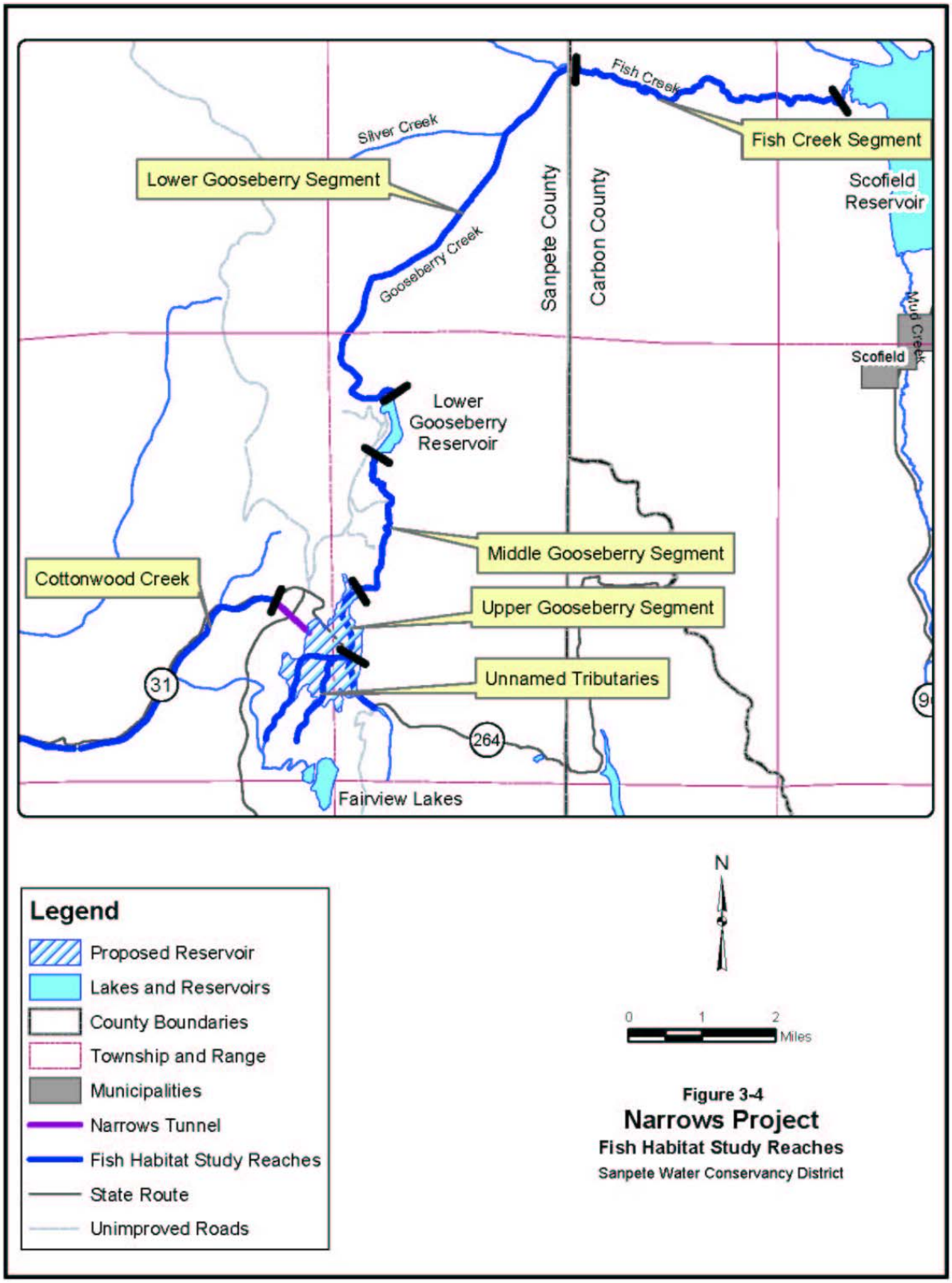


Figure 3-4.— Narrows Project Fish Habitat Study Reaches.

reservoirs is provided in the following sections of this document.

3.4.1.1 Gooseberry Creek (UDWR Class 3B – Unique)

Class 3 streams support the bulk of the stream fishing in Utah. Gooseberry Creek provides important spawning, nursery and unique habitat for cutthroat trout. The entire length of Gooseberry Creek has the potential to be affected either by reservoir inundation or by flow alterations. For ease of discussion, the stream has been divided conceptually into three segments—Upper Gooseberry Creek, Middle Gooseberry Creek, and Lower Gooseberry Creek.

The Upper Gooseberry Creek segment extends from the confluence of the three unnamed tributaries near SR-264 downstream 1 mile to Narrows Gorge and averages approximately 11 feet in width. Average monthly flows for average, wet, and dry years are shown in table 3-2. This stream segment supports a natural reproducing cutthroat trout population. The population is comprised of adult, juvenile, and YOY fish. The standing crop of cutthroat trout in this stream segment averages about 38 pounds per acre. This stream segment contains numerous riffle areas that provide cutthroat trout spawning habitat. The value of this stream segment in providing yearling habitat is shown in population estimates of over 450 fish per mile (most were YOY) since 1971. The amount of weighted usable area (WUA, the impact indicator used to determine effects on stream fisheries) for the various cutthroat trout life stages in this stream segment is shown in table 3-3. As shown, this stream segment provides only extremely limited overwinter habitat for adult cutthroat trout. Major factors contributing to the poor habitat include low winter flows and limited pool habitat.

Table 3-3.—Weighted Usable Area for Cutthroat Life Stages in Upper Gooseberry Creek with Existing Flows

Month	Life Stage	Average Weighted Usable Area (1,000 units)
January	Adult	8.4
	Juvenile	1.9
February	Adult	8.4
	Juvenile	1.9
March	Adult	8.7
	Juvenile	1.9
April	Adult	11.3
	Juvenile	3.3
May	Adult	11.7
	Juvenile	2.7
	Spawning	0.0
June	Adult	10.7
	Juvenile	2.5
	Spawning	0.0
July	Adult	13.2
	Juvenile	3.5
	Spawning	1.5
August	Adult	12.2
	Juvenile	3.7
	Spawning	1.3
	Fry	4.7
September	Adult	11.1
	Juvenile	3.0
	Fry	4.8
October	Adult	10.2
	Juvenile	2.0
November	Adult	8.9
	Juvenile	2.0
December	Adult	8.7
	Juvenile	1.9

The Middle Gooseberry Creek segment is 3.0 miles in length and extends from the Narrows Gorge downstream to Lower Gooseberry Reservoir. The Middle Gooseberry Creek segment has more flow than the upper segment because of inflow from numerous springs and seeps within and immediately downstream from Narrows Gorge. In addition, this stream segment receives flow from several tributary streams,

including Brooks and Charlie Creeks. Average monthly flows that presently occur at the upper end of this stream segment are shown in table 3-2. This stream segment also supports a self-reproducing population of cutthroat trout.

Aquatic habitat studies have been conducted on this stream segment, and the total amount of WUA for the segment is provided in table 3-4. As shown, the amount of adult and juvenile cutthroat trout habitat available in this stream segment during the September–March period is extremely limited.

The Lower Gooseberry Creek segment is the longest of the three segments and extends downstream 7.1 miles from Lower Gooseberry Reservoir to the confluence with Fish Creek. Vehicle access to this segment is

Table 3-4.—Monthly Preproject and Postproject Yellowstone Cutthroat Trout Habitat In Middle and Lower Gooseberry Creek During Average Water Year[1]

		Middle Gooseberry Creek			Lower Gooseberry Creek		
Month	Life Stage	Preproject	Postproject	Change (%)	Preproject	Postproject	Change (%)
January	Adult	62.9	57.6	8.4	355.4	344.7	-3.0
	Juvenile	18.0	16.7	7.2	61.6	60.9	-1.1
February	Adult	62.9	57.6	-8.4	359.0	348.5	-2.9
	Juvenile	18.0	16.7	-7.2	63.0	61.1	-3.0
March	Adult	64.7	57.6	-11.0	359.0	344.7	-4.0
	Juvenile	18.3	16.7	-8.7	62.6	60.9	-2.7
April	Adult	106.2	57.6	-45.8	404.9	393.1	-2.9
	Juvenile	30.1	16.7	-44.5	73.2	68.7	-6.1
May	Adult	205.8	57.6	-72.0	562.1	548.3	-2.5
	Juvenile	91.0	16.7	-81.6	75.0	56.0	-25.3
	Spawning	1.5	0.1	-93.3	0.0	0.0	-
June	Adult	202.6	57.6	-71.6	553.2	548.1	-0.9
	Juvenile	88.7	16.7	-81.2	79.6	56.1	-29.5
	Spawning	0.4	0.1	-75.0	0.0	0.0	-
July	Adult	144.4	57.6	-60.1	430.6	405.3	-5.9
	Juvenile	42.7	16.7	-60.9	71.3	73.4	+2.9
	Spawning	0.9	0.1	-88.9	0.0	0.0	-
August	Adult	127.4	57.6	-54.8	413.9	398.7	-3.7
	Juvenile	36.6	16.7	-54.4	73.0	70.4	-3.6
	Spawning	2.8	0.1	-96.4	0.0	0.0	-
	Fry	57.3	28.1	-51.0	65.3	73.1	+11.9
September	Adult	100.2	57.6	-42.5	397.3	355.4	-10.5
	Juvenile	28.4	16.7	-41.2	69.8	61.6	-11.7
	Fry	44.5	28.1	-36.9	73.6	67.1	-8.8
October	Adult	75.4	57.6	-23.6	362.2	327.4	-9.6
	Juvenile	20.9	16.7	-20.1	63.2	58.0	-8.2
November	Adult	66.4	57.6	-13.3	341.5	323.9	-5.2
	Juvenile	18.8	16.7	-11.2	60.0	57.5	-4.2
December	Adult	64.7	57.6	-11.0	348.5	330.9	-5.1
	Juvenile	18.3	16.7	-8.7	61.1	58.5	-4.3

[1] The amount of WUA is expressed in 1,000 units. Average water year is defined as 1968 flows.

limited to two or three locations. As shown in table 3-2, flow in this segment is approximately double the flow of the upper and middle segment. The total WUA for cutthroat and rainbow trout for the segment is provided in tables 3-4 and 3-5, respectively. As shown, spawning habitat for cutthroat trout currently is limited in this stream segment. Although the amount of spawning habitat appears to be low, it is not a limiting factor since YOY cutthroat trout have been plentiful whenever UDWR sampled the fish population. The amount of adult and juvenile cutthroat trout habitat is less during the September–March period than the amount of habitat available during the April–August period. Past fish population studies conducted by UDWR indicate that the cutthroat trout standing crop normally ranges from 40 to 50 pounds per acre and that the stream segment supports a fair cutthroat population. Since 1971, cutthroat trout numbers have ranged from about 400 to 750 fish per mile. Sampling prior to 1991 did not indicate the presence of rainbow trout; however, sampling of the stream prior to eradicating undesirable fish species in Scofield Reservoir resulted in the collection of adult and juvenile rainbow trout.

3.4.1.2 Fish Creek (UDWR Class 2 - Unique)

Class 2 waters are of great importance to the State fishery. These are productive streams with high aesthetic value and, according to UDWR policy, should be preserved. This segment of Fish Creek extends 6 miles from the confluence of Gooseberry Creek downstream to Scofield Reservoir. In addition to being a self-reproducing cutthroat trout population, this stream segment also is used as a spawning and rearing area by rainbow trout that migrate upstream of Scofield Reservoir (a limited number of adult rainbow trout remain in the stream). Therefore, this stream segment provides habitat for adult, juvenile, spawning, and fry life stages of both cutthroat trout and rainbow trout.

As shown in table 3-2, flow in this segment of Fish Creek is considerably greater than the flow of Gooseberry Creek. The amount of rainbow and cutthroat trout WUA in the segment is provided in tables 3-6 and 3-7, respectively. As shown in table 3-7, the existing flow regime provides only limited spawning habitat for cutthroat trout during 2 of the 4 months that spawning habitat is utilized. Population data indicate fair numbers of all cutthroat trout life stages in this segment of Fish Creek.

As shown in table 3-6, this segment of Fish Creek also supplies a desirable habitat for rainbow trout. The amount of habitat for juvenile fish remains fairly uniform, with the lowest amount of habitat available during the low flow months (October–March). Fish population surveys have shown a wide range in standing crop estimates (3.5 to 105.7 pounds per acre); and overall, the estimates have averaged almost 50 pounds of trout per acre. This level of fish biomass indicates that this segment of Fish Creek supports a good trout population. Fish population surveys conducted over the 35 years have reported as few as 40 to as many as 4,000 fish per mile. Movement of spawners into the stream from Scofield Reservoir contributes to large increases in numbers and biomass in this stream segment.

3.4.1.3 Gooseberry Creek Tributaries

Three headwater tributaries join to form Gooseberry Creek. Together, these three tributaries contain 7.5 stream miles. The three streams average approximately 4 feet in width. During late summer and early fall flow, major portions of the streams have little or no flow. The flowing reaches are used extensively by cutthroat trout for spawning and rearing of YOY fish. The standing crop

Table 3-5.—Monthly Preproject and Postproject Rainbow Trout Habitat in Lower Gooseberry Creek During Average Water Year[1]

Month	Life Stage	Preproject	Postproject	Change (%)
January	Adult	44.1	43.2	-2.0
	Juvenile	21.0	21.0	0.0
February	Adult	44.5	43.5	-2.2
	Juvenile	21.1	21.0	-0.5
March	Adult	44.5	43.2	-2.9
	Juvenile	21.1	21.0	-0.5
April	Adult	65.6	50.0	-23.8
	Juvenile	29.4	22.3	-24.1
May	Adult	142.1	133.0	-6.4
	Juvenile	49.7	51.9	+4.4
	Spawning	0.0	0.0	-
June	Adult	141.9	132.9	-6.3
	Juvenile	47.8	51.9	+8.6
	Spawning	0.3	0.0	-100.0
July	Adult	87.0	66.3	-23.8
	Juvenile	35.1	29.7	-15.4
	Spawning	0.0	0.0	-
August	Adult	79.4	56.3	-29.1
	Juvenile	35.3	25.2	-28.6
	Spawning	0.1	0.0	-100.0
	Fry	62.6	51.8	-17.3
September	Adult	54.4	44.2	-18.8
	Juvenile	24.3	21.0	-13.6
	Fry	49.7	48.8	-1.8
October	Adult	44.8	41.7	-6.9
	Juvenile	21.1	20.9	-0.9
November	Adult	42.9	41.4	-3.5
	Juvenile	21.0	20.9	-0.5
December	Adult	43.5	42.0	-3.4
	Juvenile	21.0	20.9	-0.5

[1] The amount of WUA is expressed in 1,000 units.

Table 3-6.—Monthly Preproject and Postproject Rainbow Trout Habitat in Fish Creek During Average Water Year[1]

Month	Life Stage	Preproject	Postproject	Change (%)
January	Juvenile	173.1	171.5	-0.9
February	Juvenile	173.1	171.5	-0.9
March	Juvenile	187.2	185.0	-1.1
April	Juvenile	203.1	198.4	-2.3
May	Juvenile	239.5	239.6	<0.1
	Spawning	45.9	44.9	-2.2
June	Juvenile	240.2	238.8	-0.6
	Spawning	48.4	36.9	-23.8
July	Juvenile	224.0	219.5	-2.0
	Spawning	23.6	18.2	-22.9
August	Juvenile	202.6	197.9	-2.3
	Spawning	11.0	8.2	-25.5
	Fry	226.4	223.1	-1.5
September	Juvenile	183.7	179.0	-2.6
	Fry	219.0	214.9	-1.9
October	Juvenile	172.7	170.5	-1.3
November	Juvenile	171.1	170.8	-0.2
December	Juvenile	171.0	171.6	+0.4

[1] The amount of WUA is expressed in 1,000 units. Average water year is defined as 1968 flows.

Table 3-7.—Monthly Preproject and Postproject Yellowstone Cutthroat Trout Habitat in Fish Creek During Average Water Year[1]

Month	Life Stage	Preproject	Postproject	Change (%)
January	Adult	362.7	363.0	+0.1
	Juvenile	85.3	85.5	+0.2
February	Adult	370.4	365.7	-1.3
	Juvenile	85.8	85.3	-0.6
March	Adult	414.2	406.6	-1.8
	Juvenile	88.3	88.3	0.0
April	Adult	476.9	456.1	-4.4
	Juvenile	87.5	87.8	+0.3
May	Adult	666.4	694.6	+4.2
	Juvenile	226.7	235.4	+3.8
	Spawning	0.8	6.0	+650.0
June	Adult	680.8	714.1	+5.0
	Juvenile	231.2	229.4	-0.7
	Spawning	1.7	21.8	+1,182.4
July	Adult	603.4	575.2	-4.7
	Juvenile	91.3	88.3	-3.3
	Spawning	39.8	27.3	-31.4
August	Adult	489.6	454.1	-7.3
	Juvenile	87.4	87.8	+0.5
	Spawning	17.8	14.2	-20.2
	Fry	88.6	84.2	-5.0
September	Adult	415.2	387.8	-6.6
	Juvenile	88.2	87.6	-0.7
	Fry	82.2	81.3	-1.1
October	Adult	369.2	362.5	-1.8
	Juvenile	86.0	85.2	-0.9
November	Adult	364.5	362.8	-0.5
	Juvenile	82.1	85.3	+3.9
December	Adult	363.1	363.9	+0.2
	Juvenile	363.1	363.9	+0.2

[1] The amount of WUA is expressed in 1,000 units. Average water year is defined as 1968 flows.

of cutthroat trout in these tributary streams averages approximately 86 pounds per acre. Most of the trout are YOY or yearling fish, and fish numbers have averaged over 300 fish per mile. Even though the streams are small, the standing crop indicates their high value for cutthroat trout spawning and rearing habitat.

3.4.1.4 Cottonwood Creek (UDWR Class 3)

At the present time, Upper Cottonwood Creek does not support a self-sustaining trout population because of low and intermittent flows during much of the year (table 3-2). During the spring runoff and irrigation season, the upper segment contains adequate water for fish, and UDWR maintains a rainbow trout fishery during that period by stocking catchable-size fish. As shown in table 3-2, flows in the lower portion of Cottonwood Creek are considerably greater than in the upper segment. Sampling conducted by UDWR in 1988 indicated that the lower segment of Cottonwood Creek supports excellent brown and cutthroat trout populations (approximately 210 pounds per acre). The amount of WUA for rainbow, cutthroat, and brown trout in Cottonwood Creek is provided in tables 3-8 through 3-10, respectively. As indicated in the tables, the amount of spawning habitat for all three species is limited.

3.4.1.5 Lower Gooseberry Reservoir

Lower Gooseberry Reservoir is an old reservoir that was created by placing a rock dam across Gooseberry Creek and is a popular fishing area. In 1990, the USDA Forest Service upgraded the dam to meet appropriate dam safety criteria.

This approximately 57-acre surface area reservoir is managed as a catchable rainbow trout fishery and also supports a resident cutthroat trout population. A creel survey conducted in 1993 determined that, of the trout harvested from the lake, 3% were cutthroat trout and 97% were rainbow trout. During that year, it was estimated that the lake received over 25,000 hours of fishing pressure from which 9,300 trout were harvested. Two gill nets set in the lake in 1991 collected 104 cutthroat trout ranging from approximately 6.5–15.5 inches long.

A large portion (30–40%) of the reservoir has a water depth of less than 3 feet. Areas with shallow water encourage the growth of phytoplankton and aquatic macrophytes, which can contribute to low DO levels. Lower Gooseberry Reservoir has a history of fishkills attributed to low DO concentration. Generally, the reported fishkills have been confined to the lower portion of the reservoir near the dam where water exchange is the least.

When the USDA Forest Service upgraded the dam, a new outlet structure was constructed so that water could be released from near the bottom of the reservoir. Release of water from near the bottom has improved the DO levels in the lower portions of the reservoir.

3.4.1.6 Fairview Lakes

Fairview Lakes are owned and operated by the Cottonwood-Gooseberry Irrigation Company. The lakes are managed as a catchable rainbow trout put-grow-and-take fishery by UDWR with over 9,000 catchable rainbow trout stocked annually. In 2005, the average rainbow stocked was 11 inches in length and grew 3 inches in 4 months. The stocking usually occurs in early June, and approximately 8,700 of the stocked trout are harvested. Approximately 13,000 hours of fishing pressure occurs annually on Fairview Lakes. Due to the low level of the lakes during the winter period, winter survival of the stocked rainbow trout normally does not occur. Even though Fairview Lakes are located adjacent to the project, they would not be directly affected. However, they could be affected by changes in fisherman usage, changes in UDWR fishery management programs, and possible mitigation measures.

Table 3-8.—Monthly Preproject and Postproject Rainbow Trout Habitat in Cottonwood Creek During Average Water Year[1]

Month	Life Stage	Pre Q	Preproject	Post Q	Postproject	Change (%)
January	Adult	0.98	1,832	2.98	2,910	+58.9
	Juvenile	0.98	1,456	2.98	1,928	+32.4
February	Adult	1.12	1,926	3.12	2,960	+53.7
	Juvenile	1.12	1,509	3.12	1,943	+28.7
March	Adult	1.4	2,106	3.4	3,056	+45.1
	Juvenile	1.4	1,609	3.4	1,971	+22.5
April	Adult	2.59	2,728	2.59	2,728	+0.0
	Juvenile	2.59	1,864	2.59	1,864	+0.0
May	Adult	31.56	4,254	31.56	4,254	+0.0
	Juvenile	31.56	2,093	31.56	2,093	+0.0
	Spawning	31.56	204	31.56	204	+0.0
June	Adult	33.59	4,202	33.89	4,195	-0.2
	Juvenile	33.59	2,079	33.89	2,077	-0.1
	Spawning	33.59	206	33.89	206	+0.1
July	Adult	17.57	4,481	48.17	4,158	-7.2
	Juvenile	17.57	2,167	48.17	1,953	-9.9
	Spawning	17.57	180	48.17	210	+16.6
August	Adult	15.12	4,448	45.25	4,141	-6.9
	Juvenile	15.12	2,172	45.25	1,977	-9.0
	Spawning	15.12	171	45.25	209	+21.9
	Fry	15.12	2,822	45.25	2,034	-27.9
September	Adult	2.79	2,821	18.56	4,473	+58.5
	Juvenile	2.79	1,897	18.56	2,164	+14.1
	Fry	2.79	2,915	18.56	2,761	-5.3
October	Adult	0.91	1,774	2.91	2,877	+62.2
	Juvenile	0.91	1,418	2.91	1,916	+35.1
November	Adult	1.12	1,926	3.12	2,960	+53.7
	Juvenile	1.12	1,509	3.12	1,943	+28.7
December	Adult	0.98	1,832	2.98	2,910	+58.9
	Juvenile	0.98	1,456	2.98	1,928	+32.4

[1] Weighted usable area (square feet per 1,000 feet). Average water year is defined as 1968 flows.

Table 3-9.—Monthly Preproject and Postproject Cutthroat Trout Habitat in Cottonwood Creek During Average Water Year[1]

Month	Life Stage	Pre Q	Preproject	Post Q	Postproject	Change (%)
January	Adult	0.98	3,053	2.98	4,544	+48.9
	Juvenile	0.98	1,392	2.98	1,504	+8.0
February	Adult	1.12	3,183	3.12	4,627	+45.3
	Juvenile	1.12	1,431	3.12	1,494	+4.4
March	Adult	1.4	3,430	3.4	4,788	+39.6
	Juvenile	1.4	1,496	3.4	1,475	-1.4
April	Adult	2.59	4,289	2.59	4,289	+0.0
	Juvenile	2.59	1,521	2.59	1,521	+0.0
May	Adult	31.56	7,642	31.56	7,642	+0.0
	Juvenile	31.56	1,236	31.56	1,236	+0.0
	Spawning	31.56	218	31.56	218	+0.0
June	Adult	33.59	7,579	33.89	7,570	-0.1
	Juvenile	33.59	1,212	33.89	1,209	-0.3
	Spawning	33.59	198	33.89	195	-1.5
July	Adult	17.57	7,712	48.17	7,219	-6.4
	Juvenile	17.57	1,369	48.17	1,078	-21.2
	Spawning	17.57	364	48.17	133	-63.6
August	Adult	15.12	7,584	45.25	7,276	-4.1
	Juvenile	15.12	1,356	45.25	1,103	-18.7
	Spawning	15.12	393	45.25	144	-63.5
	Fry	15.12	1,827	45.25	1,345	-26.4
September	Adult	2.79	4,420	18.56	7,736	+75.0
	Juvenile	2.79	1,512	18.56	1,368	-9.5
	Fry	2.79	1,817	18.56	1,793	-1.3
October	Adult	0.91	2,965	2.91	4,498	+51.7
	Juvenile	0.91	1,351	2.91	1,507	+11.6
November	Adult	1.12	3,183	3.12	4,627	+45.3
	Juvenile	1.12	1,431	3.12	1,494	+4.4
December	Adult	0.98	3,053	2.98	4,544	+48.9
	Juvenile	0.98	1,392	2.98	1,504	+8.0

[1] Weighted usable area (square feet per 1,000 feet). Average water year is defined as 1968 flows.

Table 3-10.—Monthly Preproject and Postproject Brown Trout Habitat in Cottonwood Creek During Average Water Year[1]

Month	Life Stage	Pre Q	Preproject	Post Q	Postproject	Change (%)
January	Adult	0.98	835	2.98	1,448	+73.4
	Juvenile	0.98	1,071	3.0	1,669	+55.8
	Spawning	0.98	22	3.0	97	+349.3
	Fry	0.98	263	3.0	559	+112.5
February	Adult	1.12	899	3.1	1,472	+63.8
	Juvenile	1.12	1,128	3.1	1,700	+50.6
	Fry	1.12	291	3.1	572	+96.6
March	Adult	1.4	1,021	3.4	1,518	+48.6
	Juvenile	1.4	1,238	3.4	1,761	+42.2
	Fry	1.4	345	3.4	597	+73.0
April	Adult	2.59	1,361	2.6	1,361	+0.0
	Juvenile	2.59	1,577	2.6	1,577	+0.0
	Fry	2.59	514	2.6	514	+0.0
May	Adult	31.56	2,324	31.6	2,324	+0.0
	Juvenile	31.56	2,690	31.6	2,690	+0.0
	Spawning	33.59	2,327	33.9	2,328	+0.0
June	Adult	33.59	2,700	33.9	2,702	+0.1
	Juvenile	17.57	2,232	48.2	2,280	+2.1
July	Adult	17.57	2,576	48.2	2,736	+6.2
	Juvenile	15.12	2,179	45.3	2,292	+5.2
August	Adult	15.12	2,539	45.3	2,736	+7.7
	Juvenile	2.79	1,406	18.6	2,248	+59.9
September	Adult	2.79	1,624	18.6	2,589	+59.4
	Juvenile	0.91	795	2.9	1,432	+80.2
October	Adult	0.91	1,035	2.9	1,652	+59.7
	Juvenile	0.91	19	2.9	93	+404.4
	Spawning	31.56	899	3.1	1,472	+63.8
November	Adult	1.12	1,128	3.1	1,700	+50.6
	Juvenile	1.12	12	3.1	89	+635.9
	Spawning	1.12	835	3.0	1,448	+73.4
December	Adult	0.98	1,071	3.0	1,669	+55.8
	Juvenile	0.98	22	3.0	97	+349.3
	Spawning	0.98	835	2.98	1,448	+73.4

[1] Weighted usable area (square feet per 1,000 feet). Average water year is defined as 1968 flows.

3.4.1.7 Scofield Reservoir

Scofield Reservoir supports a good sport fishery consisting of cutthroat trout (natural reproduction and stocking), rainbow trout (natural reproduction and stocking), and, recently, tiger trout (stocking). Historically, UDWR has stocked up to 600,000 rainbow trout into Scofield Reservoir every year. Stocking quotas typically have included 450,000 rainbow trout fingerlings and 100,000 rainbow trout subcatchables. In the past, Yellowstone and Bear Lake cutthroat trout also were stocked. Hybridization of cutthroat trout with rainbow trout is common. In 2005, tiger trout were stocked for the first time; and beginning in 2008, rainbow trout fingerlings were no longer stocked. The fingerling rainbow trout were replaced with an increase in the number of subcatchable rainbow trout stocked. Based on a 1986 creel survey, an estimated 250,000 trout (both cutthroat and rainbow) were harvested from the lake, with about 347,000 hours of fishing pressure. At 4.27 hours per angler-day, this equates to 81,241 angler days or 30 angler days per surface acre. Subsequent creel surveys in 2005 and 2007 show a considerable reduction of 67% in fishing hours, which is typical of reduction in creel survey results statewide in the last 20 years. Scofield Reservoir consistently has excellent catch rates. This fishery resource represents a significant economic resource to the local area and is considered to be the third best flat water fishery in the State.

In the past, the reservoir has experienced periodic fishkills, usually winter kills associated with low DO levels. In 1991, a fish management program eradicated undesirable fish species.

3.4.2 Methodology and Impact Indicators

A team, comprised of representatives from SWCD, Reclamation, UDWR, and the USDA Forest Service, was assembled to analyze the impact to stream fisheries and develop mitigation recommendations. Potential effects that were included in the evaluation are: stream habitat loss associated with reservoir inundation, effects of project-induced flow changes on aquatic habitat (both beneficial and adverse), and project effects on reservoir angler-days.

Available stream habitat under baseline and project alternative conditions was evaluated by instream flow incremental methodology modeling. In performing this analysis, extensive field data is collected, including hydrologic data such as velocity and depth of flow over a wide range of discharge conditions, substrate conditions, and vegetation along the banks. HSI curves then are applied for each fish species that occurs in the area. This data is used to estimate the amount of available habitat measured as WUA. WUA is the impact indicator used to determine effects on stream fisheries.

For the analysis shown in this document, data for the IFIM modeling in Cottonwood Creek was collected during low flow conditions only. Additional data will be collected during the snowmelt runoff to verify the accuracy of the hydrologic model under high flow conditions. The impact indicator for stream fisheries is the percent change in weightable usable area as measured by IFIM for the various life stages.

Impacts on reservoir fisheries are based on the average reservoir surface area. The impact indicator on reservoir fisheries is the change in surface area in Scofield Reservoir.

3.4.3 Predicted Effects

3.4.3.1 No Action Alternative

Under the No Action Alternative, project-induced changes to existing conditions would not occur. The three tributaries to Gooseberry Creek in the proposed Narrows Reservoir basin would continue to provide spawning habitat for cutthroat trout to the same extent as at present. The 1.0 mile of Upper Gooseberry Creek would continue to provide habitat for all life stages of cutthroat trout, and habitat for cutthroat and rainbow trout in Gooseberry Creek and Fish Creek would remain as listed in tables 3-3 through 3-5. Habitat for cutthroat, rainbow, and brown trout in Cottonwood Creek would remain as listed in tables 3-8 through 3-10.

Fishing conditions at Lower Gooseberry Reservoir and Fairview Lakes would remain the same as at present. Lower Gooseberry Reservoir would continue to experience occasional fishkills during winter months. Fairview Lakes likely would continue to be managed as at present with annual stocking and no overwintering of fish due to low reservoir levels. Scofield Reservoir would continue to have an average of 2,375 acres of surface area.

3.4.3.2 Proposed Action Alternative

The State Engineer stipulates that a minimum of 1.0 cfs is to be released downstream from the proposed Narrows Dam; and, if the flow is not 1.5 cfs at the Gooseberry Campground ⅛ mile downstream from the proposed damsite, SWCD is required to release 1.25 cfs from the dam. It also is stipulated that the dam be constructed with a multiple-level outlet to regulate water temperature for the trout located downstream from the dam.

The proposed project would cause flow reductions in Gooseberry and Fish Creeks as shown in table 3-2. Flows in Middle Gooseberry Creek immediately downstream from the proposed dam would be expected to be reduced, on average, by 74%, whereas flows downstream from Lower Gooseberry Reservoir would be expected to be reduced by 43%. In Fish Creek, flows would be expected to be reduced approximately 15%.

The 5,400-acre-foot diversion of project water into Cottonwood Creek would cause about a 200% increase in the base summer flow in Upper Cottonwood Creek (table 3-2). As shown, the base summer flows in Lower Cottonwood Creek would be increased by about 160%. However, the increased flows would occur only during the July-to-October period and not during the peak runoff or the low flow months (November–April). Additionally, these base summer flows would be less than the peak flows that currently shape the stream channel. Therefore, the stream channel itself would remain stable.

Providing a 2.0-cfs winter release through the Narrows Tunnel is expected to greatly increase the WUA for all fish species in Cottonwood Creek. This increased flow particularly would benefit the upper reaches of the creek and would be expected to facilitate the overwintering of fish.

The length of time required initially to fill Narrows Reservoir would, of course, depend on hydrologic conditions in the basin. During wet years, the reservoir could fill during a single spring runoff. For more normal conditions, if no diversions were made to Cottonwood Creek until the reservoir filled, it likely would fill in 2 years—almost certainly within 3 years. Under dry conditions, if diversions to Cottonwood Creek did occur during the filling period, it could take 5 to 15 years to fill Narrows Reservoir. Due to these hydrologic uncertainties, there is no firm filling schedule for the reservoir.

3.4.3.2.1 Reservoir Inundation Effects

At maximum storage, the proposed Narrows Reservoir would inundate about 1 mile of Upper Gooseberry Creek and approximately 4.3 miles of the three headwater tributaries with permanent flows that join to form Gooseberry Creek.

Based on the stream habitat that would be inundated by the proposed reservoir, it is expected that 1.3 and 2.1 acres of stream-based aquatic habitat would be lost in Gooseberry Creek and the tributaries, respectively. Using the standing crop estimates, approximately 230 pounds of stream-based cutthroat trout would be lost, of which 22% would occur in Gooseberry Creek and 78% would occur in the tributary streams, although the trout biomass likely would be converted into a flat-water equivalent.

3.4.3.2.2 Flow Alteration Effects

3.4.3.2.2.1 Middle Gooseberry Creek Segment.—As shown in table 3-2, preproject average monthly flows in this stream segment range from 1.3 to 61.8 cfs and average 11.2 cfs. The expected 1-cfs postproject flow represents a 74% reduction in annual flow in this stream segment. As described above, this segment of Gooseberry Creek supports all life stages of cutthroat trout. Adult and juvenile cutthroat trout use the aquatic habitat throughout the year, while cutthroat trout spawning habitat (including incubation) is used during May, June, July, and August, and fry are present in August and September. Table 3-4 shows the cutthroat trout habitat available on a monthly basis for the four life stages under preproject and postproject flow regime. Adult and juvenile cutthroat trout habitat is limited during the existing low flow period, which in an average year extends from October–March. Even though more habitat may occur during the high flow months, the overall trout population would be expected to be controlled by available habitat during this 6-month period. As shown in table 3-4, adult and juvenile cutthroat trout populations are expected to be reduced by as much as 72.0 and 81.6%, respectively, in the high flow months. Conversely, during the low flow period (October–March), adult and juvenile cutthroat trout habitat in an individual month would be reduced up to 23.6 and 20.1%, respectively. On an average during this period, adult habitat would be reduced 12.9%, whereas juvenile habitat would be reduced 10.8%.

Since spawning and fry life stages are in the stream segment during the spring and summer, the effect of flow reductions attributable to the project would be much greater during these seasons, with spawning habitat being reduced by almost 94% and fry habitat being reduced by almost 45%. If fry from cutthroat trout spawning upstream of the proposed dam presently are being carried into this stream reach, construction of the dam would prevent these fry from entering this reach of stream.

The project would eliminate large flows in this stream segment; therefore, it is expected that the width of the stream would be reduced. However, without the normal flushing flows, the stream could be expected to have more fine materials in the substrate, which could almost eliminate the small amount of cutthroat trout spawning habitat that is projected to remain in the stream segment. Unless the configuration of the channel of the stream is altered, the stream segment would have limited value, and 50 to 75% of trout biomass may be lost. If the channel configuration is altered, then the loss of trout biomass may not be as great.

3.4.3.2.2.2 Lower Gooseberry Creek Segment.—Operation of the proposed project would cause monthly flow reductions in this 7.1-mile stream segment that would range

from 8 to 62% and average 43% (table 3-2). The largest flow reductions would occur during the April–August period. However, due to tributary inflow between the proposed dam and this stream segment, the reductions would not be as severe as they may be in the segment immediately upstream of Lower Gooseberry Dam.

As previously discussed, this stream segment supports a self-reproducing population of cutthroat trout. The amount of habitat available for the four life stages on a monthly basis with preproject and postproject flow regimes is shown in table 3-4. Similar to the upstream segment, existing habitat for adult and juvenile cutthroat trout is most restricted during the low flow period, which extends from October–March. As discussed for the previous stream segment, habitat during this period would be expected to be a major factor that would control trout biomass in the stream. As shown in table 3-4, adult and juvenile habitat would be reduced up to 10.5 and 29.5%, respectively. However, during the low flow months, adult and juvenile habitat reductions never exceed 10% in a specific month and, for the 6-month period, average 5.0 and 3.9%, respectively. With these small reductions in adult and juvenile habitat, any change in the trout population would be expected to be negligible and difficult to detect.

Cutthroat trout spawning habitat is extremely limited with both preproject and postproject flow regimes. It appears that availability of spawning habitat is not a limiting factor, as YOY fish are normally abundant in this stream segment. Fry habitat would be expected to be only slightly affected (0.9% increase) by the proposed project.

It is expected that the proposed project would cause less than a 5% reduction in the cutthroat trout population in this stream segment. This is well within the range of fluctuations in the trout population that presently occurs. Little or no opportunity exists to mitigate the adverse impact within this stream segment.

As discussed above, rainbow trout (adults and juveniles) also were documented in this stream reach. The presence of these two life stages strongly suggests that rainbow trout also are using the stream for spawning and rearing habitat. The amount of rainbow trout habitat (WUA) for the four life stages in the entire stream reach was shown in table 3-5. Similar to cutthroat trout, adult and juvenile rainbow trout habitat is most restricted during the low flow period (October–March), and this would be expected to be a major factor that controls trout biomass in this stream segment. For this 6-month period, operation of the proposed project is expected to reduce rainbow trout adult and juvenile habitat by an average of 6.5 and 5.4%, respectively.

Rainbow trout spawning habitat is limited in this stream reach. Implementing the proposed project is expected to result in a slight increase (less then [<] 7%) of spawning habitat. Rainbow trout fry habitat is abundant in this stream reach, and implementing the proposed project also is expected to cause a slight increase (< 8%) in fry habitat (table 3-7). Neither increase is considered to be significant.

3.4.3.2.2.3 Fish Creek Segment.—The proposed project would result in a 3 to 24% reduction in the average monthly flow in Fish Creek. The largest reductions would occur during the April–August period when preproject flows are the highest. Flows during the low flow months would be reduced 10% or less, and flows during the other months would remain several times higher than those in the low flow months. Reduction in high flows would reduce the sediment transport capacity of the stream, which could increase the amount

of sediment deposited within the stream channel, reducing its spawning value.

The amount of cutthroat trout habitat available for the four life stages on a monthly basis with preproject and postproject flow regimes is shown in table 3-7. Similar to the upstream segment, adult and juvenile cutthroat trout habitat is the lowest during the October–March period, and reduced habitat during this period would be expected to be a major factor that controls the cutthroat trout population in this stream segment. As shown in table 3-7, adult and juvenile cutthroat trout habitat in a specific month may be reduced up to 7.3 and 3.3%, respectively; while in other months, available habitat may be increased. On average for the 6-month low flow period, adult cutthroat trout habitat is expected to be reduced by less than 1%, whereas juvenile habitat would be increased by about 0.5%. Both of these changes are considered to be insignificant.

The month-to-month changes in spawning and fry cutthroat trout habitat, as shown in table 3-7, may be reduced or increased. Overall spawning habitat is expected to be increased by slightly more than 15%, while fry habitat would be reduced by about 3%. The increase in spawning habitat is considered to be a significant beneficial impact, while the decrease in fry habitat is not significant.

The amount of juvenile, spawning, and fry habitat for rainbow trout in this segment of Fish Creek, based on preproject and postproject flow regimes, was presented earlier in table 3-6. Similar to the cutthroat trout, existing juvenile rainbow trout habitat is most limiting during the October–March period; and available habitat during this period would be a major factor that controls the abundance of juvenile rainbow trout in this stream segment. During this 6-month period, adult rainbow trout habitat would decrease between 0.5 and 2.7% in specific months, while juvenile rainbow trout habitat is expected to increase by up to 0.4% and decrease to 1.3% in specific months. Overall, adult and juvenile habitat reductions are expected to average about 1.3 and 0.5%, respectively. This is considered to be an insignificant impact.

Also, as shown earlier in table 3-6, impacts to rainbow trout spawning and fry habitats would be expected to decrease about 16 and 2%, respectively. If rainbow trout habitat in this stream segment was limiting, then the reduction in spawning habitat would amount to a significant impact. If so, this effect also would be carried into Scofield Reservoir, since it could affect the number of rainbow trout entering the reservoir's fishery from natural reproduction.

3.4.3.2.2.4 Cottonwood Creek Segment.— Flows in Cottonwood Creek would be increased during the July–October period (table 3-2). Increased winter flows also would be provided. This increase in summer flow would cause a slight decrease in WUA for rainbow and cutthroat trout in June, July, and August. There would be an increase in WUA for adult and juvenile rainbow and cutthroat trout in September. The higher summer flows would increase the spawning WUA for rainbow trout by 9% and decrease the spawning WUA for cutthroat trout by 41%. Overall, WUA for adult rainbow and cutthroat trout would increase by about 20%. Fry habitat would decrease by 16% for rainbow trout and by 14% for cutthroat trout. All life stages of brown trout would be benefited by the increased flows. WUA for adult brown trout would increase by 26%, WUA for juvenile brown trout would increase by 24%, spawning habitat for brown trout would increase by 410%, and habitat for fry brown trout would increase by 59%.

3.4.3.2.3 Reservoir Fishery Effects

Existing reservoir fisheries with the potential to be affected by the proposed project include Lower Gooseberry Reservoir, Fairview Lakes, and Scofield Reservoir. Each is discussed below.

3.4.3.2.3.1 Lower Gooseberry Reservoir.— Under the Proposed Action, flows from Gooseberry Creek into Lower Gooseberry Reservoir would be substantially reduced. As shown in table 3-2, most of the flow reduction would occur during the April–August period. Flow reduction during this period would reduce the exchange rate within the reservoir and may affect water quality or aquatic habitat during this period. As noted under the No Action Alternative, Lower Gooseberry Reservoir occasionally experiences fishkills due to low DO levels during the winter months. If the problem becomes more severe, it would be an adverse effect attributable to the project. If cutthroat trout spawning upstream of the proposed reservoir contributes to the abundance of cutthroat trout in Lower Gooseberry Reservoir, which appears likely, the proposed project could adversely affect the cutthroat trout population in that reservoir.

3.4.3.2.3.2 Fairview Lakes.—Project operation would not change the amount of water (acre-feet) that would be released from Fairview Lakes. The release would be spread over the entire year, rather than the present 18- to 20-week discharge period. This would allow higher water levels later in the year, which would increase the opportunity for overwintering of fish. This change in operation would have a beneficial effect on the overall quality of the fishery and potentially could decrease the amount of stocking of catchable size fish required.

3.4.3.2.3.3 Scofield Reservoir.—A primary concern regarding Scofield Reservoir as it relates to the Narrows Project has been that the decreased inflow to the reservoir resulting from the Narrows Project would further degrade the reservoir's water quality and increase the potential for fishkills. Additionally, implementing the Proposed Action would cause Scofield Reservoir to operate at a lower level and, thus, decrease the average surface area of the flat water fishery by about 245 acres (10% total reduction in surface acres for Scofield Reservoir).

3.4.3.2.3.4 Narrows Reservoir.—It is expected that, under the Proposed Action, UDWR would manage Narrows Reservoir as a cutthroat trout fishery. Although natural reproduction is expected in the tributary streams upstream of the reservoir, UDWR may need to augment natural reproduction with fingerling introductions to ensure that maximum reservoir production occurs. As an example, UDWR presently is managing Cleveland Reservoir, located about 6 miles southeast of the proposed Narrows Reservoir site, for rainbow trout and maintaining the population by stocking fingerling rainbow trout. Narrows Reservoir would provide an average of 436 surface acres of flat water fishery under the Proposed Action, fewer than under either the Mid-Sized or Small Reservoir Alternatives.

3.4.3.2.4 Fishery Mitigation

The UDWR does not recognize the creation of a reservoir fishery as adequate compensation for the loss of stream aquatic resources. Creating an additional reservoir fishery would compensate for adverse effects that may occur on Lower Gooseberry Reservoir and Scofield Reservoir. This would represent a cumulative beneficial project impact to reservoir fishery.

In summary, the Proposed Action would result in loss of cutthroat trout stream habitat

attributable to reservoir inundation and flow alteration. The project also would result in more reservoir habitat for cutthroat trout. The reservoir cutthroat trout habitat that would be created by the project would compensate for any adverse impacts that may occur on Gooseberry or Scofield Reservoirs. Therefore, mitigation for reservoir habitat has not been proposed.

A total of 11 fishery improvement and mitigation measures have been proposed by SWCD to compensate for the adverse aquatic impacts that have been identified with the proposed project. To the extent possible, an attempt was made to mitigate "in place" and "in kind." These measures have been developed in coordination with various Federal and State agencies and were described in detail in chapter 2, section 2.2.2.2.1 of this document. Table 3-11 is a summary of the aquatic impacts and proposed improvement and mitigation commitments for the Proposed Action.

The intent of the aquatic mitigation measures described above is to provide full mitigation for all adverse impacts resulting in no residual cumulative or overall impacts.

3.4.3.3 Mid-Sized Reservoir Alternative

Impacts to aquatic resources under the Mid-Sized Reservoir Alternative would be similar to those generated by the Proposed Action. The exceptions would be that 4.0 miles of tributaries to Gooseberry Creek would be inundated by the reservoir instead of the 4.3 miles that would be inundated by the Proposed Action and that the Mid-Sized Reservoir Alternative would reduce the surface area of Scofield Reservoir by 231 acres (10%), while providing 331 new surface acres at Narrows Reservoir.

A summary of the 11 fishery improvement and mitigation measures proposed for the Mid-Sized Reservoir Alternative (all of which were described in greater detail in chapter 2) is presented in table 3-12.

The residual impacts to aquatic resources caused by the Mid-Sized Reservoir Alternative would be nearly equivalent to those under the Proposed Action.

3.4.3.4 Small Reservoir Alternative

Impacts to aquatic resources under the Small Reservoir Alternative would be similar to those generated by the Proposed Action. The exception would be that 3.8 miles of tributaries to Gooseberry Creek would be inundated by the reservoir instead of the 4.3 miles inundated by the Proposed Action. In addition, the Small Reservoir Alternative would reduce the surface area of Scofield Reservoir by 205 acres (9%) while providing 215 new acres at Narrows Reservoir.

A summary of the nine fishery improvement and mitigation measures proposed for the Small Reservoir Alternative (all of which were described in greater detail in chapter 2) is presented in table 3-13.

The residual impacts to aquatic resources caused by the Small Reservoir Alternative would be nearly equivalent to those of the Proposed Action.

3.5 WATER QUALITY

3.5.1 Affected Environment

3.5.1.1 Upper Gooseberry Creek

On the basis of data collected from Upper Gooseberry Creek and Cottonwood Creek, where much of the flow is from Gooseberry Creek through the Narrows Tunnel, the water is considered very good quality. As shown in table 3-14, the dominant chemical constituents are calcium and bicarbonate,

Table 3-11.—Fishery Impacts and Mitigation Measures: Proposed Action

Impacts	Mitigation Commitment
Stream Fisheries	
Gooseberry Creek tributaries - Loss of 4.3 miles (spawning Yellowstone cutthroat).	Restore year-round flows in 2.3 miles of tributaries and stabilize 3.0 miles of Middle Gooseberry Creek.
Upper Gooseberry Creek - Loss of 1.0 mile (all life stages Yellowstone cutthroat); Middle Gooseberry Creek - 74% reduction in average annual flow for 3.0 miles (all life stages Yellowstone cutthroat); Lower Gooseberry Creek - 43% flow reduction for 7.1 miles. (Decrease of 5% adult and 4% juvenile low flow habitat for Yellowstone cutthroat); Fish Creek - Average 17% flow reduction of 6.0 miles. (Decrease of less than 1% adult and juvenile low flow habitat for Yellowstone cutthroat. Overall increase of 15% spawning and 3% fry habitat for Yellowstone cutthroat. Decrease of 1.3% adult and 0.5% juvenile low flow habitat for rainbow. Overall decrease of 16% spawning and 2% fry habitat for rainbow.)	Acquire, fence, and improve fishery habitat on the following stream segments: Mud Creek 4.0 miles Winterquarters Creek 2.5 miles Upper Fish Creek 1.0 mile Pondtown Creek 2.0 miles Price River below Scofield Reservoir 2.0 miles Provide 1.0-cfs minimum year-round release into Gooseberry Creek to provide 1.5-cfs flow at Gooseberry Campground. Provide temperature control for releases to Gooseberry Creek.
Upper Cottonwood Creek - No summer flow increase, 2-cfs winter flow provided.	Construct Upper Cottonwood Creek Pipeline and provide 2-cfs winter release.
Lower Cottonwood Creek - Average 162% annual flow increase. Average 200% summer flow increase. Overall increase in habitat of 10 to 20% for rainbow trout adult, juvenile, and spawning. Increase in Yellowstone cutthroat trout adult habitat of about 20%. Little change for Yellowstone cutthroat juvenile habitat. Average of 41% decrease in Yellowstone cutthroat spawning habitat and decrease of 14% for Yellowstone cutthroat fry habitat. Increase in habitat for all life stages of brown trout.	Provide 2-cfs minimum flow during irrigation season in Lower Cottonwood Creek.
The number of miles of stream affected by increase in flow is 4.9 miles. The number of miles of stream affected by decrease in flow is 16.1 miles.	The project would provide an average 300 acre-feet per year of additional water for release to Gooseberry Creek for flushing flows and to replenish oxygen content in Lower Gooseberry Reservoir.
Reservoir Fisheries	
Scofield Reservoir - Increased potential for poor water quality resulting in fishkills; loss of some natural reproduction in rainbow trout. Reduced surface area of 274 acres, resulting in reduced standing crop of fish.	Reduce external phosphorus loading by improving riparian areas along Mud Creek, Winterquarters Creek, Upper Fish Creek, and Pondtown Creek. These measures also will improve habitat for all life stages of Yellowstone cutthroat and rainbow trout including spawning. Lost angler days would be replaced by new fishery in Narrows Reservoir.
Lower Gooseberry Reservoir - Increased potential for poor water quality resulting in fishkills.	Provide 300 acre-feet of water from Narrows Reservoir to be used for instream flow augmentation in consultation with UDWR.
Fairview Lakes - Lower fishing pressure; less severe drawdown during fishing season and winter.	Beneficial impact. No mitigation required.
Narrows Reservoir - New reservoir fishery (average).	Would provide approximately 454 acres of flat water fishery.

Table 3-12.—Fishery Impacts and Mitigation Measures: Mid-Sized Reservoir Alternative

Impacts	Mitigation Commitment
Stream Fisheries	
Gooseberry Creek tributaries - Loss of 4.0 miles (spawning Yellowstone cutthroat).	Restore year-round flows in 2.3 miles of tributaries and stabilize 3.0 miles of Middle Gooseberry Creek.
Upper Gooseberry Creek - Loss of 1.0 mile (all life stages Yellowstone cutthroat); Middle Gooseberry Creek - 74% reduction in average annual flow for 3.0 miles (all life stages Yellowstone cutthroat); Lower Gooseberry Creek - 43% flow reduction for 7.1 miles. (Decrease of 5% adult and 4% juvenile low flow habitat for Yellowstone cutthroat); Fish Creek - Average 17% flow reduction of 6.0 miles. (Decrease of less than 1% adult and juvenile low flow habitat for Yellowstone cutthroat. Overall increase of 15% spawning and 3% fry habitat for Yellowstone cutthroat. Decrease of 1.3% adult and 0.5% juvenile low flow habitat for rainbow. Overall decrease of 16% spawning and 2% fry habitat for rainbow.)	Acquire, fence, and improve fishery habitat on the following stream segments: Mud Creek 4.0 miles Winterquarters Creek 2.5 miles Upper Fish Creek 1.0 mile Pondtown Creek 2.0 miles Price River below Scofield Reservoir 2.0 miles Provide 1.0-cfs minimum year-round release into Gooseberry Creek to provide 1.5-cfs flow at Gooseberry Campground. Provide temperature control for releases to Gooseberry Creek.
Upper Cottonwood Creek - No summer flow increase, 2-cfs winter flow provided.	Construct Upper Cottonwood Creek Pipeline and provide 2-cfs winter release.
Lower Cottonwood Creek - Average 162% annual flow increase. Average 200% summer flow increase. Overall increase in habitat of 10 to 20% for rainbow trout adult, juvenile, and spawning. Increase in Yellowstone cutthroat trout adult habitat of about 20%. Little change for Yellowstone cutthroat juvenile habitat. Average of 41% decrease in Yellowstone cutthroat spawning habitat and decrease of 14% for Yellowstone cutthroat fry habitat. Increase in habitat for all life stages of brown trout.	Provide 2-cfs minimum flow during irrigation season in Lower Cottonwood Creek.
The number of miles of stream affected by increase in flow is 4.9 miles. The number of miles of stream affected by decrease in flow is 16.1 miles.	The project would provide an average 300 acre-feet per year of additional water for release to Gooseberry Creek for flushing flows and to replenish oxygen content in Lower Gooseberry Reservoir.
Reservoir Fisheries	
Scofield Reservoir - Increased potential for poor water quality resulting in fishkills; loss of some natural reproduction in rainbows. Reduced surface area of 260 acres resulting in reduced standing crop of fish.	Reduce external phosphorus loading by improving riparian areas along Mud Creek, Winterquarters Creek, Upper Fish Creek, and Pondtown Creek. These measures also will improve habitat for all life stages of Yellowstone cutthroat and rainbow trout including spawning. Lost angler days would be replaced by new fishery in Narrows Reservoir.
Lower Gooseberry Reservoir - Increased potential for poor water quality resulting in fishkills.	Provide 300 acre-feet of water from Narrows Reservoir to be used for instream flow augmentation in consultation with UDWR.
Fairview Lakes - Lower fishing pressure, less severe drawdown during fishing season and winter.	Beneficial impact. No mitigation required.
Narrows Reservoir - New reservoir fishery (average).	Would provide approximately 277 acres of flat water fishery

Table 3-13.—Fishery Impacts and Mitigation Measures: Small Reservoir Alternative

Impacts	Mitigation Commitment
Stream Fisheries	
Gooseberry Creek tributaries - Loss of 3.8 miles (spawning Yellowstone cutthroat).	Stabilize 3.0 miles of Middle Gooseberry Creek.
Upper Gooseberry Creek - Loss of 1.0 mile (all life stages Yellowstone cutthroat); Middle Gooseberry Creek - 67% reduction in average annual flow for 3.0 miles (all life stages Yellowstone cutthroat); Lower Gooseberry Creek - 39% flow reduction for 7.1 miles. (Decrease of 5% adult and 4% juvenile low flow habitat for Yellowstone cutthroat); Fish Creek - Average 17% flow reduction of 6.0 miles. (Decrease of less than 1% adult and juvenile low flow habitat for Yellowstone cutthroat. Overall increase of 15% spawning and 3% fry habitat for Yellowstone cutthroat. Decrease of 1.3% adult and 0.5% juvenile low flow habitat for rainbow. Overall decrease of 16% spawning and 2% fry habitat for rainbow.)	Acquire, fence, and improve fishery habitat on the following stream segments: Mud Creek 4.0 miles Winterquarters Creek 2.5 miles Upper Fish Creek 1.0 mile Pondtown Creek 2.0 miles Price River below Scofield Reservoir 2.0 miles
Upper Cottonwood Creek - No summer flow increase, 2-cfs winter flow provided.	Construct Upper Cottonwood Creek Pipeline and provide 2-cfs winter release.
Lower Cottonwood Creek - Average 162% annual flow increase. Average 200% summer flow increase. Overall increase in habitat of 10 to 20% for rainbow trout adult, juvenile, and spawning. Increase in Yellowstone cutthroat trout adult habitat of about 20%. Little change for juvenile habitat. Average of 41% decrease in Yellowstone cutthroat spawning habitat and decrease of 14% for Yellowstone cutthroat fry habitat. Increase in habitat for all life stages of brown trout.	Provide 2-cfs minimum flow during irrigation season in Lower Cottonwood Creek.
The number of miles of stream affected by increase in flow is 4.9 miles. The number of miles of stream affected by decrease in flow is 16.1 miles.	
Reservoir Fisheries	
Scofield Reservoir - Increased potential for poor water quality resulting in fishkills; loss of some natural reproduction in rainbows. Reduced surface area of 234 acres resulting in reduced standing crop of fish.	Reduce external phosphorus loading by improving riparian areas along Mud Creek, Winterquarters Creek, Upper Fish Creek, and Pondtown Creek. These measures also will improve habitat for all life stages of Yellowstone cutthroat and rainbow trout including spawning. Lost angler days would be replaced by new fishery in Narrows Reservoir.
Lower Gooseberry Reservoir - Increased potential for poor water quality resulting in fishkills.	Stabilize 3.0 miles of Middle Gooseberry Creek to reduce external phosphorus loading.
Fairview Lakes - Lower fishing pressure; less severe drawdown during fishing season.	Beneficial impact. No mitigation required.
Narrows Reservoir - New reservoir fishery (average).	Would provide approximately 238 acres of flat water fishery.

Table 3-14.—Water Quality Data Summary of Project Inflows and Lower Gooseberry Reservoir (mg/L) (Conductivity in µmhos/cm)

Constituents	Gooseberry Creek[1]	Gooseberry Creek at Narrows[2]	Cottonwood Creek[3]	Lower Gooseberry Reservoir[4]
Calcium	62	38	55	38
Magnesium	10	12	18	10
Potassium	<1.0	<1.0	<1.0	<1.0
Sodium	1.0	<1.0	9.4	<1.9
Alkalinity (as $CaCO_3$)	193	147.5	201	128
Bicarbonate	236	180	245	148
Carbonate		<10.0		4.9
Chloride	<1.0	<0.5	15	<4.0
Conductivity	337	330	463	263
Nitrate/nitrite	<0.146	<0.01	<0.218	<0.099
Ammonia as N	<0.053		<0.055	<0.068
Phosphate, total	<0.019	0.04	<0.075	<0.022
Phosphate, total, dissolved.	<0.021	0.04	<0.01	<0.020
Sulfate	8.0	<5.0	<16.3	<12.8
Total dissolved solids	215	220	248	152
Total suspended solids	<8.0		92	<20.4
Aluminum			<0.03	<0.03
Arsenic	<0.003		<0.005	<0.003
Barium	<0.046		0.067	<0.047
Boron				<0.039
Cadmium	<0.001		<0.001	<0.001
Chromium	<0.005		<0.005	<0.005
Copper	<0.015		<0.012	<0.015
Iron	0.22		<0.02	0.167
Lead	<0.005		<0.003	<0.004
Manganese	0.034		<0.005	<0.029
Mercury	<0.0002		<0.0002	<0.0002
Selenium	<0.001		<0.001	<0.002
Silver	<0.002		<0.002	<0.002
Zinc	<0.033		<0.03	<0.033

[1] Averages based upon 34 samples collected by the Utah Division of Water Quality on Gooseberry Creek above Lower Gooseberry Reservoir (5932250) between June 1981 and July 2007.

[2] Averages based upon two samples collected by Franson-Noble & Associates, Inc. within the proposed reser voir basin at the crossing of road SR-264, in June and October 1993.

[3] Averages based upon 17 samples collected by the Utah Division of Water Quality on Cottonwood Creek east of Fairview at the Forest Service boundary (4946770) between April 1996 and June 1997.

[4] Averages based upon 61 samples collected by the Utah Division of Water Quality on Lower Gooseberry Reservoir above dam (5932240) between October 1980 and July 2007.

with other common ions being minor in concentration. Total dissolved solids (TDS) are low, ranging from 184–258 milligrams per liter (mg/L) in Gooseberry Creek and 160–316 mg/L in Cottonwood Creek. Trace elements are very low in concentration, with most below detection limits.

Although most of the phosphate levels in these samples were considerably less than 0.05 mg/L, previous studies conducted by UDWR indicate that the 0.05-mg/L guideline for streams is often exceeded in Cottonwood Creek. Existing soil and rock erosion may be the major sources of phosphates exceeding this pollution indicator, with livestock grazing, recreation, and wildlife also contributing. At levels of 0.05 mg/L or greater, the Utah Department of Environmental Quality (UDEQ) indicates that investigations should be conducted to develop more information concerning the sources of the phosphate.

3.5.1.2 Lower Gooseberry Reservoir

The Utah Division of Water Quality completed a limnological assessment of Lower Gooseberry Reservoir that indicates it is a fairly stable mesotrophic (moderate levels of organic and mineral nutrients) system with good water quality (State of Utah, Department of Environmental Quality, Division of Water Quality, 2008). The only parameters to exceed State water quality standards for defined beneficial uses are phosphorus, pH, and DO. The average concentration of total phosphorus in the water column has not exceeded the recommended pollution indicator for phosphorus of 0.025 mg/L; but occasionally, higher values are reported at various depths in the water column. Occasionally, DO levels and pH values have violated State standards near the bottom of the reservoir, mainly during winter ice coverage. The extensive macrophyte coverage of the bottom of the reservoir is the only factor in the reservoir responsible for this phenomenon. The reservoir is shallow, with a mean depth of 3.7 feet; has good light penetration throughout the water column; and does not stratify. The UDWR has expressed concern about nutrient loading of Lower Gooseberry Reservoir and its effect upon DO levels in the reservoir. The oxygen depletion of the reservoir during the winter is believed to result from low winter inflows combined with decomposition of organic material resulting from the extensive macrophyte growth during the summer, as mentioned above.

3.5.1.3 Scofield Reservoir

Recent studies indicate that Scofield Reservoir is mesotrophic in its present state. Data collected in 1990 and 1991 depict the reservoir as hypereutrophic, while data in 1992, after treatment and eradication of trash fish, indicate a moderately eutrophic system.

Data collected between 1995–2003 indicate a mesotrophic system (State of Utah, Department of Environmental Quality, Division of Water Quality, 2006) Eutrophication is a term applied to the organic degradation of a body of water and is associated with elevated levels of carbon, nitrogen, phosphorus, and other inorganic nutrients. The degree of eutrophication generally is exhibited by the growth and appearance of large colonies of algae in highly eutrophic waters, coupled with a green cast or color to the water. This generally occurs during the warm summer months.

Trophic State Index (TSI) is a general measure of the level of eutrophication in a reservoir. The Carlson TSI is determined using measures of secchi depth, chlorophyll, and phosphorus (Carlson, 1977). TSI values greater than 50 are indicative of a eutrophic system, and TSI values between 40–50 are indicative of a mesotrophic system. The average TSI value for Scofield Reservoir of

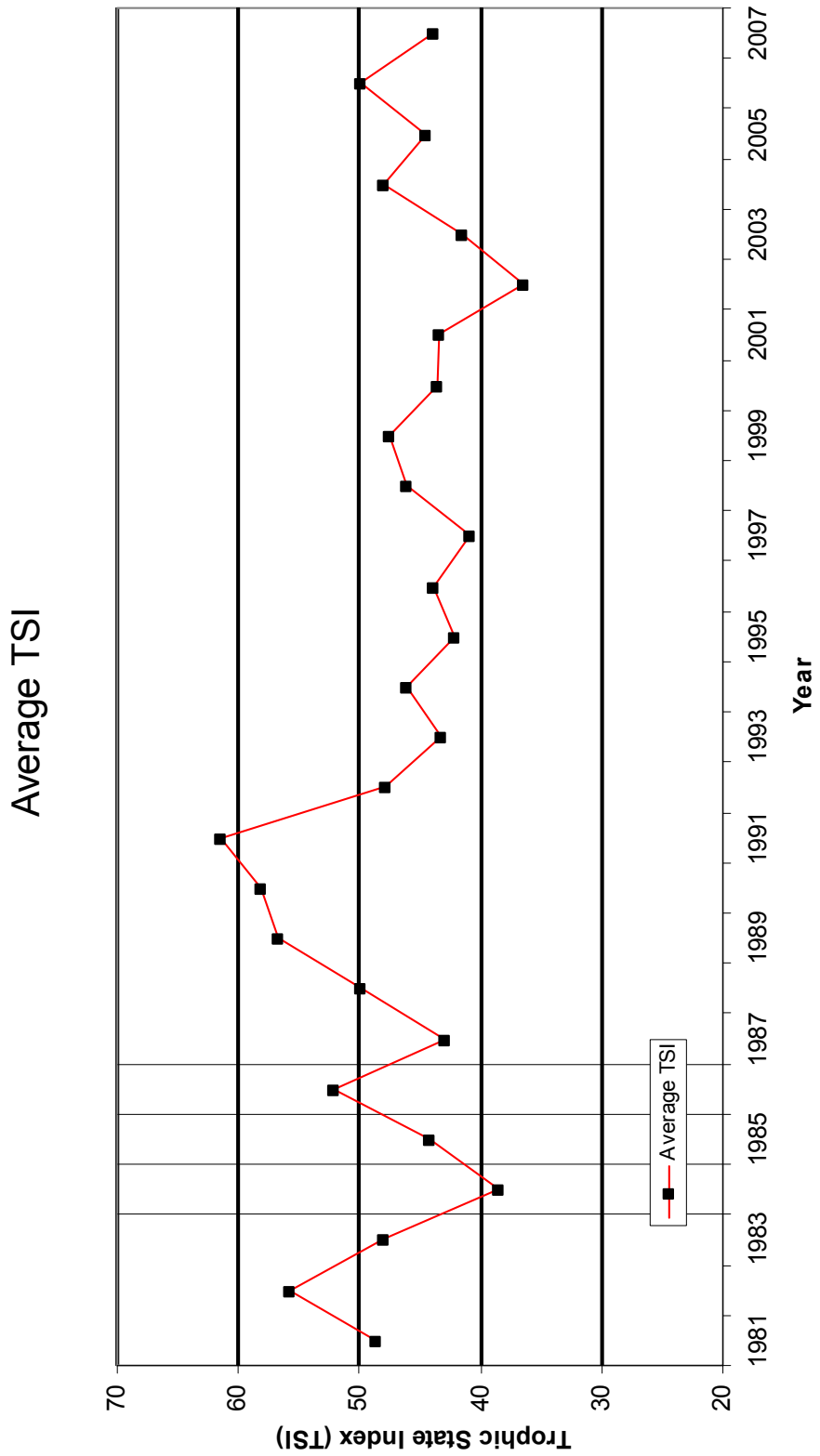


Figure 3-5.—Scofield Reservoir Average TSI.

Table 3-15.—Water Quality Data Summary of Scofield Reservoir and Inflows (mg/L) (Conductivity in µmhos/cm)

Constituents	Scofield Reservoir[1]	Fish Creek[2]	Mud Creek[3]	Pondtown Creek[4]
Calcium	<46	53	66	64
Magnesium	15	13	26	15
Potassium	<1.3	<1.1	3.1	<1.4
Sodium	<5.8	3.1	24	5.8
Alkalinity (as $CaCO_3$)	160	173	210	205
Bicarbonate	192	210	257	249
Carbonate	1.3	1.2	0.5	0.6
Chloride	<5.6	<4.7	30	7.5
Conductivity	365	341	592	425
Nitrate/Nitrite	<0.078	0.203	<0.326	<1.484
Ammonia as N	<0.099	<0.084	<0.078	<0.086
Phosphate, total	<0.049 (top) <0.103 (bottom)	<0.034	<0.084	<0.097
Phosphate, total, dissolved	<0.034 (top) <0.041 (bottom)	<0.041	<0.02	<0.027
Sulfate	<24.1	<17.8	69	22
Total dissolved solids	201	193	359	244
Total suspended solids	<5.6	<21.1	<93.7	<138.9
Aluminum	<0.030	<0.026	<0.028	
Arsenic	<0.002	<0.001	<0.002	<0.001
Barium	<0.053	<0.059	<0.064	<0.075
Boron	<0.053	<0.058	0.102	<0.071
Cadmium	<0.001	<0.001	<0.001	<0.001
Chromium	<0.005	<0.006	<0.007	<0.006
Copper	<0.012	<0.010	<0.011	<0.011
Iron	<0.133	<0.417	<0.563	<1.217
Lead	<0.005	0.005	<0.005	<0.007
Manganese	<0.092	<0.036	0.072	0.184
Mercury	<0.0001	<0.0001	<0.0001	<0.0001
Selenium	<0.001	<0.001	<0.001	<0.001
Silver	<0.002	<0.002	<0.002	<0.002
Zinc	<0.022	<0.032	<0.032	<0.029

[1]Averages based upon 542 samples collected by the Utah Division of Water Quality on Scofield Reservoir (5930980, 5930990, and 5931000) between July 1978 and July 2007.

[2]Averages based upon 124 samples collected by the Utah Division of Water Quality on Fish Creek above Scofield Reservoir (5931650) between July 1978 and November 2007.

[3]Averages based upon 66 samples collected by the Utah Division of Water Quality on Mud Creek in Scofield Town (5931480) between February 1981 and January 2008.

[4]Average based upon 94 samples collected by the Utah Division of Water Quality on Pondtown Creek above Scofield Reservoir (5931680) between September 1978 and August 2006.

53.3 (for 1979–80) was reported by UDEQ in a report entitled *Scofield Reservoir Restoration Through Phosphorus Control*. For the period 1981–2007, the average TSI value was computed to be 47.1 (see figure 3-5).

The water quality of Scofield Reservoir is considered fair. Average constituent levels of the reservoir and its tributaries are listed in table 3-15. The average detention time is about 1.4 years. The maximum depth is 66 feet, and the mean depth is 26 feet. The shallow areas with water less than about 15 feet deep normally are covered with extensive macrophyte growth, although these are normally submergent. This adds to the oxygen deficit problem during parts of the year.

The principal pollutants are nutrients, sediments, and trace elements associated with erosion and mining and nonpoint sources such as construction of roads and mine portals, domestic waste disposal, animal grazing, and natural deposits of rock containing phosphates (table 3-15).

Several independent water quality studies of Scofield Reservoir (listed in the "Bibliography") show that phosphorus is the limiting nutrient. This means that all available phosphorus is used up in producing algae or other cell bodies, while there remains a surplus of carbon, nitrogen, and other nutrients. Thus, without the input of additional phosphorus into the system, no additional algal cells can form. About 53% of the phosphorus loading to Scofield Reservoir enters from Fish Creek, according to a 1983 Utah Department of Health study. Indications are that the source of most of the phosphorus consists of naturally occurring, phosphorus-laden soils in the upper watershed.

Fishkills in Scofield Reservoir have been reported during 14 of the 46 years from 1960–2005. These fishkills are minor and generally occur in late summer. They are an indicator of water quality problems with low DO levels being the most probable cause of the fish dying.

In 1984, UDEQ received a Clean Lakes Phase II grant pursuant to the Clean Water Act, Section 314, to rehabilitate Scofield Reservoir through a program to reduce total phosphorus loading to the reservoir. UDEQ had concluded that "the most pragmatic and effective means to control the further eutrophication of Scofield Reservoir, or possibly to effect a moderate reversal of the eutrophication process, appears to be a reduction of the phosphorus load to the lake." The restoration project consisted of installing stream revetments and checkdams, revegetation of denuded streambanks, replacing water diversion systems for irrigation, providing a fish cleaning station, and developing a public awareness and education program to alert people of the pollution problem and solicit their support in reducing phosphorus loads to the reservoir. Streambank rehabilitation activities occurred on segments of Mud Creek and Fish Creek. The overall streambank work was designed to reduce stream sediments and erosion through streambank stabilization and revegetation of denuded soils in highly eroded areas.

A postproject monitoring program indicated that the project was initially effective. Streambank stabilization and revegetation occurred in the project area. Visual observations indicated that sediments were being removed from the streams. Although there is insufficient empirical data to conclusively support the effects of the implementation effort, the data indicated a decline in total phosphorus concentrations. However, many aspects of the project were voluntary on the part of the landowners. Since project completion, many of the project measures have not been maintained. In

particular, one aspect included fencing Mud Creek to prevent cattle from entering the stream, damaging the streambanks, and defecating in the stream. This was initially effective, but the landowners currently keep the gates open, thus allowing cattle access to the stream.

Utah Division of Water Quality officials believe that the presence of "rough fish," such as carp and suckers, also contribute to the water quality problems in Scofield Reservoir. These fish feed on the reservoir bottom and stir up sediments. This agitation could increase the internal phosphorus loading of the reservoir. In critical water quality years, removal of these fish species might improve the water quality of the reservoir. For example, 1992 was a critical year for Scofield Reservoir operation. Reservoir levels were extremely low, and fishkills were anticipated. However, a fish eradication program was conducted the previous year that killed the undesirable fish. No fishkills were observed in 1992, even though water levels were critically low.

In 2000, the Utah Department of Water Quality submitted, and EPA approved, a phosphorus total maximum daily load (TMDL) for Scofield Reservoir (State of Utah, Department of Environmental Quality, Division of Water Quality, 2000). The TMDL identifies total phosphorus and DO as pollutants of concern that have attributed to the impairment Scofield Reservoir's Class 3A beneficial use for cold water species of game fish. The TMDL focuses on total phosphorus as the pollutant of concern because low DO is linked to high phosphorus levels. The loading assessment quantified the current total phosphorus load to the reservoir at 6,723 kilograms per year (kg/yr). The TMDL identified three endpoints to improve reservoir water quality:

1. Shift in phytoplankton dominance from blue-green algae
2. DO level of no less than 4.0 mg/L in 50% of water column
3. TSI values between 40 and 50

These endpoints are to be met by reducing the total phosphorus load to the reservoir by 1,881 kg/yr.

3.5.1.4 Colorado River Salinity

At its headwaters in the mountains of north-central Colorado, the Colorado River has a salinity concentration of 50 mg/L. As a tributary to the Colorado River, the Price River contributes to the salinity load of the river system. The concentration progressively increases downstream as a result of water diversions and salt contributions from a variety of sources. Near Yuma, Arizona, the Imperial Dam, built in the 1930s, diverts Colorado River water into three different canals and holds the river water until it can be directed into a desilting plant. Annual salinity concentrations at Imperial Dam are expected to decrease from the 1987 measured average level of 850 mg/L to an estimated average of 779 mg/L by the year 2025, assuming continuing successful implementation of the salinity control program.

Water in the Price River suffers major quality deterioration as the stream crosses the irrigated sectors of the river basin. The deterioration results from both geologic and human factors. From about November–April, little water is released from Scofield Reservoir, and the upper portion of the basin contributes little water to the river. During this period, irrigation return flow is not significantly diluted by better quality water. Although major releases are made from Scofield Reservoir from May–October, a large part of the flow is diverted during this period into major irrigation canals in the upstream part of the basin. Significant amounts of irrigation return flow of poor

Table 3-16.—Water Quality Data Summary of San Pitch River in the Project Area (mg/L) (Conductivity in µmhos/cm)

Constituents	San Pitch at Highway US 89 North of Fairview[1]	San Pitch 2.5 Miles West of Mt. Pleasant[2]	San Pitch Above Moroni Wastewater Treatment Plant Outfall[3]
Calcium	63	70	64
Magnesium	40	50	56
Potassium	<1.6	2.9	3.3
Sodium	13	22	33
Alkalinity (as $CaCO^3$)	307	337	345
Bicarbonate	370	413	420
Carbonate	1.8	4.5	0.1
Chloride	<12.0	22	29
Conductivity	627	749	817
Nitrate/nitrite	<0.461	<0.575	<1.159
Ammonia as N	<0.056	<0.065	<0.074
Phosphate, total	<0.019	<0.046	<0.095
Phosphate, total, dissolved	<0.017	<0.024	<0.034
Sulfate	<25.5	<59.8	<78.1
Total dissolved solids	361	446	502
Total suspended solids	<15.2	<52.6	<81.9
Aluminum	<0.03	<0.032	<0.042
Arsenic	<0.004	<0.004	<0.032
Barium	0.147	0.18	<0.576
Boron	0.05	0.133	0.102
Cadmium	<0.0009	<0.001	<0.001
Chromium	<0.005	<0.005	<0.006
Copper	<0.011	<0.015	<0.017
Iron	<0.022	<0.179	<0.405
Lead	<0.003	<0.004	<0.005
Manganese	<0.008	<0.036	<0.047
Mercury	<0.0002	<0.0002	<0.0002
Nickel	<0.001	<0.002	<0.001
Selenium	<0.002	<0.003	<0.002
Silver	<0.030	<0.025	<0.019
Zinc	63	70	64

[1]Averages based upon 56 samples collected by the Utah Division of Water Quality on San Pitch River at US 89 crossing north of Fairview (4946790) between April 1986 and June 2007. The trace element (metal) samples were filtered or dissolved metals.

[2]Averages based upon 194 samples collected by the Utah Division of Water Quality on San Pitch River 2.5 miles west of Mt. Pleasant at U16 crossing (4946750) between July 1976 and June 2007. Most trace element (metal) samples were filtered or dissolved.

[3]Averages based upon 166 samples collected by the Utah Division of Water Quality on San Pitch River above Moroni WWTP (4946960) between November 1975 and May 2006. Trace element (metal) samples were filtered or dissolved.

quality enter the river downstream from points where most of the flow is diverted from the river.

Accordingly, during most of the year, the flow in Price River in the central basin is composed of relatively small amounts of good quality water from the upper basin and variable amounts of irrigation return flow and natural flow from tributaries that drain the marine shales. This increases the TDS level from about 300 mg/L to about 2,000 mg/L as measured above and below the areas of principal use. Although some deterioration in the chemical quality of the Price River probably would occur in the absence of stream regulation and irrigated agriculture in the central basin, deterioration is intensified with the presence of both.

3.5.1.5 Cottonwood Creek and San Pitch River

As indicated above, Cottonwood Creek has good water quality and generally meets all of its present beneficial use classifications. The San Pitch River is also generally good quality water above Fairview. However, the San Pitch River degrades downstream since most of the water is diverted; and near Moroni, the river is composed mostly of return flows from irrigation and municipal waste water. However, the TDS levels are generally below 500 mg/L in this reach, and the water is very suitable for irrigation. Most of the water is diverted from the stream about 2.5 miles west of Mt. Pleasant. Table 3-16 summarizes the water quality in this reach of the San Pitch River. Levels of trace elements (metals) in both streams are normally below detection levels.

Table 3-17 summarizes the water quality in the lower section of the San Pitch River and in Sixmile Creek near the mouth. Water in Sixmile Creek is very good quality with TDS levels averaging about 350 mg/L. Waters in the lower San Pitch River consist of mostly return flows and are further degraded below the proposed project area. The average TDS in the San Pitch River above Gunnison Reservoir is about 1,050 mg/L and is about 1,635 mg/L below Gunnison Reservoir. The recommended TDS criteria for irrigation water is 1,200 mg/L. Levels of trace elements (metals) in both streams are normally below detection levels.

3.5.2 Methodology and Impact Indicators

Impacts on water quality were analyzed using two different methods: comparison of reservoir flushing rates and phosphorus mass balance analysis. Scofield Reservoir was the primary focus of the water quality impact analysis since this was the predominant water quality issue identified in scoping.

3.5.2.1 Flushing Rate Comparison

Preliminary studies performed by the USGS suggest that fishkills could result from a combination of environmental factors that are intensified by decreased tributary inflow. These factors include: large populations of blue-green algae that release biological toxins, oxygen demands resulting from respiration and decomposition of algal populations, increased rate of lake water warming, and increased (relative) volume of the anaerobic hypolimnion. The study concluded that fishkills occur 80% of the time when the annual flushing rate for the reservoir is less than 0.85. When the flushing rate is 1.1 or greater, the likelihood of fish mortality drops to below 10%. During the 46 years in the 1960–2005 period, the annual flushing rate in Scofield Reservoir dropped below 0.85 nine times. This USGS study was never finalized, and subsequent studies indicate that the correlation between observed fishkills and low flushing rate is weak. In determining project impacts, flushing rates under the various alternatives were compared.

Table 3-17.—Water Quality Data Summary of Lower San Pitch River and Sixmile Creek (mg/L) (Conductivity in µmhos/cm)

Constituents	Six Mile Creek near Mouth near San Pitch[1]	San Pitch Above Gunnison Reservoir[2]	San Pitch 2 Miles East of Gunnison[3]
Calcium	48	77	88
Magnesium	35	123	80
Potassium	<1.5	4.7	5.0
Sodium	32	155	385
Alkalinity (as $CaCO_3$)	250	445	351
Chloride	301	537	424
Conductivity	2.6	6.2	2.0
Nitrate/nitrite	<26.9	161	527
Ammonia as N	655	1,713	2,635
Phosphate, total	1.433	<0.451	<2.026
Phosphate, total, dissolved	<0.074	<0.098	<0.070
Sulfate	<0.065	<0.095	<0.076
Total dissolved solids	<0.020	<0.042	<0.022
Total suspended solids	<47.9	371	264
Aluminum	351	1,147	1,635
Arsenic	<395.5	<83.9	<130.1
Barium	<0.055	<0.036	<0.045
Boron	<0.003	<0.009	<0.005
Cadmium	0.117	0.127	<0.093
Chromium	<0.083	0.186	0.361
Copper	<0.0009	<0.001	<0.001
Iron	<0.006	<0.008	<0.006
Lead	<0.011	<0.012	<0.016
Manganese	<0.073	<0.121	<0.257
Mercury	<0.003	<0.004	<0.005
Selenium	<0.008	<0.013	<0.022
Silver	<0.0002	<0.0002	<0.0002
Zinc	<0.001	<0.002	<0.002

[1]Averages based upon 71 samples collected by the Utah Division of Water Quality on Six Mile Creek above confluence with San Pitch River northwest of Sterling (4946360) between September 1976 and June 2007. The trace element (metal) samples were filtered or dissolved metals.

[2]Averages based upon 143 samples collected by the Utah Division of Water Quality on San Pitch River west of Manti above Gunnison Reservoir at CR crossing (4946450) between September 1976 and June 2007. The trace element (metal) samples were filtered or dissolved.

[3]Averages based upon 228 samples collected by the Utah Division of Water Quality on San Pitch River 2 miles east of Gunnison at U137 crossing (4946150) between October 1976 and June 2007. The trace element (metal) samples were filtered or dissolved.

3.5.2.2 Phosphorus Mass Balance Analysis

A recent study of impacts of Narrows Reservoir operations on Scofield Reservoir phosphorus loading is described in the report by Franson Noble Engineering entitled, *Eutrophication Study, Flow and Phosphorus Impacts of Proposed Narrows Project on Scofield Reservoir* (October 2006, revised). This recent study (based on the period 1978–2005) accounts for flow and phosphorus routing through Lower Gooseberry and Scofield Reservoirs under existing conditions and includes the proposed Narrows Reservoir under project conditions. Phosphorus export and uptake in the reservoirs are included.

Reservoir eutrophication models have been developed for both existing and project conditions. This mass-balance mathematical modeling of Scofield Reservoir, based on external phosphorus loading, indicates that the average probability of eutrophication is about 68 percent under existing conditions. The average in-lake total phosphorus was 0.0279 mg/L during the 28 years modeled (1978–2005). The average annual inflow of phosphorus to Scofield Reservoir during that period was 4,434 kilograms (kg). Project impacts were determined by comparing the total modeled in-lake phosphorus under the various alternatives. In interpreting the results of this study, it should be noted that the study is based on external phosphorus loading only. In addition to external phosphorus loading, other factors, including internal phosphorus loading, affect the water quality of Scofield Reservoir.

3.5.3 Predicted Water Quality Effects

Water quality impacts of main concern that might occur as a result of construction and operation of the proposed Narrows Project are as follows:

- Degradation of existing water quality in the current nondegradation segments of project area streams during construction
- Potentially decreased DO levels and increased fishkills in Lower Gooseberry Reservoir due to decreased inflow
- Increased potential for fishkills in Scofield Reservoir as a result of possible decreases in water quality due to reduced inflows
- Increase in average salinity levels in the Colorado River at Imperial Dam of 0.54 mg/L due to an average annual depletion of 5,597 acre-feet

3.5.3.1 No Action Alternative

Under the No Action Alternative, there would be no temporary water quality impacts to Gooseberry and Fish Creeks because there would be no heavy construction in the area. Low DO levels would continue to occur in Lower Gooseberry Reservoir. The total in-lake phosphorus level in Scofield Reservoir would not change. The average probability of eutrophication would remain about 68%. The TSI would average about 47.1, and the reservoir would continue to be mesotrophic. Fishkills would continue to occur in about 14 of 46 years. The average flushing rate would continue to be 1.15.

Salinity levels in the Colorado River would continue as at present under this alternative.

There would be no water quality mitigation under the No Action Alternative since there are no net impacts to water quality.

There would be no residual or cumulative impacts to water quality under the No Action Alternative.

3.5.3.2 Proposed Action Alternative

Under the Proposed Action, there could be some water quality impacts during construction; however, measures would be implemented to minimize those impacts. The contractor would be required to comply with applicable Federal and State laws, orders, and regulations concerning the control and abatement of water pollution. The contractor's construction activities would be performed by methods that would prevent entrance or accidental spillage of solid matter, contaminants, debris, and other objectionable pollutants and wastes into streams, lakes, and underground water sources. Sanitary wastes would be disposed of by approved methods.

The construction contract would require the contractor to develop and implement a Water Quality Management Plan (Erosion Control Plan) and a Storm Water Pollution Prevention Plan. The contractor also would be required to implement the best management practices (BMPs) specified in the *Nonpoint Source Water Pollution Control Plan for Hydrologic Modifications in Utah*, which is an addendum to the *Utah Nonpoint Source Management Plan*. Specifically, applicable sections such as Hydromod Planning Process, Measures to Control Construction Activities, and Impoundments would be followed and implemented. Under a worst case scenario, if sediment control facilities temporarily failed and any stream sections were significantly impaired, remediation/restoration work would be implemented to the satisfaction of the appropriate government agencies.

Any construction work occurring in streams or associated wetlands would be conducted in compliance with USACE's 404 Permit and/or Utah State Engineer's stream alteration permit, which would include the State 401 certification process.

3.5.3.2.1 Lower Gooseberry Reservoir

The average annual inflow (based on 1978–2005 data) to Lower Gooseberry Reservoir would be reduced by 40%. The average annual phosphorus load levels below the proposed Narrows Reservoir would be reduced by about 113 kg/yr, resulting from phosphorus export and uptake in the Narrows Reservoir. This would result in a 45% reduction in the average nutrient load in the total inflowing water. The average in-lake phosphorus concentration would be reduced from 0.0131 to 0.0119 mg/L, and the probability of eutrophication would be reduced from 24.3 to 19.7%. Because the DO levels are greatest near the stream inlet, a decrease in inflow is expected to decrease the overall DO level of the reservoir in winter during iced-over conditions, thus increasing the potential for fishkills unless mitigation were implemented. Mitigation is planned for this, which would include additional storage in the Narrows Reservoir and minimum streamflow releases as discussed in section 3.4, "Fisheries."

3.5.3.2.2 Scofield Reservoir

The results of the eutrophication study (Franson-Noble Engineering) with the Narrows Dam and Reservoir show that, under the Proposed Action, there would be a reduction of average annual phosphorus mass loading into Scofield Reservoir (105 kg/yr) and a slight increase of 10.8% in phosphorus in-lake concentration from 0.0279 to 0.0309 mg/L. The reduction in phosphorus loading results from basin export and uptake in Narrows and Lower Gooseberry Reservoirs. The overall probability of eutrophication for the period studied shows an increase from 68.3 to 73.5% (about a 5.2% increase). The probability of eutrophication was increased slightly every year except

1984. Figure 3-6 shows a comparison of the future without project and project phosphorus level in Scofield Reservoir based on external loading.

As a result of the Proposed Action, the inflow to Scofield Reservoir would be reduced by an annual average of 5,726 acre-feet (about 9.2%). This means that Scofield Reservoir generally would operate at a lower elevation and smaller surface area. Its average flushing rate would decrease slightly, from 1.15 to 1.14; however, the flushing rate would drop below 0.85 in 10 of the 46 years studied, instead of 8 of 46 years, as would occur in the future without the project (see figure 3-7). The critical low flushing rate would occur 22% of the time with the project as compared to 17% of the time without the project. During these periods of critical flushing rate, the probability of fishkills could be somewhat higher.

Taking into account the slight increase in in-lake phosphorus concentration and essentially no change in flushing rate, professional judgment would indicate that the overall water quality in Scofield Reservoir would be degraded only slightly by the Proposed Action without mitigation. Mitigation measures to offset this potential impact are described in section 3.5.3.2.6.

3.5.3.2.3 Proposed Narrows Reservoir

The overall water quality in the proposed Narrows Reservoir is projected to be good. The probability of eutrophication would be about 12% (compared to 73.5% for Scofield Reservoir and 19.7% for Lower Gooseberry Reservoir). The proposed Narrows Reservoir is not expected to strongly stratify due to its shape, water budget, and location. The active pool (the storage above the inactive pool) would only be 45 feet in depth, with an average drawdown of 9 feet during the recreation season and 12 feet annually. The proposed plan is to have three outlets spaced 20 feet apart, at elevations 8,640; 8,660; and 8,680 feet, respectively. The normal water surface elevation is 8,690 feet. If a mild thermocline develops, it normally would start at about 16 to 20 feet and, over the summer season, migrate down to a depth of 32 to 45 feet, depending upon the release pattern, level of water withdrawn, and type of year. Once the reservoir was constructed, filled, and operated for several years, an operating plan would be developed jointly with the State and Federal agencies to enhance habitat for fish and wildlife downstream. As a result of the small releases and stream channel conditions downstream, the water would reach ambient conditions within the first ¼ to ½ mile downstream, relative to temperature and dissolved oxygen, even if conditions were less than optimum in waters released.

Water quality at the proposed Narrows Reservoir would be protected by establishing protection zones adjacent to the reservoir. Within these protection zones, land use practices would be restricted to eliminate activities that would impact reservoir water quality.

3.5.3.2.4 Price and Colorado Rivers

The Narrows Project would have virtually no effect on the lower Price River water quality during the November–April high TDS period because the effects of depletions caused by the proposed Narrows Project would consist primarily of reduced spills from Scofield Reservoir during the snowmelt runoff period.

Implementing the Proposed Action would have a slight detrimental impact on Colorado River salinity. Construction and operation of the proposed Narrows Dam and Reservoir would remove about 1,520 tons of salt per year from the Colorado River system.

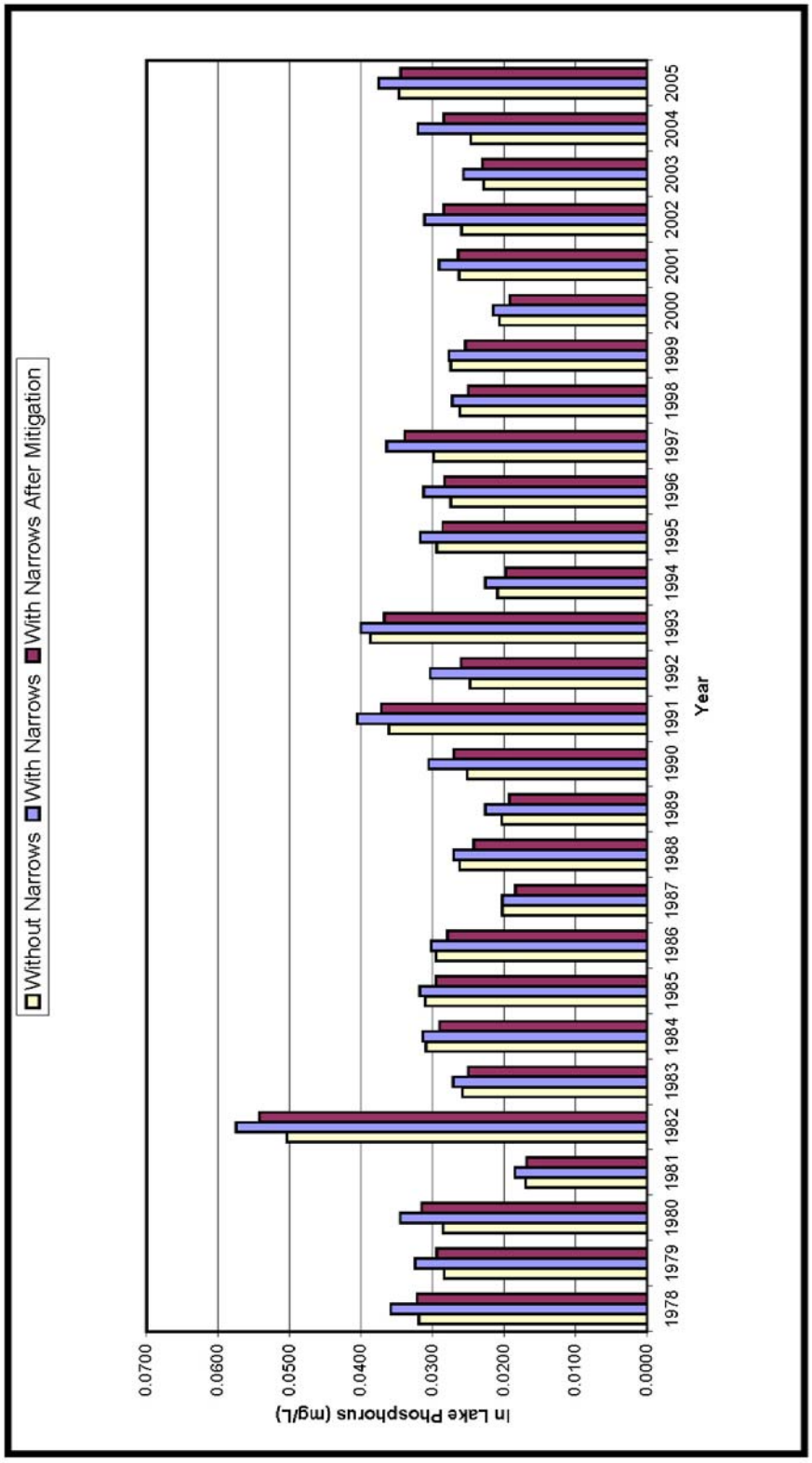


Figure 3-6.—Scofield Reservoir – Average Annual In-Lake Phosphorus Comparison.

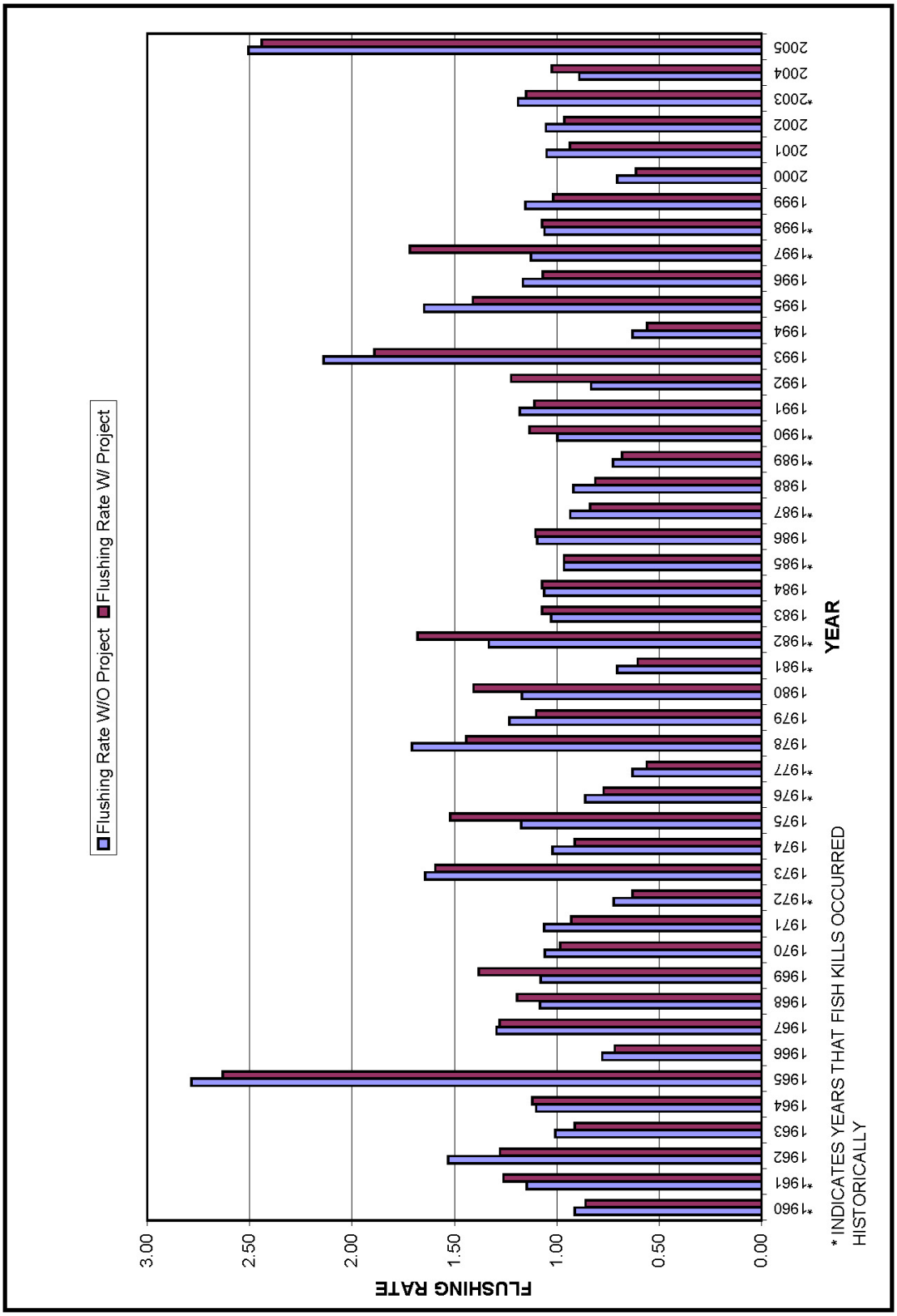


Figure 3-7.—Scofield Reservoir Comparison of Flushing Rates Future Without and With Project Conditions.

The project, however, also would cause a depletion of about 5,597 acre-feet of water to the Colorado River system. An increased salinity concentration of about 0.54 mg/L would occur at Imperial Dam.

3.5.3.2.5 Cottonwood Creek and San Pitch River

The overall water quality of Upper Gooseberry Creek is better than that of Cottonwood Creek (see table 3-14), so the additional water imported to Cottonwood Creek would improve its quality slightly. The exception may include temporary periods of slightly higher turbidity from the increased summer flows. Flows in Cottonwood Creek (below Left Hand Fork) would increase in July and August due to the increased irrigation releases, but these flows would be significantly less than peak flows that naturally occur during the spring snowmelt period. As discussed in the DEIS and the FEIS in section 3.14, "Slope and Channel Stability," the Narrows Tunnel operating gate would be automated to regulate releases through the tunnel so that even during thunderstorms, the channel forming discharge would not increase above historical conditions. Consequently, even though the Proposed Action would increase the summer base flow, it would have no effect on Cottonwood Creek channel stability because the increase would be well below the 50-year channel forming discharge.

Except during spring runoff and winter conditions, flows in the San Pitch River below the project area consist mostly of return flows from irrigation and municipal waste water. The project would increase the volume of return flows from both of these sources; however, since no new lands receive project water, the quality of return flows would be similar to existing flows or possibly would be of slightly better quality because lands would receive a more complete water supply. Consequently, the concentration of dissolved salts should be more diluted in the increased volume of return flows. The potential decrease in irrigation return flows, resulting from increasing agricultural efficiencies, would be offset by the increase of return flow from the additional project irrigation water. Even if the overall volume of return flow were reduced significantly due to increased efficiencies, the quality of the return flows likely would not change significantly, nor would the existing quality of the San Pitch River change significantly since it is already composed mostly of return flows.

As shown in table 3-17, the salinity of lower San Pitch River is about 1,150 to 1,635 mg/L TDS compared to about 350 mg/L in Sixmile Creek. If the Manti Meadows Alternative wetland mitigation area is selected, and water is delivered from Sixmile Creek and replaced with project return flows delivered to Gunnison Reservoir in exchange, there could be some impact to affected irrigated lands.

Diversions to the wetland area would have to be timed to not significantly affect the exchanged irrigation water supply, or replacement waters would need to be blended with higher quality Sixmile water to avoid impact to crops using the water. Under worst case conditions, an agreement with the Manti Irrigation Company might be needed, and minimal compensation might be required.

3.5.3.2.6 Proposed Mitigation Measures

Under the Proposed Action, water quality measures would be implemented to offset any measurable impacts to water quality in Lower Gooseberry and Scofield Reservoirs, although, as indicated above, only minor impacts, if any, are expected to occur. These measures include stabilizing the Gooseberry Creek channel, providing 300 acre-feet of water from Narrows Reservoir to augment winter flows into Lower Gooseberry Reservoir, and making improvements to

9.5 miles of stream segments tributary to Scofield Reservoir to reduce external phosphorus loading. These proposed mitigation measures are identified and discussed in section 2.2.2.

Because the proposed project would provide up to 300 acre-feet per year of water from the Narrows Reservoir to augment winter flows into Lower Gooseberry Reservoir and on down into Scofield Reservoir, DO levels in both reservoirs would be increased by the increased inflow of oxygen-rich water from Gooseberry Creek. This measure would help reduce or eliminate winter fishkills during critical periods.

The channel of Gooseberry Creek between Lower Gooseberry Reservoir and Narrows Dam would be narrowed to stabilize the banks and provide better fish habitat with the reduced flows. It is expected that, in time, the channel would narrow by itself due to the decreased flow. However, to expedite the process, certain manmade improvements would be made. These improvements also would decrease the inflow of phosphorus-laden sediments to Lower Gooseberry Reservoir and would reduce historical water quality problems. Prior to construction of these improvements, a detailed design would be developed by SWCD in coordination with the USDA Forest Service, Service, USACE, UDWR, and the Utah Division of Water Rights. Where the stream passes through private land, a right-of-way corridor adjacent to the stream would be acquired to protect the streambanks and water quality. The right-of-way corridor would be acquired in the name of the United States. Fencing also would be provided where needed to protect the stream from livestock. In addition, a high percentage of the nutrients flowing into Lower Gooseberry Reservoir would be caught in Narrows Reservoir.

These stream stabilization measures also would tend to improve the water quality in Scofield Reservoir by reducing phosphorous loading. This improvement would be realized in conjunction with the improvement of stream segments on tributary streams above Scofield Reservoir. About 9.5 miles of stream segments would be improved. The improvements would consist of bank stabilization, primarily through riparian planting. The stream segments also would be fenced to protect them from grazing impacts. This measure would reduce the amount of sediment and animal waste and, hence, the amount of phosphorous flowing into the reservoir. Historically, fishkills have occurred in Scofield Reservoir due to poor water quality. Phosphorous has been identified as the limiting nutrient in the eutrophication of the reservoir (State of Utah, Department of Environmental Quality, Division of Water Quality, 2000). Phosphorous loading occurs through several methods, including inflow of sediments, which are naturally high in phosphorous and animal waste. The Utah Division of Water Quality, in a report entitled *Scofield Reservoir Restoration Through Phosphorous Control,* concluded that "the most pragmatic and effective means to control the further eutrophication of Scofield Reservoir, or possibly to effect a moderate reversal of the eutrophication process, appears to be a reduction of the phosphorous load to the lake."

As mentioned earlier, the phosphorus loading and eutrophication models indicate that there would be a slight increase in the phosphorus concentration in Scofield Reservoir as a result of the Proposed Action. The future without the project model shows a concentration of 0.0279 mg/L of phosphorus in Scofield Reservoir. The Proposed Action phosphorus concentration is estimated to be 0.0309 mg/L for the study period from 1978–2005, an increase of 10.8%.

To reduce this impact on Scofield Reservoir, the proposed mitigation measures, as explained above, will be performed on 9.5 miles of stream segments. Mud Creek would account for 6.5 miles of the mitigation stream segments, with 2.0 miles on Pondtown Creek and 1.0 mile on Fish Creek. Water quality goals have been established to help monitor the impact of the mitigation measures related to phosphorous loading in Scofield Reservoir. A preproject phosphorous concentration in Scofield Reservoir may be achieved by reducing the phosphorous loading from these stream segments.

The model used in the eutrophication study estimates phosphorus loading would need to be reduced by 530 kg/yr. However, the model underestimates both the phosphorus loading to the reservoir and the in-lake phosphorus concentrations. The phosphorus load reduction required to achieve preproject conditions in the lake is calculated from a ratio of the model phosphorus load (4,434 kg/yr) and the TMDL estimated phosphorus load (6,723 kg/yr). The necessary phosphorus load reduction is estimated to be 805 kg/yr.

The proposed monitoring method would be to compare future water quality samples once the project is in operation, with the samples taken before that time. Calculated TSI values and an average of the phosphorus concentration in these water samples over time would indicate the effectiveness of the mitigation measures.

Salinity of the Colorado River has been increased by the development of water resources in two major ways:

1. The addition of salts from water use
2. The consumption (depletion) of water

The combined effects of water use and consumption have had a significant impact on salinity in the Colorado River Basin. The net effect of this project on Colorado River salinity is anticipated to be an increased salinity concentration of about 0.54 mg/L at Imperial Dam.

The Colorado River Basin States have agreed to limit this impact and adopted numeric criteria, which require that salinity concentrations not increase (from the 1972 levels) due to future water development. Salinity levels measured in the river may be low or high due to climatic conditions, but the goal of the Water Quality Criteria for the Colorado River Basin and the Colorado River Basin Salinity Control is to offset (eliminate) the salinity effects of additional water development (U.S. Department of the Interior, 2005).

Although it is not possible to accurately quantify the net effect of the project plan on water quality in Lower Gooseberry and Scofield Reservoirs, it is believed that the mitigation measures described above, along with the nutrient capture and export due to the project, would offset any adverse impacts caused by the water reduction and other consequences of the project, leaving essentially no residual project impact.

3.5.3.3 Mid-Sized Reservoir Alternative

Water quality impacts under the Mid-Sized Reservoir Alternative would be similar to those of the Proposed Action. The Price River depletion would be 5,298 acre-feet instead of 5,597 acre-feet under the Proposed Action, which would indicate a slightly reduced impact to water quality in the Lower Gooseberry and Scofield Reservoirs. This would be a reduction of 39% of the annual inflow to Lower Gooseberry Reservoir and 8.8% to Scofield Reservoir. The depletion to the Colorado River would be reduced slightly to 5,298 acre-feet, removing about 1,470 tons of salt per year from the Colorado River system but increasing salinity concentration at Imperial Dam by about 0.51 mg/L.

Water quality mitigation measures under the Mid-Sized Reservoir Alternative would be the same as those under the Proposed Action.

After mitigation, there would be effectively no residual project impact on water quality in Lower Gooseberry and Scofield Reservoirs. The net effect of the project on Colorado River salinity would be an increased salinity concentration of about 0.51 mg/L at Imperial Dam.

3.5.3.4 Small Reservoir Alternative

Water quality impacts under the Small Reservoir Alternative would be similar to those of the Proposed Action. The Price River depletion would be 4,841 acre-feet instead of 5,597 acre-feet under the Proposed Action, which would indicate a slightly reduced impact to water quality in the Lower Gooseberry and Scofield Reservoirs—a reduction of 36% of the annual inflow to Lower Gooseberry Reservoir and 8.3% to Scofield Reservoir. This depletion would remove about 1,380 tons of salt per year from the Colorado River system but would increase salinity concentration at Imperial Dam by about 0.46 mg/L.

Water quality mitigation measures under the Small Reservoir Alternative would be the same as those under the Proposed Action.

After mitigation, there would be no residual project impact on water quality in Lower Gooseberry and Scofield Reservoirs. The net effect of the project on Colorado River salinity would be an increased salinity concentration of about 0.46 mg/L at Imperial Dam.

3.6 WETLAND RESOURCES

3.6.1 Affected Environment

The wetlands affected by the project are not unique to the area, consisting of wetland plant communities common to high elevation mountain areas. Much of the area has been used for livestock grazing. Cattle and sheep were introduced into the area in the 1800s and, subsequently, overgrazed the vegetation to the extent that rangeland restoration was necessary. In 1908, the USDA Forest Service established a controlled grazing plan for rangelands on the Manti-La Sal National Forest. Cattle and sheep grazing are still allowed in this area.

Major plant community types occurring in the reservoir basin have been mapped (see figure 3-8). The three major plant communities that would be affected most by reservoir inundation are:

1. Vasey sagebrush
2. Silver sagebrush
3. Riparian areas including wetlands

Within the proposed reservoir basin, water collects and forms wet meadows, riparian wetlands, and willow thickets. The wet meadows are located adjacent to streamside vegetation and on higher ridges where spring seeps occur. Vegetation consists of rushes (*Juncus* spp.), sedges (*Carex* spp.), and various hydric grasses, such as tufted hairgrass (*Deschampsia casepitosa*).

Riparian wetlands occur in a dendritic pattern along small drainages within the basin. They consist of similar rush, sedge, and grass species and form narrow bands (usually 3–6 feet wide) of streamside vegetation. Less common in the reservoir basin are willow thickets. They occur primarily in the upper reaches of the proposed inundation area, usually along stream channels within the basin, and along Gooseberry and Cottonwood Creeks. Willow species include Drummond's willow (*Salix drummondaiana*), Booth willow (*S. boothii*), and Wolf willow (*S. wolfii*).

For a map showing the wetland communities within the basin study area, refer to figure 3-8.

3.6.2 Methodology and Impact Indicators

A wetlands delineation for the reservoir site was completed in 1991–92 following the procedures outlined in the USACE manual. In 2003, a wetlands delineation verification was performed for a portion of the area within the proposed Narrows Reservoir. This redelineation met the request of USACE that further studies be conducted to bring the original delineation up to the minimum standards set by the Utah Regulatory Office for the acceptance of wetlands delineations. The 2003 delineation was verified by the USACE on January 13, 2004, and was valid until January 13, 2009. Re-verification for this site was performed in 2009.

Approximately 349 acres of the proposed reservoir were verified, which represents 45% of the overall reservoir area.

It was found that the wetlands map, generated in 1992, was generally accurate; but because of methods used to create the map, the actual wetlands acreage was overstated at 100 acres. The original wetlands area within the verification area was shown as 34.78 acres, but the wetlands area in the wetlands delineation verification in 2003 was only 24.53 acres or 71% of the original acreage mapped. The 2003 verification estimated 71 acres of wetland. This 29% reduction in wetlands area is due to the methods used to map the delineation.

In 2009, the overall estimated wetlands were re-verified at approximately 89 acres. It is believed wetlands at the Narrows Reservoir project site may have shrunk from the 1992 to 2008. Because the original wetland delineation of 100 acres was generally accurate, data from that delineation was used in this SDEIS for mitigation, understanding that it is somewhat conservative compared to the verified delineation of 89 acres.

Because the primary function of wetlands is wildlife habitat, HEP was used to evaluate the wetland values. This is a “species habitat” approach to impact assessment of habitat quality. The program uses selected species for indicators to evaluate habitat for a host of other species, with the assumption that these indicator (evaluation) species are functioning units of part of an ecosystem. Impact to a particular indicator species assumes that there also would be impacts to the group of other species it represents.

HSI were ascertained for each evaluation (indicator) species. These indices range from 0.0 to 1.0, with each increment of change identical to the next. An HSI value is linearly related to the carrying capacity of the species. An HSI of “1.0” would represent the optimum habitat for the particular evaluation species, whereas “0.0” would represent habitat that is unsuitable.

HEP analysis is an indicator of the function and value of wetlands lost. Another important impact indicator is the total number of acres of wetlands lost as a result of the Narrows Project. Based on this criterion, all impacts on wetlands would be important because of the loss of acreage and function prior to implementing mitigation measures.

3.6.3 Predicted Effects

3.6.3.1 No Action Alternative

Wetland conditions are expected to remain the same as baseline conditions if the project were not constructed and if there were no future developments.

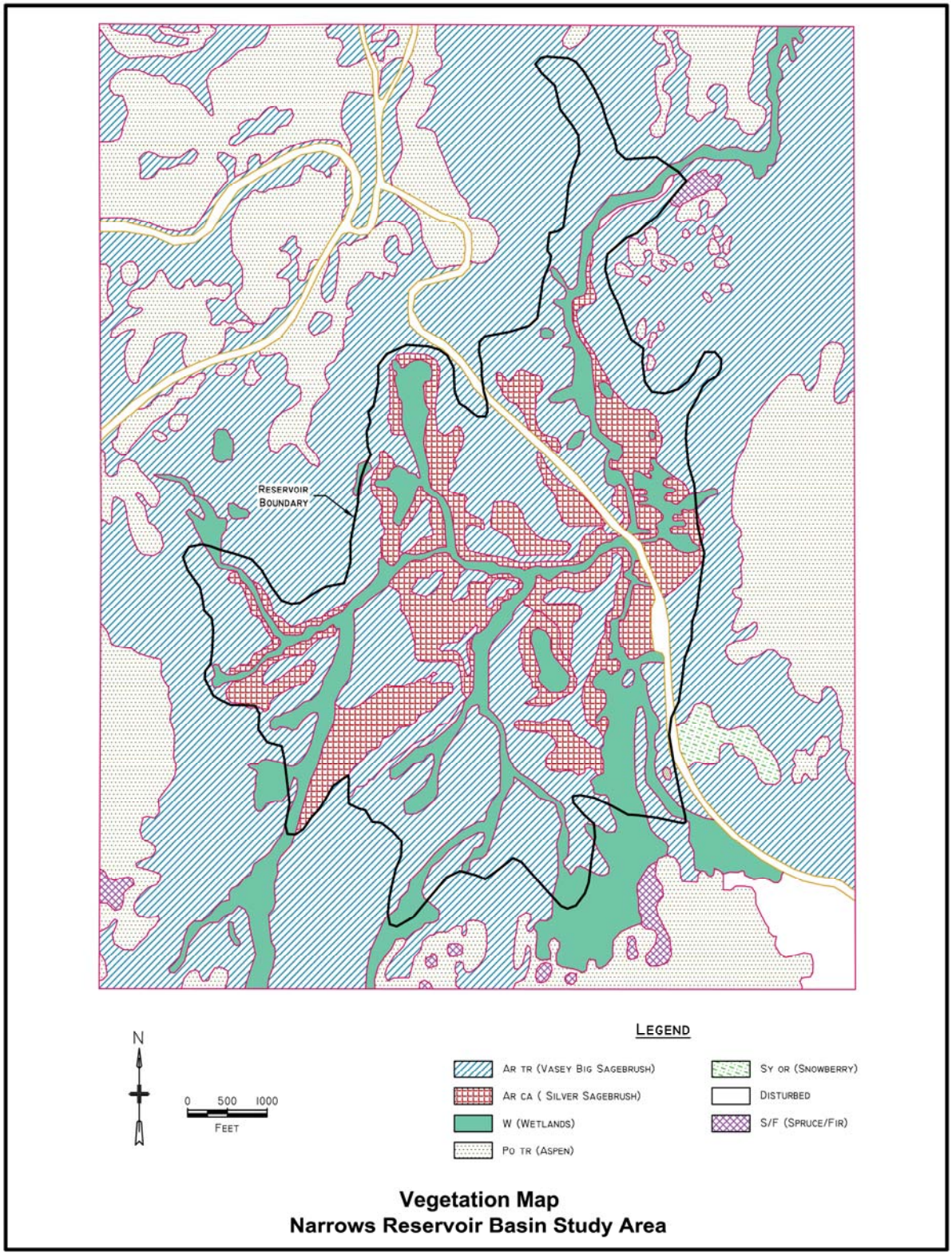


Figure 3-8.—Narrows Reservoir Basin Study Area Vegetation Map.

3.6.3.2 Proposed Action Alternative

The proposed Narrows Reservoir would inundate 89 acres of wetlands.

Hydrologic and hydraulic studies were conducted to determine the potential impacts to the riparian and wetlands vegetation of Gooseberry Creek resulting from decreased flows. Flow measurements conducted by the Utah Division of Water Rights indicate that the stream is a "gaining stream." This means that the streamflow increases as it moves downstream because the stream is being fed by the adjacent ground water aquifer. Because the stream is serving as a drain for the ground water system, an increase or decrease in stream water level would result in a corresponding increase or decrease in the elevation of the ground water table adjacent to the stream.

Water surface profile studies were conducted to determine the depth of flow in Gooseberry Creek between the Narrows damsite and Lower Gooseberry Reservoir. The studies indicated that, with the reduced flows proposed by the Proposed Action and with the existing stream cross section, the depth of flow would decrease by 6 to 11 inches under worst-case conditions. However, the project plan includes proposed modifications to this portion of the Gooseberry Creek channel. These modifications include narrowing the channel to maintain the depth of flow. In designing the stream channel modifications, the intent would be to create a stream channel that is more naturally suited to the new flow regime and that will have the same depth of flow as under baseline conditions. Therefore, the depth of ground water adjacent to the stream would not decrease, nor would there be any adverse effects on riparian and wetland vegetation adjacent to the stream. If anything, it is entirely possible that the wetland communities would be enlarged as a result of the project impacts; the current outer bounds of those communities likely would be unchanged as a result of the shallow ground water flowing toward the stream, but the wetlands likely would be increased precisely to the degree that the stream channel itself (or at least, the open water surface of the stream) narrows.

The process of narrowing the stream, as described in the SDEIS is planned so that the configuration of the narrowed streambanks would conform to that of the original streambank with respect to slope, materials, material size, and frequency as well as the water depth. The only change would be in the width of the channel and available open water surface. The result is that the same opportunity for overbank flows and wetted perimeter would exist as in the natural configuration. The gaining nature of the stream in this reach means that ground water is flowing toward and into the stream channel and that the stream does not provide the primary supply for the riparian community. The "wetted perimeter," therefore, should continue to be supplied from this source; and the stream will continue to gain as it flows. Bank saturation will not be affected here, as it would on many streams, because the direction of the ground water flows into the stream, rather than away from it. While overbank flows may be reduced in frequency, such flows, for this same reason, also are not critical to the bank saturation that supports the riparian community.

About 160 square feet (0.004 acre) of wetlands adjacent to Cottonwood Creek would be impacted by constructing the discharge structure at the end of the Upper Cottonwood Creek Pipeline. The remainder of the stream channel would not be affected. The channel presently is stable and adequately protected by natural cobble armoring.

3.6.3.3 Mid-Sized Reservoir Alternative

Impacts to wetlands resulting from implementing the Mid-Sized Reservoir Alternative would be similar to those resulting from construction of the Proposed Action. The primary difference would be the smaller amount of acreage (81 acres of wetlands) that would be inundated by Narrows Reservoir.

3.6.3.4 Small Reservoir Alternative

Impacts to wetlands resulting from implementing the Small Reservoir Alternative would be similar to those resulting from constructing the Proposed Action. The primary difference would be the smaller amount of acreage (72 acres of wetlands) that would be inundated by Narrows Reservoir.

3.6.4 Mitigation

Wetland mitigation measures are included in the project alternatives to mitigate for impacts to wetlands. The wetland mitigation measures would provide similar wildlife habitat values lost due to the inundation of the reservoir.

3.6.4.1 Proposed Mitigation – Mud Creek Area

The proposed mitigation would restore and create wetlands adjacent to Mud Creek near Scofield. This measure would entail purchasing about 220 acres of private land adjacent to Mud Creek, south of Scofield Reservoir. Portions of this land contain wetlands that have been severely damaged by past livestock grazing practices. The remaining portions are upland. It is anticipated that, by removing livestock, the wetland vegetation would return on its own with little or no other outside measures. Stream channel improvements on the Mud Creek channel would create additional wetlands adjacent to the stream. Some earthwork would be needed to create small berms and swales, which would create cells of new wetlands. These wetlands would be fed by the discharge from existing springs in the area (additional details found in section 2.2.2.2.4). Flows from Mud Creek also could be used to supply water for these wetlands. All or a portion of the required wetland mitigation could be performed at this site. The wetland area would be maintained by SWCD under a MOA with UDWR.

3.6.4.2 Alternative Mitigation – Area West of Lower Gooseberry Reservoir

Water would be diverted from an existing diversion structure on Cabin Hollow and would be transported through an existing open ditch to the 120-acre mitigation site. The water would be diverted from the ditch at several locations and allowed to flow across the uplands and to the surrounding wetlands. The existing wetlands on this site appear to have been created and maintained by the existing irrigation system. Some earthwork would be needed to create small berms and swales, creating cells of wetlands. The area around the perimeter would be excavated somewhat deeper and to a 20-foot minimum width, wider in some areas so that the edge of the swale is not abrupt but serpentine. This deeper area would allow for willows and other shrubs to be planted to create a vegetation barrier to the interior wetlands. The area would still be available for grazing, and wildlife would use the area; however, sheep would be deterred from entering the wetland by the perimeter swale, unless forced to cross the deeper water. The above perimeter swale would eliminate the need to fence the area and would allow access for wildlife. At least a portion of the required wetland mitigation could be accomplished at this site.

3.6.4.3 Alternative Mitigation – Area Between Fairview Lakes and Narrows Reservoir

This alternative would include enlarging existing wetland areas and creating new wetlands adjacent to Narrows Reservoir. About 100 acres of new wetlands would be created adjacent to Narrows Reservoir. This would be accomplished by releasing water from Fairview Lakes to inundate lands adjacent to existing wetlands. A new outlet from Fairview Lakes would be provided. The outlet would be designed to automatically begin releasing water once Fairview Lakes reaches a certain level. The releases would stop as the water level receded in the fall. The water would be conveyed to and distributed within the wetland area by a system of open ditches. Some recontouring would be performed to ensure that the soils become saturated. All or a portion of the required wetland mitigation could be accomplished at this site. This wetland area would be maintained by SWCD under a MOA with UDWR.

3.6.4.4 Alternative Mitigation – Manti Meadows

Under this alternative, return flows from the Narrows Project in the San Pitch River drainage would be available for UDWR to use at the Manti Meadows Waterfowl Management Area located southwest of Manti. Sixmile Creek water, which belongs to the Gunnison Irrigation Company and now flows into Gunnison Reservoir, would be diverted and delivered to the Manti Meadows area through existing facilities belonging to the Manti Irrigation and Reservoir Company. Narrows Project return flows arising in the San Pitch River would be delivered to Gunnison Reservoir in exchange for the water delivered to Manti Meadows. The water could be used to create at least 100 acres of new wetlands and to improve wetland habitat values of existing wetlands in the area. Some excavation and ground recontouring of existing uplands would be required to control drainage and encourage wetland development.

SWCD would have primary responsibility for implementing the wetland measures described above. SWCD would be responsible for funding and acquiring all lands and rights-of-way. SWCD would provide and transplant any native plantings needed. The wetland area would be maintained by SWCD under a MOA with UDWR.

3.6.5 Monitoring

Careful monitoring of the mitigation sites would be conducted to ensure that the value of the mitigation sites is at least equal to the value of the wetlands lost. This determination would be accomplished by performing HEP analysis of the sites prior to construction. Baseline information would be collected and compared to existing habitat values for 4 years after construction was completed to determine whether objectives were met. Monitoring would continue for a longer period of time if the wetland mitigation was not completed satisfactorily, or as otherwise deemed appropriate by USACE. If the mitigation goal is not met, additional mitigation would be provided at other alternative mitigation sites.

3.6.6 Maintenance

SWCD would be responsible to ensure that all fences are in good repair and are maintained properly. SWCD also would be responsible to install and maintain any diversion and/or irrigation facilities. The initial work would be performed concurrently with construction of other project facilities such as the dam, tunnel rehabilitation, and pipelines. All lands and rights-of-way would be acquired, and initial construction of

wetlands measures would be completed prior to initial filling of the reservoir. SWCD would be responsible to fund the monitoring of the wetland mitigation. SWCD would be responsible to enter into a MOA with UDWR, USACE, and other appropriate agencies for wetland measures. The MOA would clearly define the roles and responsibilities of SWCD, UDWR, USACE, and other parties for implementing and maintaining the wetlands measures.

3.6.7 Secondary Benefits

3.6.7.1 Upper Cottonwood Creek from the Left Hand Fork to the Mouth of the Canyon and Irrigation Diversion Works

During winter months, a 2.0-cfs release flow would be made from Narrows Reservoir to Cottonwood Creek to increase the available fish habitat and provide hydrology for wetlands along the creek. Although primarily intended as a measure to facilitate winter survival of fish, this measure also would have some beneficial effects on the riparian and wetland areas adjacent to the creek.

3.6.7.2 Lower Cottonwood Creek from the Irrigation Diversion to the San Pitch River

A 2.0-cfs minimum diversion would be provided in lower Cottonwood Creek from the canyon mouth. This measure would provide year-round flows in the stream, which would enhance the riparian corridor. This segment of stream historically has been dewatered during the irrigation season. Although primarily intended as a measure to facilitate winter survival of fish, this measure also would have some beneficial effects on the riparian and wetland areas adjacent to the creek. Due to existing irrigation diversions, from the mouth to the San Pitch River confluence, Cottonwood Creek has essentially no riparian zone. Providing flows in summer months would stimulate the growth of riparian and wetland vegetation.

3.6.7.3 Streamflows from Fairview Lakes to the Proposed Reservoir

Presently, during the spring runoff period, water is stored in Fairview Lakes and released for irrigation use in the Fairview area. This release is a transbasin diversion of water to the San Pitch River drainage. With the historic operational pattern, the small tributaries to Gooseberry Creek located downstream from Fairview Lakes are dry several months each year. This mitigation measure involves providing year-round releases, averaging about 2.6 cfs from Fairview Lakes, into two of these tributaries to Gooseberry Creek. This amounts to an average 1.3-cfs flow per channel. The total annual amount of water that is released from Fairview Lakes would not be changed. The flow, however, would be dispersed during the entire year, rather than the present 18- to 20-week discharge period.

Water released from Fairview Lakes during the year would be captured and stored in Narrows Reservoir. Upon call by CGIC, their water would be released through the Narrows Tunnel to the San Pitch River drainage. This would provide aquatic benefits to the Narrows Project and aesthetic and recreational benefits to Fairview Lakes. These benefits would result from maintaining the lakes at a higher water level during the prime summer recreational season. This measure also would result in creating approximately 2.3 stream miles of spawning and rearing habitat for cutthroat trout and creating and enhancing wetlands and riparian areas along the stream.

SWCD would be responsible for entering into operating agreements necessary to implement these year-round releases. SWCD would ensure that the releases are made according to environmental commitments.

3.6.7.4 Middle Gooseberry Creek

As part of the fishery mitigation, the channel of Gooseberry Creek would be narrowed between Lower Gooseberry Reservoir and Narrows Dam to provide better habitat with reduced flows. It is expected that the channel eventually would narrow by itself due to the decreased flow. However, to expedite the process, certain manmade improvements would be made, reducing the vertical cut and eroded banks and providing wetland and riparian areas.

3.7 VEGETATIVE RESOURCES

3.7.1 Affected Environment

Vegetation located in the study area consists primarily of plant communities common to high elevation mountain areas. Historically, the area has been used for livestock grazing and other reservoir impoundments. Cattle and sheep were introduced into the area in the 1800s and, subsequently, overgrazed the area to the extent that rangeland restoration became necessary. In 1908, the USDA Forest Service established a controlled grazing plan for the Manti-La Sal National Forest. Cattle and sheep grazing is still allowed in the area.

Major plant community types occurring in the reservoir basin have been mapped (see figure 3-8). The three major plant communities that would be affected most by reservoir inundation include vasey sagebrush, silver sagebrush, and wetlands. There are also areas within the basin that have been disturbed previously by diverting water to Cottonwood Canyon through the existing Narrows Tunnel. In addition, there are those disturbed areas associated with SR-264 that cross the north end of the basin.

The Narrows Reservoir basin was identified as the area that would be most significantly impacted by the proposed project. For this reason, the basin was studied in more detail than the other areas associated with the project. Other areas also would be directly affected by the proposed project as a result of reservoir inundation, construction disturbance, and mitigation.

A summary of vegetated areas affected by the project is listed in table 3-18.

Table 3-18.—Narrows Project Summary of Affected Vegetated Areas

Area	Acres
Reservoir basin	604
Wetland mitigation	220
Upland mitigation	790
Fisheries mitigation	90
Pipelines	63
SR-264 relocation	34
Recreational areas	12
Materials source	2
Total	1,815

3.7.1.1 Vasey Sagebrush Community

This community is the driest of the three major plant communities in the basin. It exists on the more well-drained soils of the upland slopes. The vasey sagebrush community comprises 55% (331 acres) of the reservoir basin. Dominant woody plant species of the community include vasey sagebrush (*Artemisia tridentata* var. *vaseyana*), low rabbitbrush (*Chrysothamnus viscidiflorus*), and snowberry (*Symphoricarpos oreophilis*). Dominant forbs are Pacific aster (*Aster chilensis*), yarrow (*Achillea millefolium*), and orange sneezeweed (*Helenium hoopsii*). The dominant grasses are represented by slender wheatgrass (*Elymus trachycaulus*), Letterman needlegrass (*Stipa lettermanii*), and mountain brome (*Bromus carinatus*).

Range analysis studies were conducted by the USDA Forest Service on federally owned land near the project area. Total

annual production ranged from 682 to 949 dry pounds per acre.

3.7.1.2 Silver Sagebrush Community

The silver sagebrush community lies immediately below (downslope) the vasey sagebrush community and comprises 26% (156 acres) of the basin. The soils of this community occur on both level and sloped terrain but generally are on the less well-drained and flatter areas. Consequently, they support more mesic shrub species—for example, silver sagebrush (*Artemisia cana*) and shrubby cinquefoil (*Potentilla fruticosa*). Forb species include penstemon (*Penstemon* spp.), varileaf phacelia (*Phacelia heteophylla*), and silver cinquefoil (*Potentilla anserina*). Grasses and grass-like species dominant in the area are orchardgrass (*Dactylis glomerata*), Kentucky bluegrass (*Poa pratensis*), and smallwing sedge (*Carex microptera*).

3.7.1.3 Wetland Communities (see also Section 3.6, "Wetland Resources")

Near the bottom of the basin, water collects and forms meadows, wetlands, and, ultimately, small creeks that converge to Gooseberry Creek. Wetlands communities generally form on three topographic positions in the area. These wetland communities are wet meadows, riparian sedge wetlands, and willow thickets. The wet meadows are formed in topographic depressions located adjacent to some of the streamside vegetation and on higher ridges where seeps occur. They consist of plant species such as rushes (*Juncus* spp.), sedges (*Carex* spp.), and various hydric grasses, such as tufted hairgrass (*Deschampsia caespitosa*). Similar in species and composition are the riparian sedge wetlands, which occur in a dendritic pattern along small drainages. They also consist of various rushes, sedges, and grass species, which form narrow bands (usually 3–6 feet wide) of streamside vegetation common to the area. Less common in the reservoir basin are willow thickets, occurring primarily in the upper reaches of the proposed inundation level, usually along stream channels in the basin and along Gooseberry and in Cottonwood Creeks. Willow species include Drummond's willow (*Salix drummondiana*), Booth willow (S. *boothii*), and Wolf willow (*S. wolfii*).

Former wetlands being considered as a mitigation alternative are located adjacent to Mud Creek near Scofield. In addition to Mud Creek, numerous springs emerge from the nearby side hill. The creek and springs should provide an ample water supply for wetland vegetation. This area, however, currently is overgrazed and often is covered by weedy plant species, but it has the potential of supporting stable, wetland plant communities. In addition, the streambanks have been severely damaged by cattle that are kept on the land.

Both USACE and EPA have jurisdiction over wetlands for the Narrows Project. USACE is responsible for issuing permits for activities in waters of the United States. The combined jurisdictional wetlands of the basin study area constitute 89 acres of the reservoir basin. Of the 89 wetland acres that exist in the reservoir basin, the riparian sedge and meadows comprise about 63%; whereas, the willow thickets comprise nearly 37%. Previous wetland losses within the reservoir basin include less than 0.5 acre associated with construction of SR-264.

3.7.1.4 Previously Disturbed Areas

The total previously disturbed area within the reservoir basin was calculated to be about 17 acres or 2%. Table 3-19 is a summary of vegetation communities found in the reservoir basin.

Table 3-19.—Vegetation Communities in the Reservoir Basin[1] of the Proposed Action

Affected Type	Acres
Vasey sagebrush	331
Silver sagebrush	156
Wetland communities	100
Previously disturbed	17
Total	604

[1] An almost negligible amount (<1%; 0.18 acre) of aspen forest also could be affected within the reservoir basin.

3.7.1.5 Noxious Weeds

There are extensive stands of Dalmation toadflax (*Linaria dalmatica*) and some scattered musk thistle (*Carduus nutans*) that occur in the reservoir basin area, primarily on private land. These noxious weeds occur primarily in the sagebrush communities and, to a lesser extent, in the wetland areas.

3.7.1.6 Plant Communities Adjacent to the Reservoir Basin

Major plant communities that exist within the immediate area, but are not within inundation areas, include vasey sagebrush, snowberry, aspen, and spruce/fir (see figure 3-8).

3.7.1.7 Other Plant Communities

Other plant communities were studied as part of the existing environment, which could be affected by the proposed project. Foothill areas along the west side of the Wasatch Plateau would be dissected with the conveyance pipelines. Plant communities found in those areas include valley sagebrush, scrub oak, grassland, and mountain brush.

3.7.2 Methodology and Impact Indicators

Potential impacts on wetland and riparian resources are considered significant if project implementation results in any loss of wetland acreage (extent) or function. Based on this criterion, all impacts on wetlands and riparian communities would be significant because of the loss of acreage and function prior to implementing mitigation measures.

Potential impacts on aquatic resources in streams are considered significant if project construction, implementation, or long-term operation would cause a loss of stream length due to inundation by the reservoir or stream reaches affected by the increase or decrease in flow.

Impact indicators for this issue include the number of miles of stream lost due to inundation of the reservoir or the number of miles of stream affected by flow.

3.7.3 Predicted Effects

3.7.3.1 No Action Alternative

Vegetative conditions are expected to remain the same as baseline conditions if the project were not constructed and if there were no other future developments.

Noxious weeds have the potential to spread. Control must be performed by the landowner or Sanpete County.

3.7.3.2 Proposed Action Alternative

A hydrologic study conducted on the potential impacts to the riparian vegetation of Gooseberry Creek by decreased flows suggested only a minor impact to the riparian vegetation. Flow measurement conducted by the State Engineer's office indicated that the stream was a "gaining stream." This means that the depth of the ground water table adjacent to the stream corresponds directly with the water surface of the stream—that is, an increase or decrease in stream water level results in the corresponding increase or decrease in the elevation of the ground water table. Moreover, the project plan includes

channel modification work in the middle segment of Gooseberry Creek to keep the flow levels up. Because the depth of flow in the stream would not be significantly reduced under the project, the depth of the ground water table adjacent to the stream should not be expected to be lowered.

A lack of overbank flooding due to stream regulation can result in an absence of recruitment of younger age classes of natural riparian vegetation such as cottonwood trees and willows. Overbank flooding, particularly on larger streams and rivers, both scours the banks, providing a new seedbed, and transports and deposits seed thereon. The reduction of overbank flows appears to be the result of stream regulation—that is, placing a smaller stream into a larger channel formed by larger peak flows of the unregulated stream or river.

At the proposed project, this effect would be offset by the channel modifications on Middle Gooseberry Creek, whereby the channel actually would be sized down to match the postdam stream. Base flows would be provided from the Narrows Project, but overbank flooding also still should occur as the result of natural local events such as thunderstorms, as well as from periodic flushing flow releases from the proposed Narrows Reservoir. Given the relative size of Gooseberry Creek (i.e., as compared to larger streams), the likelihood of actual scouring would be no greater than under predam conditions, but seed spreading and propagation most likely would remain similar under postdam conditions as under predam conditions. Therefore, the riparian vegetation should not be adversely affected by the project. (See also the discussion of "Wetland Resources" under section 3.6.3.2.)

Because the Narrows Project water would be added only to the flow (if any) of Cottonwood Creek when that creek is flowing well below its channel capacity, there would be no period of extended overbank flooding resulting from the Proposed Action. Flooding would result, both predam and postdam, only when the natural flow in the Cottonwood Creek basin is high. Project releases would not be added on top of such peak flows, nor would they be added to lower flows to produce additional floods. As a result of existing diversions, Cottonwood Creek is now dry much of the summer and fall. Project releases simply would provide a longer period of wetted channel, which should benefit riparian vegetation (see additional discussion in section 3.14).

The areas that are disturbed during construction have a high probability of being infested by noxious weed species. People using the area may spread the weeds by carrying the seeds on their person or on their vehicles. Seeds will get into the water and be spread downstream in both Gooseberry Creek and Cottonwood Creek. Control of noxious weeds as part of the Narrows Project would be the responsibility of SWCD.

Areas along the foothills of the west side of the Wasatch Plateau would be dissected with the diversion pipelines. Plant communities such as big sagebrush (*Artemisia tridentata var. tridentata*), gamble oak (*Quercus gambelii*), grasslands, and mountain brush communities, along with their associated wildlife species, would be disturbed by the conveyance pipelines. These disturbances, however, would be only temporary because the pipelines would be buried. Revegetation that reflects the existing plant community would be accomplished with a mixture of grasses, forbs, and shrubs. A total of 30 acres along a 17-mile-long alignment would be disturbed by the pipeline construction.

The reservoir basin was identified to receive the most significant impact by the proposed project. For this reason, the reservoir basin was studied in greater detail than the other areas associated with the project. The

affected wetlands in this area occur in a dendritic pattern in the riparian zones along small drainages. As shown in table 3-19, plant communities that would be highly impacted by reservoir inundation include vasey sagebrush, silver sagebrush, and wetlands. All vegetation in the 604 acres listed in the table would be inundated by the reservoir. (See table 3-19 for acreage breakdown by vegetative type.)

3.7.3.3 Mid-Sized Reservoir Alternative

Impacts to vegetation resulting from implementing the Mid-Sized Reservoir Alternative would be similar to those resulting from construction of the Proposed Action. The primary difference would be the smaller amount of acreage (489 acres) that would be inundated by the proposed Narrows Reservoir. This area includes 81 acres of wetlands. The affected wetlands in the reservoir basin occur in a dendritic pattern in the riparian zones along small drainages. Other impacts to vegetation would be similar to those experienced under the Proposed Action.

3.7.3.4 Small Reservoir Alternative

Impacts to vegetation resulting from implementing the Small Reservoir Alternative would be similar to those resulting from construction of the Proposed Action. The primary difference would be the smaller amount of acreage (362 acres) that would be inundated by the proposed Narrows Reservoir. This area includes 72 acres of wetlands. The affected wetlands in the reservoir basin occur in a dendritic pattern in the riparian zones along small drainages. Other impacts to vegetation would be similar to those experienced under the Proposed Action.

3.8 RECREATION AND VISUALS

3.8.1 Recreation

3.8.1.1 Affected Environment

According to the Utah Division of Parks and Recreation's *1992 State Comprehensive Recreation Plan*, the most popular outdoor individual recreational activity in Utah is fishing, followed by walking, golf, and camping. As with other major reservoirs along the Wasatch Front, Lower Gooseberry Reservoir, Beaver Dam Reservoir, and Fairview Lakes are heavily fished and overcrowded.

Boating also ranks as one of the more popular outdoor recreation activities in Utah, yet not enough flat-water boating and boat launching lanes presently are available to meet public demand. Information from the Utah SCORP suggests that additional boating facilities are needed for the potential growth in demand for recreation users statewide.

Family-favored activities are sightseeing, developed camping, primitive camping, and fishing, among others. First choices for new facilities near communities are picnicking, fishing, special event areas, ice skating, and snowmobiling.

Beaver Dam is a heavily used day-use area for anglers near the proposed project, and there are several developed USDA Forest Service campground facilities in close proximity to the project area. The Lower Gooseberry Reservoir (16 units); Gooseberry (10 units); Flat Canyon (13 units); and Lake Campground (51 units) are all fee areas, with a 92-day season of use from June 15 through September 15. Water, sanitation facilities, tables, and fire grills are provided. Boulger Reservoir is a nondeveloped, dispersed camping area in the area. There are vault toilet facilities there. These campgrounds (with the exception of Boulger) are typically

full on weekends and one-third full on weekdays throughout their season of use.

The proposed reservoir area is known as a very popular location for snowmobile enthusiasts. The USDA Forest Service and UDOT maintain unloading, parking, and sanitation facilities along SR-31, immediately west of the proposed reservoir area, from which snowmobiles embark for travel along groomed trails following Skyline Drive and SR-31, as well as in the proposed reservoir area itself.

Whitewater boating is limited mostly to a relatively short season when flows are peaking, coinciding with the high flows from the White River, when the gates at Scofield Reservoir are closed. In wet years, spills from Scofield may contribute to the peak. When Scofield releases again are started up to supply irrigation demands downstream, the level of boating falls off significantly. The segment of the river between Scofield Reservoir and the picnic area above Price Canyon Dam (approximately 15 river miles) contains Class I–III rapids. The segment of the river between the picnic area above Price Canyon to Castle Gate (approximately 8.5 river miles) contains Class III–V rapids. This segment of the river is more challenging and requires skill and careful maneuvering to avoid the hazards of the narrow canyon. The segment of the river that receives the greatest us is between Woodside to the confluence with Green River. This segment of the river contains Class III–V rapids. The apparent reason for the greater use in this area is the flow regime and the wilderness setting of the river segment.

3.8.1.2 Methodology and Impact Indicators

Recreation use rates at Narrows Reservoir would be expected to approximate the use rates at Joe's Valley Reservoir based on the number of campsites and other such facilities per acre of water surface area (1,170 acres). Joe's Valley Reservoir has a total of 64 campsites, essentially the same as the 60 sites in the Proposed Action. A preliminary estimate includes 46 sites located in the campground and 18 near the boat ramp, of which 10 are picnic sites.

The proposed number of campground units and picnic sites for the Proposed Action, the Mid-Sized Reservoir Alternative, and the Small Reservoir Alternative are intended only as reasonable estimates. The actual number, including restroom type and quantity, boat ramp capacity, group site accommodations, and other facilities, would be determined in detail during the recreation facility design process for the proposed project.

Scofield and Joe's Valley Reservoirs, both constructed by Reclamation, are in the same vicinity as the proposed Narrows Reservoir. Both reservoirs are heavily used for recreation. Scofield State Park receives an annual visitation of about 105,200 visitors. Annual revenues approach $98,400. Table 3-20 shows average annual recreation use for both reservoirs.

Table 3-20.—Narrows Project Nearby Reservoirs Present Recreation Use

Reservoir	Average Annual Use (Visitor Days)
Joe's Valley	85,000
Scofield	105,200

Source: Reclamation reported recreation use data for 2003–08.

Recreation use of the reservoirs includes fishing, boating, camping, picnicking, summer home use, horseback riding, snowmobiling, and hunting. Although total recreation visitor days (RVD) (average number of visitors in a 12-hour period) are available for these areas, there is no breakdown of data for the number of visitor days spent on each specific activity.

Lower Gooseberry Reservoir, Beaver Dam Reservoir, and Fairview Lakes are heavily fished. In the immediate project area, Gooseberry Creek is used to a lesser degree by fishermen.

Dispersed recreation occurs outside of areas where existing recreation facilities are built. It occurs mostly along or adjacent to roads and includes activities such as driving for pleasure, camping, hiking or mechanized trail use, hunting, fishing, and wilderness travel. Based on the Recreation Opportunity Spectrum (ROS) system for classifying recreation opportunities, as described in the 1986 *Manti-La Sal National Forest Land and Resource Management Plan (LRMP)*, the dispersed recreation opportunity within the proposed reservoir area would be classified as "Roaded Natural." There are nearly 413,672 acres of land with this classification within the Manti-La Sal National Forest. As indicated in table 3-21, the 1980 recreation use of these lands was about 524,036 visitor days or an average of 1.3 visitor days per acre per year. By the year 2030, the demand for this type of recreation use is expected to increase to about 1,587,912 visitor days per year or 3.8 visitor days per acre per year.

Other areas within the Gooseberry Creek and Fish Creek drainage, but outside the reservoir basin, provide dispersed recreation opportunities classified as "Roaded Natural," "Semiprimitive Motorized," "Semiprimitive Nonmotorized," and "Primitive." The 1980 use and estimated 2030 project demands for these types of recreation opportunities are summarized in table 3-21.

3.8.1.3 Predicted Effects

3.8.1.3.1 No Action Alternative

The existing recreational facilities in and around the project area are overcrowded. Under this alternative, the overcrowding would continue.

3.8.1.3.2 Proposed Action Alternative

Under this alternative, recreation facilities, including a 60-unit campground, boat ramp, 10 picnic sites, and a corresponding number of restroom facilities, would be provided at the proposed Narrows Reservoir. The recreation facilities would draw heavy use from not only Sanpete, Carbon, and Emery Counties but also from the Provo/Orem and metropolitan Salt Lake City areas. The proposed Narrows Project would help meet the demand for additional boating facilities in the area. In addition, it is expected that the reservoir would develop into an excellent flat-water fishery. A conservation pool would be provided to ensure successful overwintering of fish.

The proposed Narrows Reservoir would increase the State and regional inventory for fishing, boating, and water play. At the top of the active capacity water level for the

Table 3-21.—Manti-La Sal National Forest Dispersed Recreation 1980 Use and Estimated 2030 Demand

ROS Class	1980 Base		2030 Demand	
	RVDs	Gross Acres	RVDs	Gross Acres
Primitive	2,806	48,082	20,800	48,082
Semiprimitive nonmotorized	18,162	117,891	58,256	117,891
Semiprimitive motorized	158,194	831,807	473,287	831,807
Roaded natural appearing	524,036	413,672	1,587,912	413,672
Total	703,198	1,411,452	2,140,255	1,411,452

Proposed Action, the proposed project's facilities are expected to attract a total of 43,911 additional visitor days per year of total developed recreation use. These use rates are based on use rates of Joe's Valley Reservoir.

Construction of the proposed Narrows Project and its associated recreation facilities would cause the loss of 237 acres of "Roaded Natural" dispersed recreation on Reclamation withdrawn lands and 466 acres on private lands. It is estimated that these 703 acres would provide approximately 910 visitor days at 1980 levels of use and would provide about 2,670 visitor days of use in 2030. This reduction in dispersed use would be offset by the new facilities that would act as an attraction to local communities and individuals from the Wasatch Front who already contribute above 60% of the use on the Manti-La Sal National Forest. It is anticipated that the 43,911 visitor days of newly developed recreation use would be paralleled by an equal amount of dispersed recreation in the reservoir vicinity within the first 5 years of operation. This growth in recreation use would be a direct effect of the project and would require more intensive management in the area surrounding it (approximately, the area 8–10 miles in each direction).

At times when this newly developed recreation site and others in the area are at capacity (most of the summer season and particularly holiday weekends), users would move into nearby nondeveloped or dispersed areas. Some reservoir users actually would prefer dispersed sites regardless of developed site availability, and others would use dispersed sites to avoid associated fees.

The amount of dispersed use within 8–10 miles of the proposed reservoir is already at a level considered to be crowded during holidays and big game hunting seasons. The additional attraction of the new flat-water fishery in this area is expected to increase dispersed use to a point that the USDA Forest Service would need to place restrictions on areas available for this type of use. Such restrictions may include special measures for sensitive areas such as wetlands. In addition to increased resource protection and rehabilitation costs, conflicts among such activities as ice fishing and snowmobile use, hiking, and ATV users could be expected.

Along with increased dispersed use in the area, nearby developed recreation facilities would be impacted. Gooseberry Campground and the Lower Gooseberry Reservoir units are immediately adjacent to the proposed reservoir, as is the Scenic Byway and snowmobile parking area. Skyline Drive, Flat Canyon Campground, and the limited facilities at Beaver Dam and Boulger Reservoirs are also within reasonably close proximity.

Implementing the Proposed Action would cause Scofield Reservoir to operate at a lower level, thus reducing the surface area available for fishing and other forms of recreation by about 12% (274 acres). It is expected that this would result in the loss of about 12,708 visitor days per year, including fishing, based on the Reclamation data referenced in table 3-20. Based on use rates obtained in 2005 and 2007 creel surveys by UDWR, there would be a loss of 3,239 angler days of fisherman use.

Recreation use of Scofield without enlargement would have experienced fewer visitor days. There would have been fewer angler days of fisherman use had Scofield not been enlarged. The aquatic mitigation measures of restoring year-round flows in two small tributaries to Gooseberry Creek and maintaining Fairview Lakes at a higher elevation during the prime summer recreational season also would provide angler benefits to the area.

Under the Proposed Action, more frequent fishkills and accelerated eutrophication also could degrade the park. However, water quality mitigation has been provided. Whereas the total inventory of water-based recreation may be increased, some of it would be offset by a downgraded State park at Scofield. The higher elevation of the proposed Narrows Reservoir would have a shorter season of use at an elevation of more than 8,600 feet than would the Scofield Reservoir at about 7,600 feet. Greater snow cover would probably occur at elevation 8,600 feet, causing less access because of deep snow and later snowmelt.

Depending on the type of hydrologic year, water levels in Narrows Reservoir would fluctuate between 25–75% of the full pool area during the recreation period, 25% on average, and up to 75% in an extended drought cycle. Recreation action may be affected, particularly for those using the boat dock at maximum drawdown.

3.8.1.3.3 Mid-Sized Reservoir Alternative

Under this alternative, recreation facilities would include a 50-unit campground, a boat ramp, 8 picnic sites, and a corresponding number of restroom facilities. At the top of the active capacity for the Mid-Sized Reservoir Alternative, the facilities are expected to attract 35,550 additional visitor days per year of developed recreation use (see table 3-22). According to Reclamation data, about 12,059 total RVDs, including fishing, would be lost at Scofield Reservoir (see table 3-23). Based on UDWR data, about 3,073 angler days per year would be lost at Scofield Reservoir. About 740 visitor days of dispersed recreation use at 1980 use levels would be lost, and about 2,160 visitor days at projected 2030 use levels would be lost. Impacts to recreation would be similar to those described in the Proposed Action.

Table 3-22.—Proposed Recreation Use at the Narrows Project

Alternative	Surface Area Acres	Visitor Days per Acre	Visitor Days
Proposed Action	604	X 72.7 =	43,911
Mid-Sized Reservoir	489	X 72.7 =	35,550
Small Reservoir	362	X 72.7 =	26,317

Source: Reclamation gathered information from USDA Forest Service records (2003–08); visitor days per year at Joe's Valley Reservoir (85,000), divided by 1,170 surface acres.

Table 3-23.—Proposed Recreation Use at the Narrows Project Including Impacts to Scofield

Alternative	Visitor Days for Narrows	Visitor Days for Scofield	Overall Visitor Days for Alternatives
Proposed Action	43,911	-12,708	31,203
Mid-Sized Reservoir	35,550	-12,059	23,491
Small Reservoir	26,317	-10,853	15,464

Source: Reclamation gathered information from USDA Forest Service and State Parks (2003–08); visitor days per year at Joe's Valley Reservoir (85,000), divided by 1,170 surface acres; and Scofield Reservoir (105,200), divided by 2,268 surface acres.

3.8.1.3.4 Small Reservoir Alternative

Under this alternative, recreation facilities would include a 40-unit campground, boat ramp, 6 picnic sites, and a corresponding number of restroom facilities. At the top of active capacity for the Small Reservoir Alternative, the facilities are expected to attract 26,317 additional visitor days per year of developed recreation use (see table 3-22). According to Reclamation data, about 10,853 total RVDs, including fishing, would be lost at Scofield Reservoir. Based on UDWR data, about 2,766 angler days per year would be lost at Scofield Reservoir (see table 3-23). About 560 visitor days of dispersed recreation use at 1980 use levels would be lost, and about 1,650 visitor days at projected 2030 use levels would be lost.

Impacts to recreation would be similar to those described in the Proposed Action.

3.8.2 Visual Resource

3.8.2.1 Affected Environment

The project features would be located within the Manti-La Sal National Forest on the Wasatch Plateau. The dam and diversion works would be located in the Gooseberry Valley, a tributary to the Price River, at about elevation 9,000 feet.

The characteristic landscape is consistent with typical high elevation mountain areas. The topography on top of this plateau is rolling and contains shallow basins covered with sage/grass communities bordered by spruce/fir, interspersed with aspen.

The Narrows damsite is within 2 miles of the intersection of two State highways, SR-31 and SR-264. Both highways have been designated as National and State Scenic Byways. SR-31 connects Fairview in the Sanpete Valley with Huntington in Emery County. SR-264 connects Scofield with SR-31 at Skyline Drive. These are major commuter routes for miners from the Sanpete Valley working in the coal mines on the east side of the Wasatch Plateau. In addition to commuting and recreation traffic, SR-31 serves as a route for hauling livestock from the Sanpete Valley to summer ranges.

It should be emphasized that scenery is an important natural resource and recreational element in this part of the forest. It is primarily through the visual sense that most visitors perceive the forest and its interrelated components. There is additional visual sensitivity here due to the adjacent Scenic Byway, which serves as a forest gateway/ viewing corridor for many recreationists.

3.8.2.2 Methodology and Impact Indicators

General direction for visual resource management located on page III-17 of the *Manti-La Sal National Forest Land and Resource Management Plan* states, "Forest resource uses or activities should meet the adopted Visual Quality Objective (VQO) as displayed on the Planned Visual Quality Objective Map."

The Manti-La Sal LRMP has assigned a VQO to each area of the forest, reflecting the desired management emphasis of the specific area. Some of those objectives assigned by the LRMP allow a noticeable degree of change from the existing condition, as determined during the visual assessment conducted in 1986, in order to facilitate subsequent use in reaching comprehensive forest management goals.

The term, visual quality objective, refers to the degree of acceptable visual alteration of the landscape and is defined as follows: a desired level of scenic excellence based on physical and sociological characteristics of an area. Typically, more stringent VQOs are incorporated to protect the most highly visible and most frequently seen areas that have the greatest amount of variety in vegetation and other features, which occur naturally. These long-term VQOs or goals are based on a large-scale visual inventory and management process called the Visual Management System (VMS), which has been used by the national forests for the past two decades. Although inherently subjective, the VMS framework facilitates the attainment of aesthetic goals while balancing other important resource needs.

Much of the reservoir itself, and particularly the anticipated area of mud flat to become exposed when the reservoir is drawn down, is located on private land, which, consequently, has no assigned VQO. A portion of the

project near the proposed dam and rerouted section of SR-264 is located in an area designated with a VQO of "Partial Retention."

The objective of the classification of Partial Retention is to ensure that management activities do not visually dominate the characteristic landscape. Management activities should repeat form, line, color, or texture commonly observed in the area. Management activities may introduce form, line, color, or texture, which are found infrequently, or not at all, in the surrounding scenery, but any changes should remain visually subordinate to the characteristic landscape. Reduction in form, line, color, or texture to meet partial retention should be accomplished as soon after project completion or, at a minimum, within the first year. Any activity must be blended into the landscape so as to attract little uncharacteristic attention.

3.8.2.3 Predicted Effects

3.8.2.3.1 No Action Alternative

The scenic character of the area would remain undisturbed. Neither positive or negative visual impacts on the landscape would occur under this alternative.

3.8.2.3.2 Proposed Action Alternative

Temporary and permanent landscape disturbances would be apparent from the placement of project features such as the rerouting of SR-264 and construction of the Narrows Dam structure. These more permanent features would be acceptable in this area of partial retention, especially in the long term. The dam would be within the setting of other dams in the area, and the rerouted portion of the Scenic Byway would serve as a viewing corridor and not a dominant element. Maintaining views within the parameters of partial retention would be contingent upon successful restoration/ revegetation of the old highway alignment and any scarred areas associated with the dam. Care would need to be taken in developing any associated recreation facilities to ensure that their design is subordinate to the surrounding landscape.

The Narrows Reservoir would be the most noticeable feature. The reservoir would have a surface area of 604 acres when full; however, during the recreation season, the surface area would average 454 acres. A body of water generally is considered to be aesthetically pleasing; however, as the reservoir is drawn down, exposed mud flats around the more shallow parts of the reservoir may be visually detractive but should remain naturally appearing as they follow the natural line of the reservoir's shore. Although viewed from the Scenic Byway and the reservoir itself, these mud flats primarily would be located on private lands that have no VQO designation. However, it is anticipated that these areas would appear more natural over time; and the additional variety provided by the new water body would well offset any negative effect. In the short term, it is anticipated that the visual impact of exposed mud flat or shoreline would be negligible due to steeper topography and the duration and angle of view.

The aquatic mitigation measures of restoring year-round flows in two small tributaries to Gooseberry Creek and maintaining Fairview Lakes at a higher elevation during the prime summer recreational season also would provide aesthetic benefits to the area.

During project construction, increased human activity, heavy machinery, and surface excavation would temporarily detract from the scenery. Such detractions would be visible in localized areas where construction would occur. Minor disruption of traffic on SR-264 would be expected since the existing

road would not be inundated until dam construction was completed and the relocated road is serviceable. Temporary disruption on SR-31 is expected.

3.8.2.3.3 Mid-Sized Reservoir Alternative

Under the Mid-Sized Reservoir Alternative, temporary and permanent landscape disturbances would be the same as those described for the Proposed Action but at a somewhat reduced scale. The proposed Narrows Reservoir would have a surface area of 489 acres when full. During the recreation season, the surface area would average 277 acres. Detractions associated with project construction would be the same as those described for the Proposed Action.

The net effect to visual quality in comparison with the Proposed Action would be largely unnoticeable to the casual forest visitor. A dam still would be built, and a portion of highway would be rerouted. Possibly, there would be less than a proportionate impact relative to exposed mud flats because the Mid-Sized Reservoir Alternative would fill steeper topography near the dam.

3.8.2.3.4 Small Reservoir Alternative

Under the Small Reservoir Alternative, temporary and permanent landscape disturbances would be the same as those described for the Proposed Action but at a somewhat reduced scale. The proposed Narrows Reservoir would have a surface area of 362 acres when full. During the recreation season, the surface area would average 238 acres. Detractions associated with project construction would be the same as those described for the Proposed Action.

The net effect to visual quality in comparison with the Proposed Action would be largely unnoticeable to the casual forest visitor. A dam still would be built, and a portion of highway would be rerouted. Possibly, there would be less than a proportionate impact relative to exposed mud flats because the smaller reservoir would fill steeper topography near the dam.

3.9 CULTURAL RESOURCES

Cultural resources are defined as physical or other expressions of human activity or occupation. Such resources include culturally significant landscapes, prehistoric and historic archaeological sites as well as isolated artifacts or features, traditional cultural properties (TCPs), Native American and other sacred places, artifacts, and documents of cultural and historic significance. Section 106 of the National Historic Preservation Act of 1966 (NHPA) stipulates that Reclamation take into account the potential effects of a proposed Federal undertaking on historic properties. Historic properties are defined as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the *National Register of Historic Places*.

3.9.1 Affected Environment

The affected environment for cultural resources corresponds to the APE as defined in the regulations to Section 106 of the NHPA (36 CFR Part 800). According to 36 CFR 800.16(d), the APE "means the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist."

The APE for the proposed Narrows Project includes the areas impacted by construction activities associated with the construction of the dam as well as the land areas eventually inundated by the reservoir pool area. Also included would be any disturbed areas associated with the construction of a proposed pipeline to Cottonwood Creek as well as

additional pipelines to deliver water to existing water distribution systems. Finally, impacts from the proposed rehabilitation of an existing tunnel to Cottonwood Creek, the development of recreation facilities, staging areas, access roads, borrow areas, and any other ancillary facilities linked to the proposed Narrows Project would be included in the APE.

Reclamation will complete cultural resource compliance, as stated in Appendix F, "Environmental Commitments," of the SDEIS, as a means to fulfill Section 106 of the NHPA. These commitments state that any areas associated with the construction of the proposed project will be subject to Class I and Class III cultural resource inventories to identify and evaluate all cultural resources. If historic properties are located within the APE, and if they will be adversely affected by construction activities associated with the proposed project, an MOA will be developed. The MOA would be among Reclamation; the Utah State Historic Preservation Office; the USDA Forest Service; the Advisory Council on Historic Preservation (ACHP), if it chooses to participate; and SWCD. The MOA would outline cultural survey protocols, report and treatment plan requirements, and procedures for mitigation on potential impacts to identified and unidentified (inadvertent discovery situations) historic properties. The MOA also would include, among other stipulations, a Native American consultation summarization and would identify the cultural resource APE for the proposed project.

Numerous cultural resource inventories previously have been conducted within the proposed project area. Under a contract with Dames and Moore in 1979, the University of Utah conducted a Class I and Class III cultural resource inventory on a portion of the proposed project APE.

The 1979 Class III inventory identified two prehistoric archaeological sites near the proposed dam and reservoir area. The sites were open lithic scatters with few formal tools. No further evidence of cultural materials was present on these sites. From the limited data available, the proposed project area appears to support the idea that high altitude areas were utilized as temporary, seasonal hunting grounds during the Archaic period, about 2,000 to 4,000 years before present. In addition, a total of 26 isolated artifacts were recorded during the cultural resource inventory.

Also, one historic cultural resource site, a stone structure foundation, was located during the 1979 inventory. The three cultural resource sites were not evaluated for their NRHP eligibility in 1979. As a result, the sites will be revisited and evaluated for eligibility as stated in the environmental commitments for cultural resources.

The design and, therefore, the APE of the proposed project have changed since the 1979 cultural resource inventory. Class I and Class III cultural resource inventories have not been performed for the Upper Cottonwood Creek, Oak Creek, or East Bench Pipeline alignments; new road alignments; borrow areas; staging areas; new campgrounds; marinas; wetland mitigation areas; or haul roads. Class I and Class III inventories covering the entire APE of the proposed project will be conducted prior to initiation of final design and construction in accordance with 36 CFR Part 800.

3.9.2 Methodology

The methods used to identify, assess the adverse effects to, and resolve the adverse effects to historic properties will be developed in accordance with 36 CFR Part 800. If historic properties exist within the proposed project APE and if adverse

effects to the properties will occur as a result of the proposed project, Reclamation will execute an MOA with SHPO and SWCD to resolve the adverse effects.

The selected methodology will establish the presence of historic properties within the APE for each alternative through background research, consultation, and an appropriate level of field investigation, taking into account the number of alternatives and the magnitude of the undertaking and its likely effects. The views of all of the signatories to the MOA and other concerned parties will be considered. As the project APE is refined, Reclamation shall proceed with the identification and evaluation of historic properties in accordance with 36 CFR Part 800.4(b)(1) and (c).

3.9.3 Predicted Effects

Predicted effects to cultural resources as a result of the proposed project will be determined following the Class I and Class III inventories of the entire project APE.

The cultural resource inventories conducted in 1979 identified three cultural resource sites that would be inundated by the reservoir pool. No determination of eligibility for these resources was made, however, and until contemporary inventories can be completed for all aspects of the proposed project APE, a prediction of effects to cultural resources cannot be made. However, execution of a MOA, as referenced above, will serve to avoid or mitigate for any adverse effects to cultural resources.

3.9.3.1 No Action Alternative

Both the known and unknown cultural resources within the APE for the proposed project would remain unaffected, except by potential natural erosion forces, vandalism, or off-road vehicle use. This would result in a no effect determination for cultural resources for the project.

3.9.3.2 Proposed Action Alternative

Under the Proposed Action, several known and an unknown number of cultural resources would be adversely affected by the project. The MOA will be executed to satisfy Reclamation's Section 106 responsibilities for the proposed project if historic properties are present within the APE. Reclamation would ensure that the undertaking is carried out in accordance with the stipulations of the MOA.

In addition to the MOA, environmental commitments designed to comply with Section 106 responsibilities will be included in the ROD.

3.9.3.3 Mid-Sized Reservoir Alternative

Cultural resource impacts under this alternative and measures to protect the resources would be the same as those described above in the Proposed Action.

3.9.3.4 Small Reservoir Alternative

Cultural resource impacts under this alternative and measures to protect the resources would be the same as those described above in the Proposed Action.

3.10 Economic and Social Resources

3.10.1 Affected Environment

Social and economic conditions in Carbon and Sanpete Counties are underscored by a century-long dependence upon agriculture. Both valleys originally were developed for agricultural use; however, rich coal deposits were discovered in Carbon County during the 1860s. As a result, the mining industry has become the principal economic activity in the

area. Agriculture still remains a significant economic activity in both Carbon and Sanpete Counties. Lack of sufficient irrigation water and concerns over neglected longstanding agreements on water rights constrain the agricultural sector in Sanpete County.

Population in the two-county project area is 43,185 according to the 2000 census. Carbon County had a 2000 population of 20,422. A 2007 census population estimate for this county was 19,364, which is about a 5% decrease since 2000. Sanpete County's population in 2000 was 22,763. For 2007, the population estimate was 24,644, which is an increase of approximately 8% from the 2000 census. The largest community in the two counties is Price with latest census population data from 1990 and 2000; for 1990, the population was 8,712, which decreased to 8,402 in 2000.

The College of Eastern Utah in Price and Snow College in Ephraim are significant cultural and economic resources for Carbon and Sanpete Counties, respectively. The two counties have had a higher than average rate of unemployment since 1960 (refer to table 3-24). For 2007, the unemployment rate for Carbon County was 4.6%, Sanpete County was 3.6%, and the State of Utah was 3.0%. The leading economic sectors in Carbon County in 2006 (in order of importance) were mining, services, government, trade, and manufacturing. Leading economic sectors in Sanpete County include government, services, trade, agriculture, and manufacturing.

Because of a larger population base, the city of Price rates higher on community facilities than do the north Sanpete County communities. Moroni and Spring City both have a particular need for improvements in police and fire protection, health care, housing, restaurants, day care facilities, youth recreation facilities, and cultural opportunities. In recent years, the construction and continued growth of the State Correctional Facility at Gunnison has created a sharp increase in the demand for housing in the project area, resulting in housing shortages. Educational facilities in the project area appear average, based on statewide norms.

Agriculture in Sanpete County is of major economic significance and involves a sizable number of people. From 1992–2002, the census of agriculture data shows the number of farms increased by 9%, whereas the number of acres in production changed by less than 1%. The average farm size decreased from 643 acres in 1992 to 471 acres in 2002. About 55% of the land in Sanpete County is used for agriculture. Of that amount, a total of 113,647 acres or 32% is cropland.

Agriculture plays a much smaller role in Carbon County's economy. Only 21% of Carbon County's total acres is used for agriculture. Of that amount, 18,247 acres or 9% is cropland in the 2002 agricultural census. Since 1992, the number of farms increased by 33.5%; but average farm size declined from 1,604 to 821 acres.

As discussed in earlier sections of this SDEIS, agricultural development is limited severely by inadequate water supplies. The

Table 3-24.—Sanpete and Carbon Counties Annual Unemployment Rates (%)

Locale	1960	1970	1980	1990	2000
Sanpete County	5.7	7.1	15.0	9.4	4.6
Carbon County	8.3	9.4	10.1	6.1	5.8
State of Utah	5.2	4.1	6.0	4.4	3.2

limited precipitation, averaging just above 4 inches during the summer months, makes irrigation essential to successful crop production. Yet the demand for irrigation water cannot be met by the fluctuating direct flows in local streams or the limited storage supplies currently available. Present irrigation practices in the project area encourage excessive early season diversion and low farm efficiency. Because of inadequate storage, there is a tendency to apply excessive water during spring and early summer, when water is plentiful, to obtain maximum soil moisture and sustain crops as long as possible after streamflows have diminished. Water supply studies show that shortages occurred during 1960–2002 on lands that would be served by the Narrows Project. Shortages during those years ranged from 3 to 44% of the diversion requirement. Because shortages are unpredictable, irrigators are unable to implement crop rotation and other practices necessary for optimum production. Table 3-25 presents the annual diversion requirements of the project-eligible lands within the Narrows Project area, quantifying the total water needs of currently irrigated lands and the extent to which these needs have been satisfied on an average annual basis. Principal crops grown in the project area in order of importance include pasture, alfalfa hay, small grains (barley, oats, and wheat), and meadow hay.

Table 3-25.—Average Diversion – Existing Supply and Remaining Demand (acre-feet)

Average Head of Canal Diversion Requirement[1]	Average Historical Supply[2]	Average Shortage	Average Shortage (Percent)
51,700	36,450	15,250	29.5

[1] After full implementation of all planned water conservation or efficiency improvements.

[2] Includes an estimated 2,250 acre-feet of precipitation occurring during the nongrowing season that remain in the soil at the beginning of the growing season.

Under existing conditions, two crops of alfalfa are harvested each year; and in some years (less than 25% of the time) when weather conditions are favorable, a small third crop is harvested. One crop of meadow hay normally is harvested, and the aftermath is used as late summer and fall pasture. Small grains are used as rotation crops for hay and pasture. Small grains also sometimes are used as a “nurse” or companion crop for alfalfa. The most common small grain crop is barley. Corn silage, which makes up less than 1% of the irrigated area, is raised primarily by dairymen and livestock feeding operations. Present and projected project crop distribution and yields in Sanpete County are summarized in table 3-26.

Of the 15,420 acres of irrigated farmland within the Sanpete County project area, an estimated 9,252 acres are irrigated by sprinkler. The remaining acreage is flood irrigated. Water shortages within the project area average about 30% annually. Each pressurized pipeline distribution system generally has a regulating pond at its head. Water is diverted out of the streams into these ponds to provide system regulation and to allow sediments to settle out.

Irrigators in the Fairview area rely on the Narrows Tunnel to convey water stored in Fairview Lakes to Cottonwood Creek. As described in chapter 2, the tunnel is in a critical state of disrepair.

3.10.2 Regional Impact Analysis

The number of jobs created in Sanpete and Carbon Counties during construction of the Narrows Project would not be significant based on a regional impact analysis conducted for this study on the Proposed Action, Mid-Sized, and Small Reservoir Alternatives. At the regional level, the project would cause positive economic output to the study area. Potentially, the most significant short-term impact would occur from construction activities.

Table 3-26.—Summary Crop Distribution and Yield for Sanpete County

Crop/Unit	Distribution of Total Crop Production (%)[1]	1990 Yields[2]	Project Yields: With Full Water Supply[3]
Pasture (per animal unit month)	39	5.0 AUM per acre	8.0
Alfalfa hay (per ton)	31	3.5 tons per acre	5.2
Small grains (per bushel)	12	80.0 bushels per acre	85.0
Meadow hay (per ton)	8	2.0 tons per acre	2.5
Other crops	2	NA[4]	NA
Fallow and idle	8	NA	NA

[1] Distribution would be essentially the same for present and project conditions; source is *1999 Utah State Water Plan*, Sevier River Basin, table 10-2.

[2] Estimates were generated by SWCD for this study.

[3] Estimates for irrigators purchasing enough project water to obtain a full water supply.

[4] NA = Not applicable.

The modeling package used in this study to assess the regional economic effects of construction of each alternative is IMpact Analysis for PLANning (IMPLAN). IMPLAN is an economic input-output modeling system that estimates the effects of economic changes in an economic region.

IMPLAN data files are compiled for the study area from a variety of sources, including the U.S. Bureau of Economic Analysis, the U.S. Bureau of Labor, and the U.S. Census Bureau. This analysis used 2004 IMPLAN data for Utah's Sanpete County, where most of the construction activity would occur for the regional impact analysis.

The expenditures associated with construction were placed into categories that represent different sectors of production in the economy. The expenditures that are made inside the study region were considered in the regional impact analysis. Expenditures made outside the study area were considered "leakages" and would have no impact on the local economy. Some construction items (specialized equipment and skilled labor) are more likely to be purchased outside the region and brought to the construction site because of their high cost and lack of availability in the region.

Because of the scale of the construction project, it was assumed that local suppliers and contractors would be able to supply only a portion of the necessary construction, equipment, supplies, and expertise. The regional impact analysis assumed that approximately 50% of the labor wages would be spent locally, and approximately 45% of the construction equipment and supplies would be purchased locally.

This analysis also assumed that the majority of the construction expenditures will be funded from sources outside the study area. Money from outside the region that is spent on goods and services within the region would contribute to regional economic impacts, while money that originates from within the study region is much less likely to generate regional economic impacts. Spending from sources within the region represents a redistribution of income and output, resulting in a negligible increase in economic activity.

For the purpose of this study, the construction costs allocated to labor and construction materials spent in the region were used to measure the overall regional impacts. These overall impacts would be spread over the construction period and would vary year by

year proportionate to actual expenditures. It was estimated that the regional impacts on employment, regional output, and income would be less than 1% of the study area's base employment, output, and income (see table 3-27).

Table 3-27.—Regional Impacts

	Regional Base Data	Regional Impacts	% Change
Employment (Full-time jobs)	9,443	50	<1
Output (millions of dollars)	$802	$5.8	<1
Income (millions of dollars)	$234	$0.9	<1

The regional impacts from the construction costs for all the alternatives would be similar in that the impacts would be less than 1% of the regional employment, output, and income.

These regional construction impacts would be lost after construction was completed. A small amount of regional impacts related to O&M activities would be expected but would not significantly impact the overall regional economy in the study area. The additional water amount provided by each of the alternatives would support the existing community lifestyles and social structure in the study area.

3.11 LAND RESOURCES

3.11.1 Affected Environment

The proposed Narrows Project is located near the exterior boundaries of the Manti-La Sal National Forest. The damsite and other project features would be located on 225 acres of Reclamation withdrawn land. SWCD has acquired 366 acres of private lands for project uses from owners by perpetual easement or in fee. SWCD would purchase 1,340 additional acres of private and State School Trust lands for project needs (table 2-4).

While there are some private in-holdings, the majority of the lands located within the forest boundaries are federally owned and are administered by the USDA Forest Service pursuant to specific authorities granted by Congress to the Secretary of Agriculture and pursuant to the public land laws.

Lands within forest reserves may, however, be appropriated and used for irrigation works constructed under authority of the Reclamation Act of 1902 (32 Statute 388). Therefore, by Secretarial Order dated April 1, 1941, Reclamation withdrew certain forest lands from public entry under the first form of withdrawal (as provided in Section 3 of the 1902 Act). These lands were withdrawn for the construction, operation, and maintenance of the Gooseberry Project. The Gooseberry Project, as originally planned, was never constructed. However, a portion of the original project was constructed as the Scofield Project. The remainder of the Gooseberry Project, subsequently, was renamed the Narrows Project and is presently proposed as a non-Federal project. Today, approximately 6,728 acres of the lands originally withdrawn by Reclamation for the Gooseberry Project remain under Reclamation withdrawal for the Narrows Project.

The 1941 Reclamation withdrawal of lands within the Manti-La Sal National Forest created the potential for two Federal agencies—Reclamation and the USDA Forest Service—to have overlapping jurisdiction on the same lands. However, the authority of the Secretary of the Interior under the 1902 Act to withdraw and administer lands for Reclamation purposes is limited to the specific uses provided for in that Act—that is, Reclamation projects. As a result, whereas Reclamation's withdrawal is dominant, its jurisdiction has been somewhat nominal

because no Reclamation project actually was constructed on those lands; as a result, the USDA Forest Service exercised the only meaningful jurisdiction over them per the master interagency agreement between Reclamation and the USDA Forest Service. Once Reclamation initiated planning and environmental compliance activities for the Narrows Project, however, the overlap between the authorities of the Secretary of the Interior under the 1902 Act and those of the Secretary of Agriculture became real.

At present, both agencies have administrative authority over these lands—but each for activities related only to its own mission. Thus, Reclamation has jurisdiction over the withdrawn lands for uses associated with or incident to environmental compliance, planning, construction, or O&M of projects under the Reclamation laws, such as the Narrows Project; and the USDA Forest Service has jurisdiction over the withdrawn lands for uses associated with or incident to national forest activities, such as recreation, grazing, and timber sales. If the Narrows Project were constructed, it is anticipated that the Reclamation withdrawal would be revoked for any lands not needed for the project.

Land ownership and use characteristics of Sanpete and Carbon Counties are summarized in tables 3-28 and 3-29, respectively. Federal and State-owned land comprises approximately 60% of each county's total land base; whereas, privately owned land accounts for 38% of the land base in Sanpete County and 41% of the land base in Carbon County. Of the total agricultural land in Carbon County, only 2% has been developed for cropland, and the remainder is rangeland. Comparatively, 36% of the total agricultural land in Sanpete County has been developed for cropland. An inventory of prime and unique farmland (Public Law 95-87) did not reveal any prime or unique farmland in the project area.

Table 3-28.—Land Ownership – Sanpete and Carbon Counties, 1999

	Sanpete County[1]		Carbon County[2]	
Owner	(acres)	(percent)	(acres)	(percent)
Federal	528,591	51.7	450,162	47.5
State	59,914	5.9	123,887	13.1
Private	434,105	42.5	373,511	39.4
Total	1,022,609	100	947,632	100

[1] Utah Division of Travel Development, Sanpete County.
[2] Utah Division of Travel Development, Carbon County.

Table 3-29.—Land Use Characteristics, Sanpete and Carbon Counties

	County	
Item	Sanpete[1]	Carbon
Total acres	1,022,609	[2]947,632
Urban	1,664	[3]9,200
Percent of total	.16	.98
Agricultural (acres)	359,717	[4]201,679
Percent of total acres	35	21
Cropland (acres)	113,436	[6]17,200
Percent of agriculture acres	32	9
Rangeland (acres)	246,281	184,479
Percent of agriculture acres	68	91

[1] State Office of Plans and Budget, 1990 Census information.
[2] Southeastern Utah Association of Governments, 1990 Census.
[3] Utah State Agricultural Statistics, 1991.
[4] U.S. Department of Agriculture National Agricultural Statistics Service, 1997.
[5] Social Assessment of Narrows Project, J. Lynn England, 1991.
[6] Utah Agricultural Statistics Service, 1997.

Lands approximately 3 miles east of the project area are under a Federal coal lease and are currently being mined. Additional mineable coal reserves are believed to exist beneath lands east of the East Gooseberry Fault approximately 1 mile east of the project area. A nearby landowner with both land and mineral rights to the east of the proposed reservoir, between the proposed dam and the currently operating Skyline mine, expressed to Reclamation in April 2009 his intent to mine his coal, but exact plans and timing are

unknown at this time. Lands immediately adjacent to the project area (within the Gooseberry Graben) are not believed to have mineable coal reserves due to an offset of several hundred feet within the Gooseberry Graben area.

Agricultural land use within the project area is based on the livestock economy of the area—principally, cattle and sheep operations and a number of Grade A dairies. Other land uses include the turkey industry, large garden spots, potatoes, raspberries, and Christmas or ornamental trees.

The majority of the land area that would be inundated by the reservoir is privately owned; the dam, however, would be on Federal land. Some of the private land near the proposed dam and reservoir within the national forest boundary has been subdivided for summer homes and recreation development. Such development must comply with the zoning and building codes of the Sanpete County Commission and the sanitation requirements of the Utah Department of Environmental Quality. The area adjacent to the proposed Narrows Reservoir is county-owned and is zoned as Forest Watershed 1–10 (one dwelling per 10 acres). The primary areas now under development include the area approximately 2 miles east of Lower Gooseberry Reservoir and the area on the north side of privately owned Fairview Lakes.

The Fairview Lakes development contains approximately 150 to 200 memberships in the privately owned Fairview Lakes Association. The memberships include the right to use a specific lot in the area north and east of Fairview Lakes and south of the project area to park a trailer or construct a cabin. This area has been rezoned, and the one dwelling per 10 acres development ratio does not apply to this area. As a result, it has been developed with lots every 1+ acre each. About 50 cabins have been constructed within the past 5 years. The cabins are used during the winter as well as the summer, since the general area is a popular cross-country skiing and snowmobiling area. Many of the other lots have one to three trailers parked on them for the summer season (June–September). The private landowners allow their members to use some of the area southwest of Fairview Lakes for recreation use.

Portions of three grazing allotments occur within the project area. They include Swen's Canyon allotment, the Gooseberry-Cottonwood allotment, and the Beaver Dams-Boulger allotment.

Additional allotments that may be impacted by the mitigation measures include the Fairview, Cabin Hollow, and Pondtown allotments.

Swen's Canyon allotment is located in two watershed drainages. That portion, which is located in the same drainage as the proposed Narrows Dam and Reservoir, consists of 583 acres, of which all is suitable for grazing land in fair range condition. Grazing capacity of that portion is about 115 AUMs.

The Beaver Dams-Boulger allotment is a combination of two allotments. Grazing use includes 1,200 head of sheep with a season of July 6 to October 5. It is grazed with a rest rotation grazing system where part of the allotment is rested each year.

The Cottonwood-Gooseberry allotment is grazed by 900 head of sheep with a season of July 6 to September 30 using a rest rotation grazing system. Suitable grazing land was determined during a range analysis conducted during 1976.

A summary of information concerning the three grazing allotments and four grazing permits is presented in table 3-30. Range conditions and grazing were discussed earlier in the vegetation section of this chapter.

Table 3-30.—Grazing Allotments Within the Narrows Project Vicinity[1]

Allotment	Swen's Canyon	Gooseberry-Cottonwood	Beaver Dams-Boulger
Permits	1	1	1
Acreage			
Federal[2]	2,277	4,229	3,014
Private	1,473	384	940
Total	3,750	4,613	3,954
Suitable grazing	3,000	3,096	2,631
Number of Sheep Allowed			
Federal	559	1,200	900
Private	400	0	0
Period of use	July 1–September 30 (3.0 months)	July 6–September 30 (2.90 months)	July 6–October 5 (3.06 months)
Animal Unit Months[3]			
Federal	335	696	551
Private	240	0	0
Condition of Suitable Grazing Land			
GOOD			
Number of acres	326	542	360
Percent	11	18	14
FAIR			
Number of acres	2,057	2,088	1,551
Percent	69	67	59
POOR			
Number of acres	617	466	720
Percent	20	15	27

[1] Source: USDA Forest Service (1992); Personal communication, USDA Forest Service Supervisory Range Conservationist. Reverified by personal communication (2003).

[2] Includes Reclamation withdrawn and USDA Forest Service lands.

[3] 1 AUM = 5 sheep.

3.11.2 Methodology and Impact Indicators

Information on numbers of livestock and grazing seasons was obtained from USDA Forest Service grazing permits. Grazing capacity is derived from range analysis data and other studies to determine grazing capacity.

Impact indicators are the change in AUM available for livestock use. The changes are caused by direct and indirect effects such as increased recreational use and mitigation. Additional areas will be impacted as additional homes are built.

3.11.3 Predicted Effects

3.11.3.1 No Action Alternative

Construction of summer homes on private land outside of platted subdivisions is expected to continue at the current rate until development reaches the zoning restrictions of one dwelling per 10 acres. Development of the Fairview Lakes complex would continue as presently planned. Sheep and cattle grazing would continue as described for the existing environment.

Mining of Federal and private coal reserves would continue at current levels consistent with market demands and as coal leases are available.

3.11.3.2 Proposed Action Alternative

Major changes in land use are not anticipated under the Proposed Action. Construction of summer homes outside of platted subdivisions might be accelerated but would be limited by zoning restrictions of one dwelling per 10 acres. Development of the Fairview Lakes complex would continue as previously planned although build-out may occur earlier. Narrows Reservoir, SR-264 and forest development roads relocation, the recreation area, and the conservation easements adjacent to the reservoir would reduce the available grazing area by 856 acres. This area is about 10% of the suitable grazing acreage in the area. The Proposed Action may result in the direct loss of 114 AUM grazing use (856 project acres per 1.5 acres per sheep month = 571 sheep months per 5 sheep months per AUM = 114 AUM); however, indirect loss of grazing (estimated to be about 1,014 acres) may occur on adjacent areas around the reservoir, between the highway and the reservoir, and around camping and residence areas. The total grazing impact is estimated to be 249 AUM (1,870 acres per 1.5 acres per sheep month = 1,247 sheep months per 5 sheep per AUM = 249 AUM). This impact of grazing includes both private and Federal lands. Restrictions on the number of sheep and cattle allowed and/or realignment of grazing allotments may be required due to implementing the Proposed Action.

As the recreation use increased and summer home development proceeded, there could be additional areas in the upper Gooseberry drainage that would not be available for livestock grazing due to anticipated or existing livestock-people conflicts. For every 7 to 10 acres of additional land that cannot be grazed due to conflicts with traffic and/or people, there may be a loss of 1 AUM (5 sheep months) grazing use. Grazing permits and allotment boundaries may need to be adjusted. Land use in the *Manti-La Sal National Forest Land and Resource Management Plan* would change to reflect project implementation.

No reduction of acres of mineable coal reserves is anticipated as long as the dam is designed to withstand the effects of induced seismicity from mining approximately 1 mile away.

3.11.3.3 Mid-Sized Reservoir Alternative

As with the Proposed Action, major changes in land use are not anticipated under this alternative. Narrows Reservoir, SR-264 relocation, the recreation area, and the conservation easements adjacent to the reservoir would reduce the available grazing area by 736 acres. This area is about 7% of the suitable grazing acreage in the area. The Mid-Sized Reservoir Alternative may result in the direct loss of 98 AUM (736 project acres per 1.5 acres per sheep month = 491 sheep months per 5 sheep months per AUM = 98 AUM); however, indirect loss of grazing (estimated to be about 811 additional acres) may occur on adjacent areas around the reservoir, between the highway and the reservoir, and around camping and residence

areas. The total grazing impact is estimated to be 206 AUM (1,547 acres per 1.5 acres per sheep month = 1,031 sheep months per 5 sheep month per AUM = 206 AUM). This impact to grazing includes both private and Federal lands. For every 7 to 10 acres of additional land that cannot be grazed due to conflicts with traffic and/or people, there may be a loss of 1 AUM (5 sheep months) grazing use. Grazing permits and allotment boundaries may need to be adjusted. Land use in the *Manti-La Sal National Forest Land and Resource Management Plan* would change to reflect project implementation.

No reduction of acres of mineable coal reserves are anticipated as long as the dam is designed to withstand the effects of induced seismicity from mining approximately 1 mile away.

As the recreation use increased and summer home development proceeded, there could be additional areas in the upper Gooseberry drainage that would not be available for livestock grazing due to livestock-people conflicts. Livestock grazing is generally not compatible in, or immediately adjacent to, dwellings and high recreation use areas.

3.11.3.4 Small Reservoir Alternative

As with the Proposed Action, major changes in land use are not anticipated under this alternative. Narrows Reservoir, SR-264 relocation, the recreation area, and the conservation easements adjacent to the reservoir would reduce the available grazing area by 610 acres. This area is about 7% of the suitable grazing acreage in the area. The Small Reservoir Alternative may result in the direct loss of 81 AUM (610 project acres per 1.5 acres per sheep month = 407 sheep months per 5 sheep months per AUM = 81 AUM); however, indirect loss of grazing (estimated to be about 705 additional acres) may occur on adjacent areas around the reservoir, between the highway and the reservoir, and around camping and residence areas. The total grazing impact is estimated to be 175 AUM (1,315 acres per 1.5 acres per sheep month = 877 sheep months per 5 sheep month per AUM = 175 AUM). This impact to grazing includes both private and Federal lands. For every 7 to 10 acres of additional land that cannot be grazed due to conflicts with traffic and/or people, there may be a loss of 1 AUM (5 sheep months) grazing use. Grazing permits and allotment boundaries may need to be adjusted. Land use in the *Manti-La Sal National Forest Land and Resource Management Plan* would change to reflect project implementation.

No reduction of acres of mineable coal reserves would be anticipated as long as the dam were designed to withstand the affects of induced seismicity from mining approximately 1 mile away.

As the recreation use increased and summer home development proceeded, there could be additional areas in the upper Gooseberry drainage that would not be available for livestock grazing due to livestock-people conflicts. Livestock grazing is generally not compatible in or immediately adjacent to dwellings and high recreation use areas.

3.12 PUBLIC SAFETY

3.12.1 Affected Environment

The public safety issue raised, related to development of the Narrows Project, deals with increases in recreational traffic. The area adjacent to the proposed Narrows Reservoir is served by two State highways, SR-31 and SR-264. These two-lane roads are narrow and winding. Both highways are maintained for year-round use by the Utah Department of Transportation.

Average daily traffic (ADT) numbers for these roads are listed in table 3-31.

Table 3-31.—Projected Average Daily Traffic in Vicinity of Narrows Reservoir During Recreation Season (Vehicles Per Day)

	No Action[1]	Proposed Action[2]	Mid-Sized Reservoir Alternative[2]	Small Reservoir Alternative[2]
SR-31 in Fairview Canyon	1,540	1,792	1,744	1,691
SR-264 adjacent to Narrows Reservoir site	820	1,072	1,024	971

[1] Based on 2000 UDOT traffic surveys.
[2] Based on two persons per vehicle and 92-day recreation season.

ADT values shown in the table are based on UDOT traffic counts taken in 2000.

3.12.2 Methodology and Impact Indicators

Narrows Project impacts on public safety were quantified by comparing projected ADT values under each of the action alternative conditions with the ADT under the No Action Alternative. Increased ADT was estimated based on projected recreation visitor days created by each of the alternatives and using an average of two persons per vehicle. All of the increase in traffic was assumed to occur within a 92-day recreation season from June 15–September 15.

The impact indicator for public safety is the percent increase in ADT.

3.12.3 Predicted Effects

3.12.3.1 No Action Alternative

There would be no increase in ADT under the No Action Alternative. ADT values for SR-31 and SR-264 would be expected to remain as shown in table 3-31.

3.12.3.2 Proposed Action Alternative

As shown in table 3-31, ADT on SR-31 would increase by 252 or 16% under the Proposed Action. ADT on SR-264 would increase by 31%. However, even with these increases, both roads would still be well within their design capacity. In order to increase safety, additional turning lanes with adequate sight distance would be provided at recreation area entrances and exits.

3.12.3.3 Mid-Sized Reservoir Alternative

ADT on SR-31 would increase by 204 or 13% under the Mid-Sized Reservoir Alternative. ADT on SR-264 would increase by 25%. As with the Proposed Action, additional turning lanes with adequate sight distance would be provided at recreation area entrances and exits to enhance public safety.

3.12.3.4 Small Reservoir Alternative

ADT on SR-31 would increase by 151 or 10% under the Small Reservoir Alternative. ADT on SR-264 would increase by 18%. As with the Proposed Action, additional turning lanes with adequate sight distance would be provided at recreation area entrances and exits to enhance public safety.

3.13 AIR QUALITY RESOURCES

3.13.1 Affected Environment

Ambient air quality is monitored by UDEQ, Division of Air Quality at locations throughout the State of Utah. There are no existing monitoring sites near the proposed Narrows Project located in Sanpete County. The closest monitoring station is located in

north Provo. Data from this station cannot be used as an estimate of the existing air quality in the impact area of influence because Provo is an urban/suburban area. The actual ambient air quality in Sanpete County most likely is much better than that in north Provo because of the lower population density and lack of significant major emission sources.

For the purposes of air quality management, geographic areas of the country are classified as "attainment" or "nonattainment" with the National Ambient Air Quality Standards. All air quality standards are classified as being met in Sanpete County and, therefore, would have an "attainment" classification. The Narrows Dam and Reservoir area is located in a fairly remote and rugged mountainous terrain. The air quality associated with this area is generally excellent. Primary sources of existing air pollutants in the project area include dust, smoke from campfires in area campgrounds, and exhaust emissions from intermittent traffic and recreational vehicles.

Dozens of summer homes are located in the vicinity of the project. High levels of dispersed recreational use of this area are common.

3.13.2 Methodology and Impact Indicators

The primary air quality requirement is that the project must not exceed the NAAQS for particulate matter. The standards for particulate matter, expressed as micrograms per cubic meter ($\mu g/m^3$), are as follows: 150 $\mu g/m^3$ (24-hour), 50 $\mu g/m^3$ (annual arithmetic average). For the purposes of determining the attainment status of the standards, particulate matter is measured in the ambient air as PM_{10}.

The impact indicator for this issue is the number of days the project would exceed NAAQS for particulate matter (PM_{10} levels).

3.13.3 Predicted Effects

3.13.3.1 No Action Alternative

Some vehicle traffic, recreationists, recreational vehicles, and animal life would continue to be present in the project area.

Noise and air pollution are not expected to significantly increase under the No Action Alternative (table 3-32).

3.13.3.2 Proposed Action Alternative

Typical PM_{10} emissions associated with construction activities described in the Proposed Action were estimated, using emission factors from the Fourth Edition of AP-42, Environmental Protection Agency's *Compilation of Air Pollutant Emission Factors* (EPA, 1985). Approximately 232 pounds per day (lb/day) of construction

Table 3-32.—Number of Days PM_{10} Dust Emissions Exceed NAAQS in Sanpete County During Construction of Narrows Project

Alternative	Ambient Standard for PM_{10}	Daily Emissions	Number of Days PM_{10} Emissions Exceed Standards
No Action	150 $\mu g/m^3$	$\leq$150 $\mu g/m^3$	0
Proposed Action	150 $\mu g/m^3$	$\leq$150 $\mu g/m^3$	0
Mid-Sized Reservoir	150 $\mu g/m^3$	$\leq$150 $\mu g/m^3$	0
Small Reservoir	150 $\mu g/m^3$	$\leq$150 $\mu g/m^3$	0

dust PM_{10} emissions would be produced from activities described in the Proposed Action.

Most of these emissions are 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 (for example, soil stabilization or watering of stockpiled materials) would reduce daily PM_{10} emissions from 232 lb/day to less than the national standard of 150 lb/day.

Air quality would experience short-term impacts during construction of the Proposed Action. Fugitive dust emissions and emissions from internal combustion engines would be generated by excavation and earth-moving vehicle traffic on unpaved surfaces. The contractor would meet all applicable regulations concerning exhaust and dust control. Following construction, long-term impacts on air quality would include some increased vehicle emissions and campfires due to additional recreational facilities that would result from the project. This, along with the increased use associated with project O&M, would contribute to some increased level of air pollutants. This impact would not be significant to the excellent overall air quality of the Narrows Project area.

Wherever and whenever necessary, the contractor would comply with all Federal regulations and take proper and efficient measures to reduce dust and exhaust pollution that might originate from construction to prevent it from becoming a nuisance to people or causing damage to crops, cultivated fields, or dwellings. The contracting officer would be particularly critical of dust pollution resulting from the manufacture of concrete aggregate or excessive exhaust pollution resulting from improperly tuned engines or improperly equipped vehicles and equipment. The contractor would be held liable for any damage caused by dust and air pollution from construction operations.

3.13.3.3 Mid-Sized Reservoir Alternative

Air quality effects associated with this alternative would be the same as those described above for the Proposed Action.

3.13.3.4 Small Reservoir Alternative

Air quality effects associated with this alternative would be the same as those described above for the Proposed Action.

3.14 SLOPE AND CHANNEL STABILITY

3.14.1 Affected Environment

Fairview Canyon, which contains Cottonwood Creek, is a steep, narrow canyon located east of Fairview, Utah. Highway SR-31 is located in the canyon. The canyon is approximately 7 miles long. The stream elevation at the mouth of the canyon is about 6,300 feet and about 8,800 feet near the summit. Typical slopes of the canyon wall are 2:1 to 2.5:1 (ratio of horizontal to vertical distance). Numerous landslides are located throughout the canyon on both sides. In several places, continual road maintenance is required to repair damage caused by landslides.

A total of 104 landslides were identified from aerial photographs and during a 1991 field review along the slopes of a 6-mile reach of Cottonwood Creek. The review team was comprised of individuals from various government agencies and private consulting firms. The review was to determine the impact of projected flow increases from Narrows Tunnel on adjacent slopes of Cottonwood Creek. The state of activity of the slides was noted, with 85 slides classified as “active” and 19 classified as “dormant.” The certainty of landslide identification included 89 slides as “definite,” 13 as “probable,” and 2 as “questionable.” The

distances of the landslides from the tunnel portal ranged from 0.3 mile to 6.1 miles. Dominant types of slope movement of the 104 landslides are shown in table 3-33.

Table 3-33.—Fairview Canyon Slope Movement[1]

Type of Movement	Number of Landslides
Slump earthflow	8
Debris slide	64
Debris flow	8
Earthflow	1
Slump	22
Debris cone	1

[1] Based on the type of material involved in the movement (soil, rock, or debris) and the dominant type of movement (whether the material is sliding, flowing, falling) or a combination thereof.

Based on observations during the review, it was determined that landslide activity is not related to stream channel stability or the flow in Cottonwood Creek but is caused by saturation from water sources on the hillsides.

Over the majority of the reach between the confluence with Left Fork and the mouth of the canyon near Site 7 (figure 3-9), Cottonwood Creek is a small, steep, step-pool stream that is confined in a narrow canyon.

The natural drainage area upstream of Left Hand Fork is relatively small, and the size of the channel between Left Fork and the Narrows Tunnel outlet is primarily a product of the flows that have been imported to the reach since construction of the tunnel in the 1930s. Between the mouth of the canyon and the confluence with the San Pitch River, Cottonwood Creek flows across an alluvial fan through the town of Fairview (refer to figure 3-9 for location of stream reaches and features).

Upstream, in approximately 0.3 mile of the 0.9-mile-long reach, the tunnel outlet and Left Fork cross a relatively wide, mountain meadow area at a gradient of about 5% and has a slightly sinuous planform. The bed material in this area is primarily angular cobbles and gravel, and the banks are well defined and root-reinforced. A surface sediment sample collected at approximately the midpoint of the reach had a median size of 69 mm and contained particles up to about 450 mm in size. A series of log-drop check structures have been installed in this portion of the stream. Large, angular cobbles have been placed around many of the structures to provide additional stability. Some of this material likely has been transported away from the structures and is represented in the bed material sample. Some of the structures have been flanked due to lateral movement of the channel. At the downstream end of the meadow reach, the valley bottom narrows considerably, and the stream gradient steepens.

In the approximately 5.3-mile reach between Left Fork and the mouth of the canyon, the planform and gradient of the reach are controlled by the bedrock geology of the canyon and by material that has been delivered to the valley bottom by the numerous landslides that occur along the reach. Steep, colluvial slopes that are underlain by bedrock outcrop consisting of interbedded layers of moderately cemented sandstones and shales extend to the edge of the channel in many locations.

Based on the USGS 7½-minute quadrangle maps, the channel gradient averages about 4.2% between the mouths of Left Fork and Hys Fork, steepens to about 9.1% between Hys Fork and Maple Fork, and then flattens to about 6.6% between Maple Fork and the mouth of the canyon. In several locations below Left Fork, beaver activity significantly affects the planform and profile, creating depositional areas behind the dams, deflecting the stream alignment at the dams, and, in some locations, creating

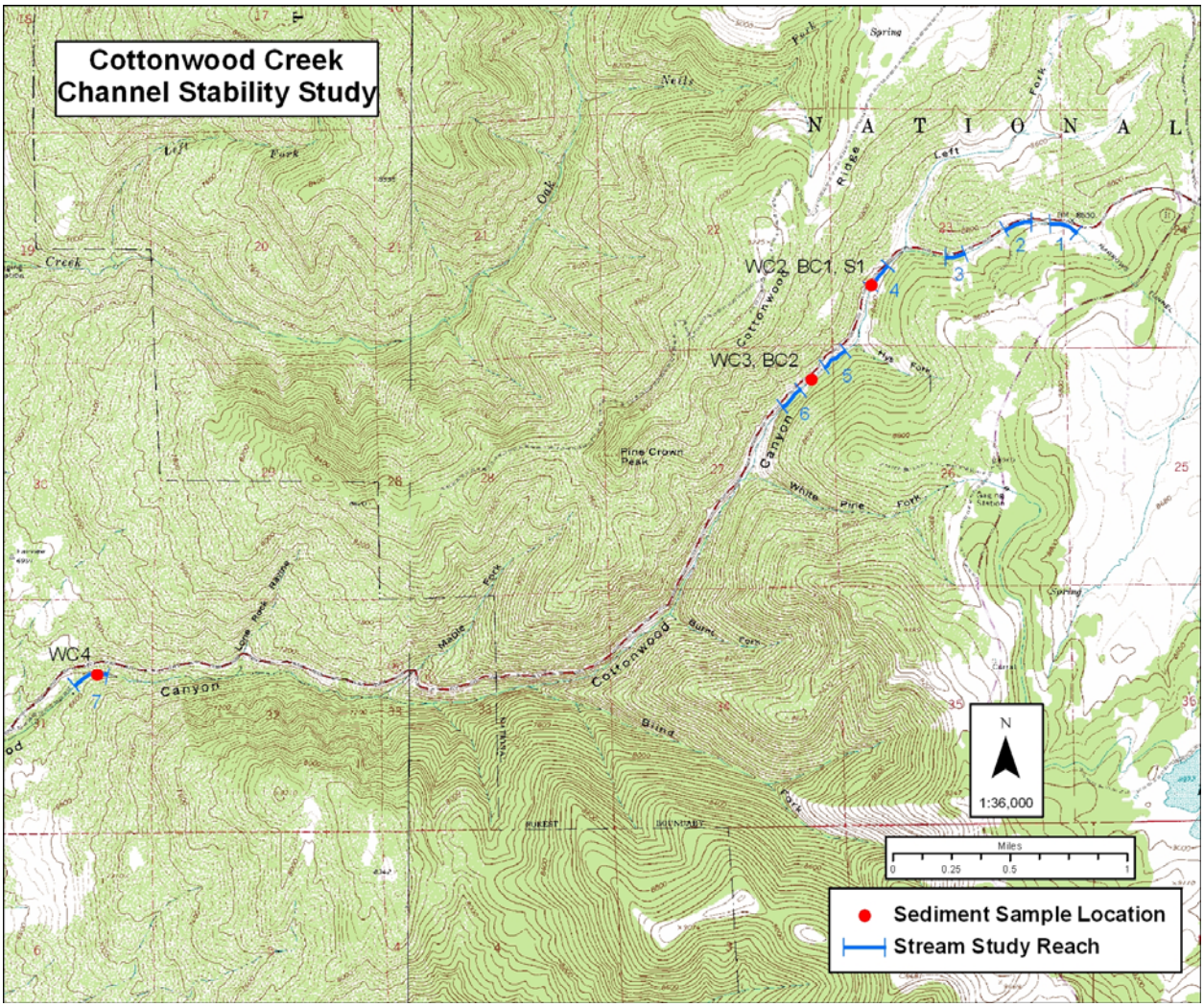


Figure 3-9.—Cottonwood Creek Channel Stability Study Reaches.

split-flow reaches. The bed material along this portion of the reach consists of particles ranging in size from sand to boulders exceeding 2 feet in diameter.

The finer-grained gravel and cobble-sized material are found in the flatter-gradient portions of the reach where depositional zones are created by beaver activity and in-channel bars along the margins of the channel, while the boulder steps tend to occur in steeper, more confined reaches. A subsurface sediment sample, taken from the bank-attached gravel bar at the same location as surface sample WC2 (approximately 0.2 mile downstream from Left Fork), contained particles ranging in size from fine sand to coarse gravel and had a median size of 14 mm, while the surface sample had a median size of about 50 mm. This relatively fine-grained material is representative of the material that deposits in depositional zones, while the coarser surface layer is indicative of the typical mobile surface pavement that occurs in gravel bed streams to regulate transport of the relatively low supply of finer-grained material. Steeper, step-pool reaches that provide a positive vertical control for the channel profile also occur between the flatter areas. The median size of the boulders in the

step-pool reach just upstream of WC2 was about 380 mm and ranged up to 900 mm in diameter.

In portions of the reach where the valley bottom is wider than the stream (e.g., between Left Fork and Hys Fork), the overbank sediment contains a mixture of gravel, cobbles, and fines (sands, silts, and some clays) that support thick stands of willows and other riparian species. In the confined, steeper portions of the reach between approximately the mouth of Hys Fork and the mouth of the canyon, the channel is primarily boulder step, with a narrow riparian corridor along the channel. Upland species (e.g., evergreen trees) grow very near the channel edge in many locations. A surface bed material sample that was taken about 0.25 mile downstream from Hys Fork had a median size of 103 mm and contained particles up to 250 mm in diameter. The boulder steps in this area had a median size of about 300 mm and ranged up to 750 mm in diameter. There is little evidence of a flood plain along this portion of the reach. Where a flat overbank surface that can be inundated by relatively frequent flows occurs, this feature is very localized and discontinuous and is typically the result of a local deposition zone caused by a downstream obstruction or by an expansion zone caused by bedrock outcrop or debris along the valley margins. The lack of a well-developed flood plain indicates that the stream is laterally very stable, due to the confinement in the bottom of the canyon. There is some minor, localized bank erosion; however, in most cases, the toe of the banks is armored with coarse-grained material, much of which likely is composed of colluvium from the adjacent valley walls or by bedrock outcrop. In some locations, angular cobbles and boulders in the right (north) bank are likely side-case material associated with construction of SR-31.

In the downstream portions of the reach near Site 7, the stream has incised within terraces created by debris flow deposits and colluvium near the head of the alluvial fan. Bank heights in this reach range from 6 to 10 feet, and the overbank material is composed of a heterogeneous mixture of sands to boulders. The stream profile is controlled by bedrock outcrop and large, woody debris jams in portions of this reach and has a step-pool character in other areas. A surface sediment sample (WC4) taken in the depositional area upstream of the large, woody debris jam had a median size of 113 mm and contained particles up to 450 mm in diameter. Bed material in the reach downstream from the mouth of the canyon is very coarse-grained and appears to be very stable. As is typical on coarse grained alluvial fans, this portion of the reach likely loses a significant amount of flow to infiltration. (Upstream diversions also reduce the surface flow in this portion of the reach.)

The processes associated with the step-pool morphology, such as that in most of the reaches in Cottonwood Creek downstream from the tunnel outlet, had been studied by numerous researchers (Ashida et al., 1976, 1982; Griffiths, 1980; Whittaker and Jaeggi, 1982; Whittaker and Davies, 1982; Whittaker, 1987a, 1987b; Chin, 1989; Grant et al., 1990; Montgomery and Buffington, 1997). This morphology "is generally associated with steep gradients, small width-to-depth ratios, and pronounced confinement by valley walls" (Montgomery and Buffington, 1997). Step-pool channels are sediment supply limited, which means that their capacity to transport sediment is much greater than the supply (Grant et al., 1990; Mussetter, 1989). Step spacing typically varies from one to four channel widths (Bowman, 1977; Whittaker, 1987b; Chin, 1989; Grant et al., 1990) and corresponds to maximum flow resistance, providing stability for a bed that would otherwise be mobile

(Whittaker and Jaeggi, 1982; Abrahams et al., 1995). In these types of channels, the grain sizes that are found in the bed are mobile only during extreme floods; and the step-pool morphology is re-established during the falling limb of the flood hydrograph (Sawada et al., 1983; Whittaker, 1987b; Warburton, 1992).

Discharges on the order of the 50-year flood or larger typically are required to form or modify the steps (Grant et al., 1990). Tracer studies have demonstrated that transport of the finer-grained material stored in the pools between the steps is mobilized during frequent flow events, but the transport of this material is strongly supply limited (Schmidt and Ergenzinger, 1992). Because of the above described characteristics, step-pool streams are resilient to changes in discharge and sediment supply (Montgomery and Buffington, 1997).

As is clearly shown in the above cited literature, the channel forming or dominant discharge in creeks such as Cottonwood Creek is not related to frequently occurring flows associated with the mean annual (or 1.5- to 2-year) flood peak. The concept of the dominant discharge is derived from work on self-formed, alluvial channels in which the boundary material is mobilized over a broad range of discharges, including those that occur for a few to several days per year. These channels typically are able to adjust their cross-sectional shape, planform, and gradient to achieve a state of dynamic equilibrium with the water and sediment supply. The self-formed alluvial streams on which the dominant discharge concept is based typically have well-developed flood plains in which there is a distinct top of bank with a relatively flat overbank area (i.e., bankfull).

Portions of the relatively short reach of Cottonwood Creek between the mouths of Left Fork and Hys Fork have areas that, at a superficial level, appear to fit the definition of a flood plain. (For example, there is a relatively flat overbank area in the narrow valley bottom that is two to three times wider than the channel, and there is a well-defined bankline. The channel capacity in this area appears to be on the order of the 2- to 5-year flood peak.) Closer examination, however, shows that these areas are primarily the result of beaver activity in this locally flatter reach of the stream. As previously discussed, the overbank material is a heterogeneous mixture of materials ranging in size from cobbles to silt and clay. The finer-grained areas are depositional zones that developed behind beaver dams, and much of the nonlinear planform is caused by flow deflection around the remnants of breached dams.

In the step-pool reaches of Cottonwood Creek, the processes that control the size, gradient, and planform are very different from those that control these features in the self-formed streams that have well-developed flood plains. The channel is confined between the valley walls, occupying essentially the entire valley bottom. The lateral and vertical accretion processes that create flood plains do not occur because the channel is laterally confined, and the concept of the bankfull discharge is essentially meaningless. The bed shear stresses in the step-pool reaches of the stream, indicated by a hydraulic analysis of the peak of the 2-year flood, are substantially less than are required to mobilize the boulder steps that locally control the profile of the channel.

3.14.2 Methodology and Impact Indicators

Because the review team determined that existing landslides in the canyon are not related to stream channel stability or the flow in Cottonwood Creek, it was determined that the project would have no effect on the

landslides. Therefore, no additional analysis of the landslides was performed.

As mentioned previously, the majority of Cottonwood Creek is a step-pool stream. This determination is based on a detailed field review. The project effects on channel stability are based on physical characteristics of the stream, the processes associated with step-pool morphology, and the impacts of the project on the flow characteristics. The impact indicator is flows exceeding the 50-year channel forming flow because of project operation.

3.14.3 Predicted Effects

3.14.3.1 No Action Alternative

Under the No Action Alternative, there would be no change in channel forming discharge in Cottonwood Creek over its present value; therefore, there would be no impact to Cottonwood Creek channel stability.

3.14.3.2 Proposed Action Alternative

Under the Proposed Action, increased flows in Cottonwood Creek will occur due to releases from Narrows Reservoir through the Narrows Tunnel and Upper Cottonwood Creek Pipeline. These increased flows will occur below Left Hand Fork where the Upper Cottonwood Creek Pipeline will discharge into the creek. Figure 3-10 is a hydrograph based on daily flow data that compares present, or No Action Alternative, flows in Cottonwood Creek with flows that will occur under the Proposed Action. The figure is based on 1968 data, which is an average year. As shown in the figure, the peak discharge of about 112 cfs occurs during the snowmelt runoff period. Presently, summer base flows are about 18 cfs. Under the Proposed Action, the summer base flows would increase to about 50 cfs. The maximum flows possible through the tunnel would increase by 45 cfs, from a preproject capacity of 15 cfs to a Proposed Action capacity of 60 cfs.

The 50-year rainfall peaks expected in the canyon range from 330 cfs below Left Fork to 570 cfs near the mouth of the canyon. The possible maximum increase in tunnel flows is less than 15% of the rainfall peaks. The snowmelt peak is not a consideration because the tunnel will not operate during the snowmelt runoff. Based on the physical characteristics of Cottonwood Creek and the impacts of the proposed project on the flow characteristics, the project is unlikely to have a significant impact on the stability of the creek. To ensure that the tunnel releases will not cause an impact, the measures described below will be implemented.

As described previously in chapter 2, remote control of the Narrows Tunnel operating gate would be provided to automatically regulate the releases through the tunnel. These controls would be coupled to an automated stream gauging station on Cottonwood Creek near the mouth of the canyon. The streamflow in Cottonwood Creek would be constantly monitored by these controls. As the streamflow increases during high runoff events such as thunderstorms, the tunnel operation would be discontinued when the flow exceeds 100 cfs. The project releases would not resume until after the flows drop below 100 cfs. Under this operating regime, the project flows through the tunnel would not increase streamflows above what is considered safe for channel stability. Increased flows under project conditions would be well below the 50-year channel-forming discharge.

Erosion along the banks of Cottonwood Creek would be carefully monitored, especially during the first year of operation, to verify that the project has no effect on Cottonwood Creek channel stability.

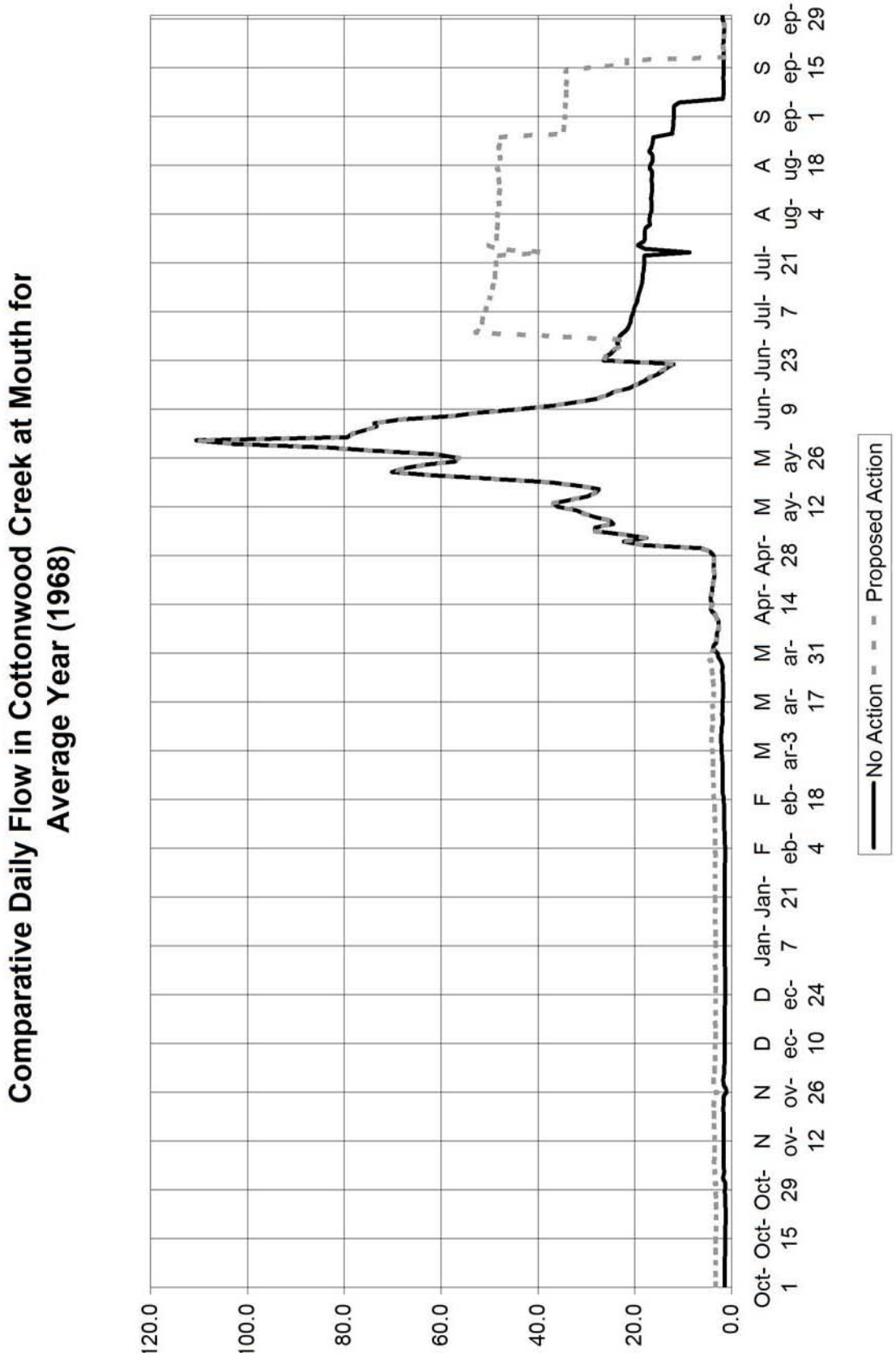


Figure 3-10.—Comparative Daily Flow in Cottonwood Creek at Mouth for Average Year (1968).

Appropriate action would be taken if additional erosion above background levels is observed during project operation. Remedial actions could include placing additional armoring materials in the channel or along the bank or revising project operation to avoid more widespread stability problems.

3.14.3.3 Mid-Sized Reservoir Alternative

Channel flows in Cottonwood Creek with the Mid-Sized Reservoir Alternative would be similar to the Proposed Action; therefore, there would be no impact to Cottonwood Creek channel stability. Monitoring of Cottonwood Creek channel stability would take place to ensure that there are no measurable impacts as described in the Proposed Action.

3.14.3.4 Small Reservoir Alternative

Channel flows in Cottonwood Creek with the Small Reservoir Alternative would be similar to the Proposed Action; therefore, there would be no impact to Cottonwood Creek channel stability. Monitoring of Cottonwood Creek channel stability would take place to ensure that there are no measurable impacts, as described in the Proposed Action.

3.15 GEOLOGIC RESOURCES

3.15.1 Affected Environment

The reservoir basin lies within a high elevation, shallow valley in the Wasatch Plateau subprovince of the Colorado Plateau. This subprovince represents the transition between the Colorado Plateau to the east and the Basin and Range Province to the west. Several ridges isolate the valley basin, which lies about 8,680 feet above sea level.

The proposed Narrows Dam and Reservoir area is underlain by the Cretaceous age North Horn formation. This formation consists primarily of interbedded sandy, clayey siltstone, silty claystone, silty sandstone, and limestone with occasional thin seams of coal. Bedrock crops out on the steeper slopes of the left abutment and in the drainage located immediately upstream of the left abutment. There is less exposure of bedrock on the right abutment. Unconsolidated sediments overlying bedrock consist primarily of a mixture of residual soil (weathered rock) and colluvium that generally consists of silty sand with some fine to coarse gravel. A geologic study performed by SWCD indicates that there is low potential for reservoir-induced landslide activity in the reservoir basin.

The North Horn formation is overlain by the Flagstaff Limestone formation, which consists primarily of microcrystalline limestone with thinly bedded shale and silty claystone. Abundant fossils are common within the limestone, and the boundary between the formations is transitional. The Flagstaff Limestone formation generally is present in the higher elevations and beyond the actual limits of the proposed dam and reservoir.

The Flagstaff Limestone formation is present at the downstream portal area of the existing Narrows Tunnel.

Bedrock generally is covered by a mantle of residual soils and/or colluvium. These unconsolidated sediments are about 5–10 feet thick with some areas in excess of 27 feet. The unconsolidated sediments are composed of a mixture of clay, silt, and sand with minor amounts of organic deposits. Within the active stream channel of Gooseberry Creek and its tributaries, there are limited deposits of recent alluvial sand and gravel.

The structure of the Wasatch Plateau is dominated by a series of north-trending faults across the broad, west-dipping monocline of the plateau. The Sevier fault zone lies closest to the damsite at a distance of about 20 miles.

The local structure is dominated by north-trending faulting around the site area. The dam and reservoir sites are located entirely on a down-dropped block between two fault traces, which is known as the Gooseberry Graben. Variation in orientation of beds indicates that the dam area is located on a westward-plunging synclinal fold with the axis running about 1,000 feet south of the proposed dam axis.

Three faults have been mapped in the vicinity of the Narrows Project. These faults, shown in figure 3-11, are all north-trending normal faults, and the West Gooseberry Fault, the Fairview Lakes Fault, and the East Gooseberry Fault are from west to east.

Observed earthquakes in the region of the Narrows damsite date back to 1853, giving a historical data base of about 157 years. A network of seismograph stations throughout the region currently provide the accurate location of any seismic event. Geologic evaluation of the Wasatch Plateau area indicates that existing faults are not active. Maximum seismic events for the area are, therefore, projected to be controlled by random background earthquakes—that is, events not attributable to specific faults or geologic structures.

The largest earthquake recorded in the Wasatch Plateau Province is a magnitude 4.9 event. The maximum random earthquake event postulated for the Wasatch Plateau is a 5.5 event, occurring beneath the site at a depth of 3 miles. Such an event would produce a maximum acceleration of approximately 0.35 g (acceleration of gravity). Earthquake activity related to mining activities would not be expected to produce events that exceed magnitude 4.5 and, therefore, would not produce the maximum earthquake. Earthquake epicenters are shown on figure 3-12.

3.15.2 Methodology and Impact Indicators

Geologic hazards are not of notable concern in the project area; however, earthquake epicenters have been mapped adjacent to the project area. The highest recorded magnitude earthquake recorded for the Wasatch Plateau Province is 4.9.

The impact indicator for this issue is number of known geologic hazards within the vicinity of the dam and reservoir.

3.15.3 Predicted Effects

3.15.3.1 No Action Alternative

Geologic conditions and earthquake hazards would remain the same as at present under this alternative.

3.15.3.2 Proposed Action Alternative

From a geoseismic standpoint, the recommended Narrows damsite is suitable for construction. No significant geologic hazards were found in the embankment or reservoir area, and no seismic activity would be expected to occur from, or be induced by, this reservoir. Faults that occur in the site vicinity are believed to be inactive; however, design of project facilities would be based on a “maximum credible earthquake” (MCE). Preliminary studies indicate that the appropriate MCE would be of magnitude 5.5. Further review of the appropriate MCE would be performed prior to final design of the dam.

During construction, detailed observations of the subsurface conditions would be monitored by qualified personnel.

There would be no residual geology or seismicity impacts under the Proposed Action. There would be no geology or seismicity mitigation measures under the Proposed Action.

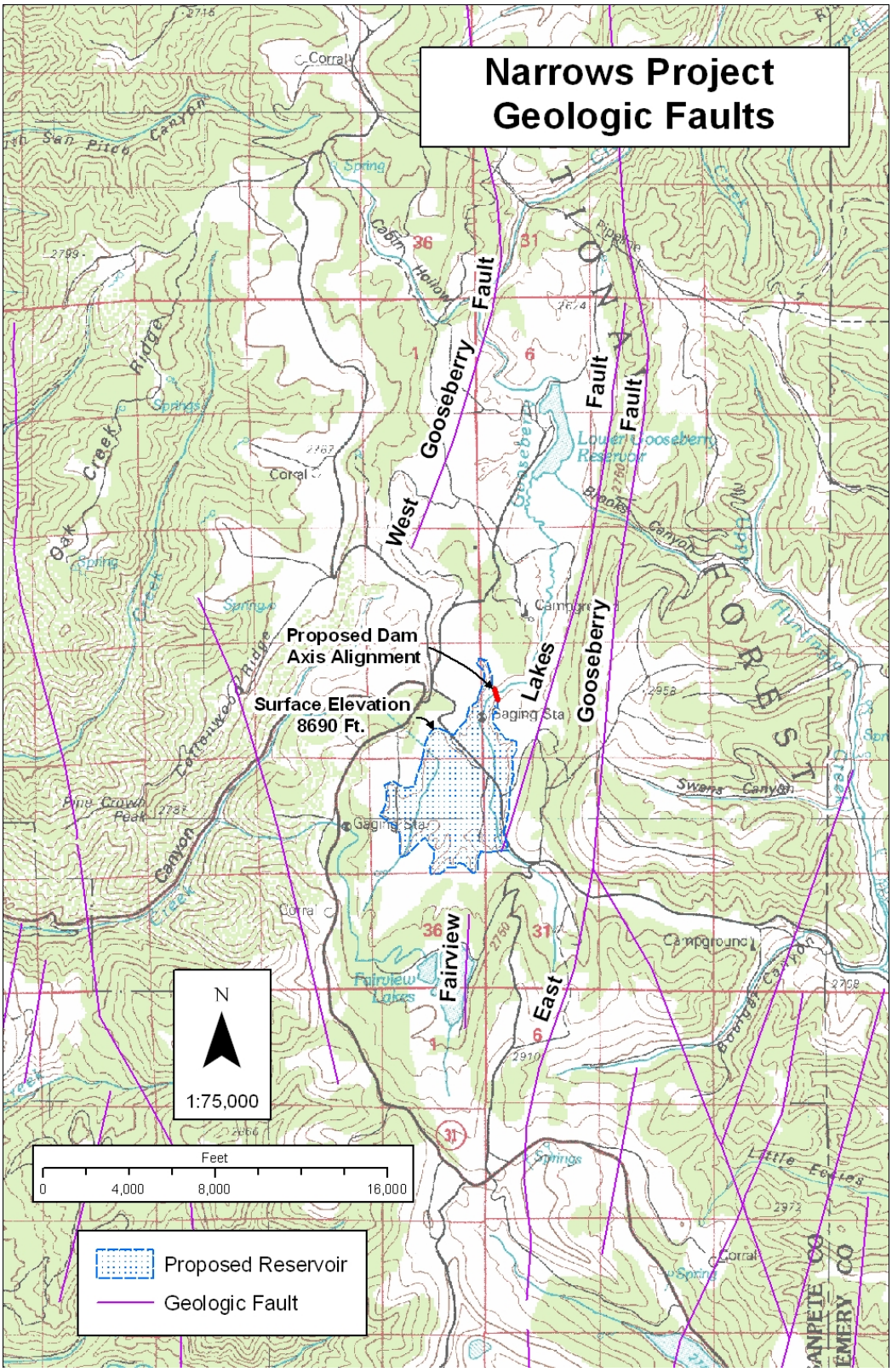


Figure 3-11.—Narrows Project Geologic Faults Location Map.

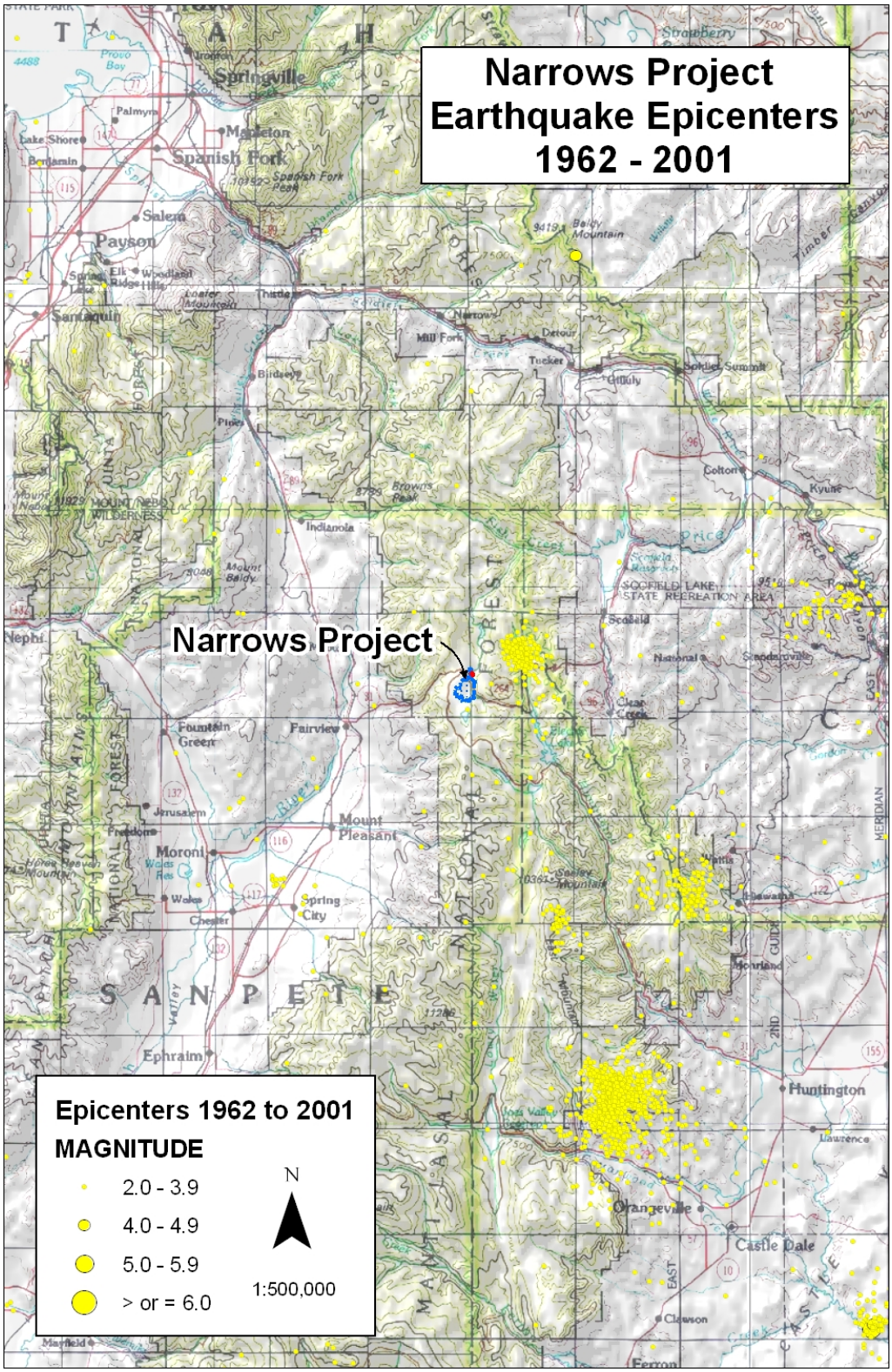


Figure 3-12.—Narrows Project Earthquake Epicenters Location Map.

3.15.3.3 Mid-Sized Reservoir Alternative

As described for the Proposed Action, no significant geologic hazards were found in the embankment or reservoir area, and no seismic activity would be expected to occur from, or be induced by, this alternative. Design of project facilities would be based on a MCE.

Detailed observations of the subsurface conditions would be monitored by qualified personnel during construction.

There would be no residual geology or seismicity impacts measures under the Mid-Sized Reservoir Alternative. There would be no geology or seismicity mitigation measures under the Mid-Sized Reservoir Alternative.

3.15.3.4 Small Reservoir Alternative

As described for the Proposed Action, no significant geologic hazards were found in the embankment or reservoir area, and no seismic activity would be expected to occur from, or be induced by, this alternative. Design of project facilities would be based on a MCE. Detailed observations of the subsurface conditions would be monitored by qualified personnel during construction.

There would be no residual geology or seismicity impacts measures under the Small Reservoir Alternative. There would be no geology or seismicity mitigation measures under the Small Reservoir Alternative.

3.16 SOIL RESOURCES

3.16.1 Existing Environment

Soils in the project service area and along the Oak Creek and East Bench Pipelines alignments have developed under semiarid conditions. They are highly calcareous, are high in inherent plant nutrients, have weak to moderate developed soil profiles, and have a wide range of soil textures. They are derived principally from both old and recent alluvial materials eroded from geologic materials of the Wasatch Plateau. The lands are found on benches and terraces formed by the coalesced alluvial fans of the stream's tributary to the San Pitch River. A broad area of valley fill material of deeper soils is found west of Mount Pleasant and in small cove areas at the base of the large alluvial fans. Valley fill also is found in the flat valley or river bottom areas west and southwest of Moroni.

Soils within the vicinity of the proposed Narrows Reservoir are formed mostly in colluvial, alluvial, and residuum materials weathered from sedimentary rocks, limestone, sandstone, and shale. Soils on the high ridges along the west side of the area are formed in materials derived primarily from limestone, while soils in the central and eastern sections of the project area are formed in materials dominated by sandstone, (silty) shale, and some limestone.

Soils are dark colored, rich in bases, freely drained, and cold. Mean annual soil temperature is less than 47 degrees Fahrenheit (°F), and the mean summer soil temperature is less than 59 °F. Average annual precipitation ranges from 20–25 inches, and the growing season is approximately 90–100 days. All but two of the soil series described are in the Cryoboroll Great Group, Boroll Suborder, and Mollisol Order of soil classification. The two exceptions, Fairview and Gooseberry series, are classified as being in the Cryaquoll Great Group, Aquoll Suborder, and Mollisol Order.

The erosion hazard for the soils within the vicinity of the proposed reservoir ranges from severe to low, with over 80% of the area being classified as having a moderate or low erosion potential. Precipitation runoff rates range from rapid to slow, with most of the area having a moderate to slow runoff rate. Average sediment yields in the vicinity of the

proposed reservoir are estimated to be 73 tons per square mile per year. With a drainage area of about 5.5 square miles, there is an estimated sediment load of 400 tons per year at the proposed damsite. This drainage area excludes the area that drains into Fairview Lakes.

3.16.2 Methodology and Impact Indicators

Project effects on soils resources were determined by determining the number of acres of soils that would be disturbed by construction activities or project operation and by the amount of sediment entering Gooseberry Creek. These two items serve as impact indicators.

3.16.3 Predicted Effects

3.16.3.1 No Action Alternative

Under this alternative, soil erosion would continue at historical rates, with about 73 tons per square mile per year of sediment entering Gooseberry Creek. This would continue to generate a sediment load of about 400 tons per year at the proposed damsite. Soil disturbance due to construction would not occur, and soils within the study area would not be inundated.

3.16.3.2 Proposed Action Alternative

Under the Proposed Action, about 604 acres of land would be inundated by Narrows Reservoir. An additional 32.4 acres would be disturbed by construction of SR-264 relocation and recreation area. Development of a rockfill material source area outside of the reservoir basin would disturb another 2.0 acres. Earthfill material source areas would be developed within the reservoir basin, and contractor staging areas and tunnel spoil areas also would be located below the low water level of the reservoir basin.

The alignment of the proposed highway relocation crosses relatively gentle terrain, and cut and fill slopes would be minimal. All cut and fill slopes would be revegetated to minimize erosion. Roadways in the recreation area would be paved to minimize dust and soil erosion. Following construction, the rockfill material source area would be recontoured, topsoil would be replaced, and the area would be revegetated. Virtually all runoff from disturbed areas would flow into Narrows Reservoir that would act as a trap for all upstream sediment. The current sediment load in Gooseberry Creek downstream from the proposed Narrows Reservoir would be reduced by about 400 tons per year with construction of the Proposed Action. This sediment would accumulate in the reservoir.

The Upper Cottonwood Creek Pipeline would be constructed in a previously disturbed area along the shoulder of SR-31. Construction of the Oak Creek and East Bench Pipelines would disturb about 30 acres. As part of the construction process, the ground would be recontoured and revegetated with native plants to minimize erosion and to restore the natural appearance.

Mitigation for disturbances to soils under the Proposed Action would be accomplished by revegetating all cut and fill slopes to minimize erosion. Roadways in the recreation area would be paved to minimize dust and soil erosion. Following construction, the rockfill material source area would be recontoured, topsoil would be replaced, and the area would be revegetated.

Residual impacts to soils under the Proposed Action would include inundating 604 acres by Narrows Reservoir and the 32.4 acres that would be covered by relocating SR-264.

3.16.3.3 Mid-Sized Reservoir Alternative

Under the Mid-Sized Reservoir Alternative, about 489 acres of land would be inundated by Narrows Reservoir. The reservoir would reduce the sediment load to Gooseberry Creek by about 400 tons per year. Other impacts such as those caused by SR-264 relocation, pipeline construction, and development of material source areas would be the same as under the Proposed Action.

Mitigation for disturbances to soils under the Mid-Sized Reservoir Alternative would be similar to that proposed under the Proposed Action.

Residual impacts to soils under the Mid-Sized Reservoir Alternative would include inundating 489 acres by Narrows Reservoir and the 32.4 acres that would be covered by relocating SR-264.

3.16.3.4 Small Reservoir Alternative

Under the Small Reservoir Alternative, about 362 acres of land would be inundated by Narrows Reservoir. The reservoir would reduce the sediment load to Gooseberry Creek by about 400 tons per year. Other impacts such as those caused by SR-264 relocation, pipeline construction, and development of material source areas would be the same as under the Proposed Action.

Mitigation for disturbances to soils under the Small Reservoir Alternative would be similar to that proposed under the Proposed Action.

Residual impacts to soils under the Small Reservoir Alternative would include inundating 362 acres by Narrows Reservoir and the 32.4 acres that would be covered by relocating SR-264.

3.17 TRACE ELEMENTS

3.17.1 Affected Environment

A trace element survey was conducted in accordance with current Reclamation practices to identify where concentrations of potentially toxic elements such as selenium, arsenic, and mercury likely would be to occur in irrigation return flows under project conditions. Accumulations of these substances can be harmful to humans and wildlife. A total of 11 soil samples, collected in 1990, were analyzed by the USGS. The results are shown in table 3-34 for arsenic, mercury, and selenium from three representative sites in the project area.

Study results indicate that all three elements analyzed are present in low to moderate concentrations; therefore, further testing for these elements was not considered necessary.

Data also was gathered from the National Geochemical Database that contained extensive information on soils in the vicinity of the survey area. Most of the data was from the National Uranium Resource Evaluation Surveys conducted from 1976–80. The primary objective of these surveys was to prospect for uranium; however, many other trace elements also were analyzed in the survey. Located in the vicinity of the survey area were 59 soil sampling sites from this. Almost all sites were in Quaternary alluvium.

The data indicate that most trace elements are present in concentrations within the common range for western soils. Cobalt was the only element consistently present in concentrations outside the common range. However, cobalt is not considered hazardous in the alkaline soils of the region. Limited water analysis data indicate cobalt was not detected in the San Pitch River.

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Table 3-34.—Narrows Project Trace Elements Data Summary Total Concentrations in Soil

Site and Sample Number	Arsenic (ppm)[1]	Mercury (ppm)	Selenium (ppm)
Upper Alluvial Fans Shallow Phase			
1	6.4	0.02	0.2
2	7.6	N0.02	0.2
Alluvial Fans Moderate to Deep Phase			
3	6.2	0.02	0.2
4	6.3	0.02	0.2
5	5.3	N0.02	0.2
6	4.9	N0.02	0.1
Valley Fill Deep Phase			
7	4.0	N0.02	0.2
8	3.7	0.02	0.2
9	4.5	N0.02	0.2
10	5.0	N0.02	<0.1
11	5.6	N0.02	<0.1
Geometric Mean Concentration of 733 Western Soils[2]	5.5	0.046	0.23
Common Range in Western Soils[3]	1.2-22.0	0.0085-0.25	0.039-1.4

[1] ppm = parts per million.
[2] Shacklette and Boerngen, USGS Paper 1270, 1984.
[3] Values chosen to represent an expected 95% range (Tidball and Ebens, 1976).

Table 3-35 summarizes the number of soil samples with noteworthy concentrations of trace elements. Although these elements were found at elevated concentrations at scattered sites, it appears that none of the elements are present in concentrations of concern in the existing project return flows.

Table 3-35.—Sanpete Valley Soil Samples with Uncommonly High Trace Element Concentrations

Element	Number of Samples	Number at Uncommonly High Concentration
Silver	59	[1]20
Molybdenum	59	[2]23
Uranium	59	[2]6
Selenium	59	[2]5

[1] Used 1,000 parts per billion as threshold value.
[2] Exceeds the expected 95% range (Tidball and Ebens, 1976).

The data presented in table 3-36 indicate that trace elements are present in low concentrations in ground water in or near the proposed Narrows Project. A review of the STORET data for the San Pitch River indicated low concentrations of the same trace elements present in the surface water in the Narrows Unit.

The data presented in table 3-37, from the EPA STORET database, indicates that water quality of the San Pitch River in the project area is generally acceptable. The San Pitch River shows some improvement in water quality through the project area, possibly due to high quality inflows from the Manti-La Sal drainage.

Table 3-36.—Comparison of Ground Water in the Narrows Project with Selected Standards

	EPA Standards (micrograms per liter [µg/L])			Ground Water Concentrations (µg/L)		
Element	**Drinking Water[1]**	**Aquatic Life[2]**	**Irrigation Water[3]**	**Number of Samples**	**Range**	**Mean**
Aluminum		87	5,000			
Arsenic	50	190	100	2	1-2	1.5
Barium	1,000			2	80-100	90
Beryllium		5.3	100			
Boron			750	23	20-450	112
Cadmium	10	1.1	10	2	<1	<1
Chromium	50	210	100	2	<5	<5
Hex. Cr.		11				
Cobalt			50			
Copper	1,000	12	200	2	<20-29	24.5
Cyanide	200	5.2				
DBCP	1					
Fluoride	1,400-2,400			28	<100-2,700	382
Iron			5,000	12	3-190	27.6
Lead	50	3.2	5,000	2	<5	<5
Lithium			75	2	<10-20	15
Manganese	50		200	2	<5-41	23
Mercury	2	0.012		2	<.0.5	<0.5
Molybdenum			10			
Nickel		96	200			
Nitrate	45,000			37	0-43,000	12,100
Selenium	10	5	20	9	<1-5	2
Silver	50	0.12		2	<2	<2
Strontium				2	460-1,800	1,130
Uranium[5]	20	[4]300		12	1.1-23.6	5.3
Vanadium			100			
Zinc	5,000	47	2,000	2	<20	<20

[1] Primary or secondary standards.
[2] Freshwater criteria.
[3] Adapted from *Water Quality Criteria for Agriculture* (1972).
[4] Canadian criteria.
[5] Data from National Geochemical Database.

Table 3-37.—Water Quality Data for the San Pitch River[1]

STORET Station Location	EC at 25 °C	SAR	Soluble Cations, (meq/L)				Soluble Anions (meq/L)				Toxic Elements, (µg/L)			
			Ca	Mg	Na	K	CO_3	HCO_3	SO_4	Cl	Arsenic	Boron	Mercury	Selenium
Above Narrows Project														
San Pitch River 1 mile west of Milburn	1,300.8	.025	11.41	4.36	0.70	0.10	0.03	5.36	10.93	0.24	1.70	121	0.06	0.38
Cottonwood Creek 1.5 miles east of Fairview	459.0	.019	2.63	1.80	0.29	0.04	0.00	4.38	0.58	0.09	0.93	89	0.05	0.40
Fountain Green Hatchery - east outflow	426.0	1.00	1.70	1.48	1.26	0.03	0.00	4.36	0.10	0.14	1.00	50	0.10	1.00
Fountain Green Hatchery - west outflow	431.9	0.28	2.30	1.48	0.39	0.03	0.00	4.30	0.16	0.11	1.00	50	0.10	1.00
Within Narrows Project														
San Pitch River above Moroni Wastewater Treatment Plant outfall	791.8	0.64	3.06	4.50	1.25	0.09	0.01	6.76	1.41	0.81	2.47	75	0.14	0.97
San Pitch River 2.5 miles west of Mt. Pleasant	771.4	0.56	3.33	4.23	1.09	0.08	0.00	6.72	1.47	0.54	3.09	155	0.14	1.32
Just below Narrows Project														
San Pitch River 1 mile west of Chester	1,111.0	1.07	3.55	5.08	2.22	0.21	0.08	7.02	2.09	1.34	3.42	220	0.00	0.45
Below Narrows Project														
San Pitch River northwest of Manti	1,272.0	2.28	4.28	8.31	5.71	0.13	0.00	8.12	6.15	2.20	5.00	260	0.07	1.00
San Pitch River below Gunnison Reservoir	1,630.8	2.46	2.61	10.26	6.23	0.14	0.28	9.26	6.17	3.86	6.00	No data	0.10	1.00
San Pitch River at U-137 crossing	2,591.3	6.78	4.26	6.85	15.99	0.14	0.07	6.87	5.73	11.59	5.54	349	0.15	1.07

[1] °C = degrees Celsius; SAR = specific absorption rate; meq/L = milliquivalent per liter.

3.17.2 Methodology and Impact Indicators

Data gathered from the National Geochemical Database have been used as a baseline for concentrations of select trace elements in the soils and ground water within the project area. The impact indicator for this issue is measured by the increase in levels of select trace elements in ground water due to the construction and operation of the Narrows Project.

3.17.3 Predicted Effects

3.17.3.1 No Action Alternative

An increase of potentially toxic trace elements is not expected under the No Action Alternative.

3.17.3.2 Proposed Action Alternative

Lands in the project area have been irrigated for more than 50 years, and the results of the data gathered showed no significant quantities of trace or toxic elements in the ground water and in the San Pitch River; therefore, no increase of potentially toxic trace elements is anticipated under project conditions. There would be no residual impacts associated with potentially toxic trace elements under the Proposed Action.

3.17.3.3 Mid-Sized Reservoir Alternative

No increase of potentially toxic trace elements is anticipated under implementation of the Mid-Sized Reservoir Alternative. There would be no residual impacts associated with potentially toxic trace elements under the Mid-Sized Reservoir Alternative.

3.17.3.4 Small Reservoir Alternative

No increase of potentially toxic trace elements is anticipated under implementation of the Small Reservoir Alternative. There would be no residual impacts associated with potentially toxic trace elements under the Small Reservoir Alternative.

3.18 Indian Trust Assets

The United States has a trust responsibility to protect and maintain rights reserved by, or granted to, American Indian tribes or Indian individuals by treaties, statutes, and Executive orders. These rights are sometimes further interpreted through court decisions and regulations. This trust responsibility requires that agencies, such as Reclamation, take actions reasonably necessary to protect these trust assets.

Reclamation policy is to reasonably protect ITAs from adverse impacts of its programs and activities. ITAs are property interests held in trust by the United States for the benefit of Indian tribes or individuals.

There are no ITAs located within the project area.

3.19 Environmental Justice

On February 11, 1994, the President issued Executive Order 12898 on Environmental Justice in Minority Populations and Low Income Populations. As a result of that Executive order, each Federal agency is required to analyze the environmental effects, including human health, economic, and social effects, of Federal actions, including effects on minority communities and low-income communities.

In the project area, there are no minority or low-income populations.

3.20 Related Laws, Rules, Regulations, and Executive Orders

The Council of Environmental Quality regulations (40 CFR 1500.2 and 1502.25) encourage related environmental laws, rules, regulations, and Executive orders to be integrated concurrently to the fullest extent possible in an EIS.

The following environmental laws, rules, regulations, and Executive orders have been considered during preparation of this SDEIS. It has been determined that the Narrows Project would have no adverse effect upon them.

- Executive Order 11988 (Flood Plain Management)
- Wild and Scenic Rivers Act, Public Law 90-542. In 2007, the USDA Forest Service and Bureau of Land Management evaluated thousands of river miles for potential inclusion in the National Wild and Scenic Rivers System. In determining suitability, a key question was, does the river segment have Outstanding Remarkable Values (ORV). The USDA Forest Service conducted an environmental impact statement to evaluate the suitability of 86 eligible river segments (840 miles) including 21 miles of Fish Creek and Gooseberry Creek. The Record of Decision, signed November 2008, determined that Fish Creek and Gooseberry Creek were not suitable to be designated by Congress as components of the National Wild and Scenic Rivers System. All the nonsuitable river segments are no longer afforded agency interim protection under the Wild and Scenic Rivers Act and continue to be managed under the direction of the respective agencies.
- Executive Order 13007 (Indian Sacred Sites)
- Executive Order 11990 (Protection of Wetlands)

3.21 Cumulative, Irreversible and Irretrievable Commitment of Resources

3.21.1 Cumulative Resource Issues

The following discussion addresses the cumulative impacts to area resources in the Upper Colorado River Basin. Any analysis of cumulative impacts must deal with the issue of scope, both in terms of spatial and temporal scales. In the following discussions, these scales will vary depending upon the resource under evaluation.

Since 1960, some 30 water resources projects have been built or are under construction by Reclamation in the Upper Colorado River Basin (table 3-38). Reclamation estimates that those projects have provided full irrigation service to 158,460 acres with supplemental service to another 204,870 acres. These developments account for an estimated 62,776,000 megawatt hours of generated power and some 431,100 acre-feet of M&I water supplied annually. Recreational use associated with these projects, including sightseeing, picnicking, camping, boating, fishing, hunting, and other activities, is estimated at 45,068,970 annual recreation days. In terms of average annual permanent employment opportunities, these projects are responsible for some 18,716 jobs.

Aside from providing a net increase of 41,900 annual recreation days, and providing 855 acre-feet of M&I water annually, the Narrows Project would not affect the above resources. No new acres of cropland would

Table 3-38.—Water Resource Developments Included in Cumulative Impact Analysis[1]

Development and Location (State)	Actual or Estimated Completion Date
Colorado River Storage Project Storage Units	
Wayne N. Aspinall Unit, Colorado	1977
Flaming Gorge Unit, Wyoming and Utah	1963
Glen Canyon Unit, Utah and Arizona[2]	1965
Navajo Unit, Colorado and New Mexico	1963
Colorado River Storage Project Participating Projects	
Florida Project, Colorado	1963
Paonia Project, Colorado	1962
Silt Project, Colorado	1966
Smith Fork Project, Colorado	1963
Hammond Project, New Mexico	1975
Central Utah Project, Utah	
Bonneville Unit	2024
Jensen Unit	1989
Vernal Unit	1961
Emery County Project, Utah	1965
Lyman Project, Wyoming	1980
Seedskadee Project, Wyoming	[2]
Navajo Indian Irrigation Project, New Mexico	1987
San Juan-Chama Project, New Mexico	1976
Bostwick Park Project, Colorado	1971
Dallas Creek Project, Colorado	1989
Dolores Project, Colorado	1990
Frying Pan-Arkansas Project, Colorado	1977
Grand Valley Unit, Colorado (Colorado River Basin Salinity Control Project)	2006
Paradox Valley Unit, Colorado (Colorado River Basin Salinity Control Project)	1990
Animas-La Plata Project, Colorado and New Mexico (CRSP)	2010
Ruedi Reservoir Round 2 Water Sale, Colorado (Fryingpan-Arkansas Project)	1986
Lower Gunnison Basin Unit, Colorado (Colorado River Water Quality Improvement Program)	1995
Dolores Project Modifications	1996
Price-San Rafael Rivers Unit, Utah (Colorado River Water Quality Improvement Program/Colorado River Basin Salinity Control Program)	Ongoing
Narrows Project, Utah (Sanpete Water Conservancy District)	2011

[1] Scofield Dam and Reservoir are not included in table because project was constructed before 1963 (built in 1943).
[2] Fontenelle Dam and Reservoir were completed in 1964. Irrigation development has been deferred indefinitely.

be irrigated; no new power would be generated; and no new permanent jobs would be created. Because there would be no net change in existing levels of these resources in the Upper Colorado River Basin, it is assumed that there would be no cumulative impact from the proposed project; and it has been determined that further analysis of cumulative impacts of the above described resources is not necessary.

Several resource issues have been affected by past Reclamation developments and would be affected by the proposed project; thus, they have the potential to contribute to cumulative (additive) impacts within the region and beyond. These issues involve stream depletions that can impact fisheries and endangered native fishes and changes in salt loading within the Colorado River. These issues are treated below under the headings of fisheries, threatened and endangered species, and water resources, use, and quality.

3.21.1.1 Fisheries

The spatial scope of impacts to fishery resources in the current study is defined in part by interstate compacts for the delivery of prescribed amounts of water to the Lower Colorado River Basin States via releases from Lake Powell. Within the Upper Colorado River Basin, the cumulative impacts of several projects may be most significant at the level of individual drainages. For example, flows in the Price River have been depleted by earlier projects. At present, there is no minimum flow requirement below Scofield Dam; and, at times, the flow is completely shut off at the dam. The Narrows Project would not affect minimum flows of the Price River.

Many of the impacts to fishery resources from the 30 Reclamation projects in the Upper Colorado River Basin are the direct result of water depletions. Depletions would occur as a result of the Narrows Project. These depletions are discussed below.

3.21.1.2 Threatened and Endangered Species

The same argument used for spatial scope for fisheries resources applies to endangered native fishes—the Upper Colorado River Basin is a discrete water unit. The Colorado pikeminnow, bonytail chub, razorback sucker, and the humpback chub are endemic to the Colorado River Basin including downstream portions of the Green, Yampa, Gunnison, San Juan, and Colorado Rivers. These species evolved in the Colorado River and its larger tributaries under conditions of warm water, large seasonal flow fluctuations, heavy sediment loads, extreme turbulence, and a wide range of dissolved solid concentrations. These conditions have been altered by man's activities, and all four species have experienced population declines. Below Glen Canyon Dam, approximately 15 reservoirs have controlled and altered the Lower Colorado River to the point that the four species are rare or nonexistent.

In the Upper Colorado River Basin, the Colorado pikeminnow and bonytail and humpback chubs historically occupied some 1,350 miles of stream. Developments have inundated 364 miles of fish habitat and modified temperatures in 448 additional miles of stream (table 3-39). The Glen Canyon Unit flooded 186 miles of streams in the Upper Colorado River Basin and altered flow, temperature, and water quality in the 293 miles of Colorado River that flows through Marble and Grand Canyons. Although this reach was once considered significant native fish habitat, only a remnant population of humpback chub remain in the river between Lakes Powell and Mead. Navajo Reservoir on the San Juan River and Flaming Gorge Reservoir on the Green River inundated 72 and 137 miles of native fish

Table 3-39.—Loss of River Habitat for Endangered Fish Species in the Upper Colorado River System from Reclamation Developments (miles)

Project and River	Eliminated by Inundation	Loss Due to Water Quality Change	Total
Wayne N. Aspinall Unit Gunnison River		50	50
Flaming Gorge Unit Green River	72	65	137
Glen Canyon Unit Colorado River	186	[1]293	479
San Juan River	71		71
Navajo Unit San Juan River	35	40	75
Total	364	448	812

Known Endangered Fish Habitat

Development	Feature	Location	Miles from Project
Grand Valley Unit	Irrigation system improvements	Colorado River at Grand Junction, Colorado	0
Paradox Valley Unit	Brine well field	Colorado River at mouth of Dolores River, Utah	75
Animas-La Plata Project	Ridges Basin and Southern Ute Reservoirs	San Juan River near Aneth, Utah[2]	100
Ruedi Reservoir Round 2 Water	Sale of reservoir water	Colorado River at Grand Junction, Colorado	120
Lower Gunnison Basin Unit	Irrigation system improvements	Gunnison River downstream from Delta, Colorado	15
Uinta Basin Unit	Irrigation system improvements	Green River above and below mouth of Duchesne River, Utah	25

[1] Altered habitat in lower basin caused by Glen Canyon Dam.

[2] One juvenile pikeminnow collected in 1978.

habitat, respectively. The dams and reservoirs associated with the Wayne N. Aspinall Unit on the Gunnison River did not directly impact endangered fish habitat but may have indirectly affected downstream areas through changes in temperatures and flow.

Because of the potential for cumulative impacts from Reclamation projects, the Service requested Section 7 consultation (Endangered Species Act) for various Colorado River Basin native fishes in 1980 on virtually all developments constructed, under construction, or in advanced planning stages. Consultation was made contingent on completing fishery studies funded by Reclamation. Study goals included collection of data to support actions that would ensure continued existence of the fishes while permitting orderly development of water resources for various States. Subsequently, several developments have received nonjeopardy opinions—the Animas-La Plata Project; the Lower Gunnison Basin, Paradox Valley, Grand Valley, the Uinta Basin Units; and the Dolores Project modifications. In 1990, the Service reversed itself and declared that construction of the Animas-La Plata Project would jeopardize the existence of a small population of Colorado pikeminnow

downstream from the project site. The Service called for further study and issued a biological opinion in 1991 and a final biological opinion in 1996 that allowed for construction but limited the annual project depletion. The Service provided an opinion (February 1998) on Reclamation's biological assessment of impacts associated with construction of the Price-San Rafael Salinity Control Project. To minimize the possible adverse effects of the Narrows Project on the Colorado pikeminnow, bonytail chub, humpback chub, and razorback sucker, SWCD would participate in the Recovery Program as described earlier.

Projects that have not directly inundated endangered fish habitat may have indirectly affected endangered fishes through depletions of mainstream flows and changes in water quality (table 3-39). The Narrows Project would result in a 5,597-acre-foot depletion to the Colorado River.

3.21.1.3 Water Resources, Use, and Quality

During the last decade, Reclamation developed the Colorado River Simulation System (CRSS) model to improve estimates of individual and cumulative impacts from developments on salinity and requirements for future salt load reductions. One conclusion from the CRSS analysis is that hydrologic uncertainty cannot be reduced or simplified. The Colorado River Basin hydrologic record shows numerous wet and dry periods that cause the salinity in the river to vary by as much as 200 mg/L from average conditions. These fluctuations tend to mask the impacts of both development and salinity control projects.

Given these limitations, historical and project data can be used to estimate a range of salinity effects at Imperial Dam (table 3-40). The range is due to effects from other developments on flow and salinity. The cumulative impact of the developments listed may be more than 200 mg/L. Nearly one-third of the increase is attributable to depletions caused by reservoir evaporation, but these reservoirs also tend to stabilize the riverflow and, thereby, reduce the seasonally high salinity that formerly occurred in the Colorado River.

3.21.2 Irreversible and Irretrievable Commitments of Resources

Renewable and nonrenewable resources would be irreversibly or irretrievably committed by construction and operation of the Narrows Project. Although it would be theoretically possible to reverse commitments of some of these resources, the Council on Environmental Quality has stated that ". . . construction and facility uses are basically irreversible since a large commitment of resources makes removal or nonuse thereafter unlikely." This section briefly describes these commitments for all alternatives, with the exception of the No Action Alternative. Under that plan, there would be no commitment of resources other than moneys already spent, which are estimated to total just over $1 million.

3.21.2.1 Construction Materials

About 375,000 cubic yards of permeable and impermeable earth material, gravel, cobble, and riprap would be irretrievably committed to use in dam embankments and associated features. Much smaller amounts of concrete aggregate would be used. Imported cement and manufactured materials would be irretrievably committed to the project features. Fuels, explosives, and electrical power would be consumed in construction.

3.21.2.2 Land

Narrows Reservoir and other project features (damsite, recreation facilities, and road

Table 3-40.—Cumulative Stream Depletions and Salinity Changes

Project or Unit	Depletion (acre-feet/year)	Change in Salt Loading (tons per year)	Range of Individual Project Salinity Impacts for 1941-2040[1] (mg/L)	
			Minimum	Maximum
Wayne N. Aspinall Unit	9,000	0	0.4	1.7
Flaming Gorge Unit	65,000	0	2.6	12.1
Glen Canyon Unit	525,000	0	20.8	91.2
Navajo Unit	26,000	0	1.1	4.9
Florida Project	14,000	11,500	1.1	4.1
Paonia Project	10,000	4,700	.6	2.5
Silt Project	6,000	13,200	.8	2.8
Smith Fork Project	6,000	2,800	.4	1.5
Hammond Project	10,000	7,900	.7	2.9
Central Utah Project				
Bonneville Unit	166,000	-21,600	5.8	27.7
Jensen Unit	15,000	33,200	2.0	7.1
Vernal Unit	12,000	27,700	1.7	5.9
Upalco Unit	12,000	6,200	.8	3.1
Emery County Project	8,000	0	.3	1.5
Lyman Project	10,000	0	.4	1.9
Seedskadee Project	281,000	0	11.3	50.6
Navajo Indian Irrigation Project	267,000	220,000	20.0	75.7
San Juan-Chama Project	110,000	-16,000	3.8	18.3
Bostwick Park Project	4,000	11,200	0.6	2.2
Dallas Creek Project	17,000	9,800	1.1	4.5
Dolores Project	81,000	50,650	5.4	21.5
Fryingpan-Arkansas Project	69,000	-3,500	2.7	12.4
Paradox Valley Unit	1,500	-180,000	-7.7	-23.2
Animas-La Plata Project	155,000	6,470	6.0	27.6
Ruedi Reservoir Round 2 Water Sale	49,000	-15,000	1.3	7.3
Lower Gunnison Basin Unit	-2,000	-141,000	-6.1	-18.7
Grand Valley Unit	0	-166,000	-7.2	-21.7
Uinta Basin Unit	0	[2]-25,500	-1.1	-3.3
Dolores Project Modifications	0	-32,000	-1.4	-4.2
Price-San Rafael Rivers Unit	25,300	-161,000	-5.9	-16.3
Narrows Project	5,597	-1,520	0.3	1.3
Total	1,957,397	-49,330	[3]	[3]

[1] Maximum annual range of salinity impact at Imperial Dam as predicted by the CRSS computer model developed by Reclamation. The range of effects considers the uncertainty of the hydrosalinity analysis, as well as a wide range of hydrologic and development conditions. The maximum annual range represents the widest variation in salinity impacts possible by a project in any 1 year of operation. The average impact would fall about midway between these extremes.

[2] Mean of 21,000 to 30,000 tons of reduction expected from unit.

[3] Salinity impacts of the individual developments cannot be added directly because of synergistic effects.

relocations) would permanently alter use on about 786 acres of land currently functioning primarily as rangeland and wildlife habitat. Geologic studies of the reservoir and damsite have not identified any critical mineral resources within the reservoir basin or damsite.

3.21.2.3 Water Resources

The Narrows Project would commit up to 5,400 acre-feet of water from Upper Gooseberry Creek and its tributaries, which are located in the Price River drainage, to project purposes. Initially, about 4,900 acre-feet would be used for irrigation, and 500 acre-feet would be designated for municipal use in the northern Sanpete County area.

Under present Utah water law and the 1984 Compromise Agreement, commitments of water resources essentially would remain permanent, provided that they are beneficially used. Although the area's water resources would not be irretrievably or irreversibly committed, use of the project water would probably be long term in nature.

3.21.2.4 Fish and Wildlife Habitat

The inundation by the reservoir of about 1 mile of UDWR Class 3B-Unique stream fishery in Upper Gooseberry Creek and 4.3 miles of cutthroat trout spawning and rearing habitat in the Gooseberry Creek tributaries would be essentially irreversible. The commitment of land around the reservoir to recreation and wildlife uses also would be essentially irreversible, since to do otherwise could jeopardize the water quality of the reservoir as well as the proposed wildlife mitigation plan. Streamflow patterns resulting from project operation would be subject to change should water needs in service areas change, but current trends indicate that the proposed operational criteria would be long term and would constitute a basically irreversible commitment.

3.21.2.5 Aesthetics

Narrows Project would irreversibly alter the scenery of the feature sites by the building of structures, excavation of landscape, and inundation of the reservoir. The construction scars would be revegetated where practical; but the visual impact, which could be unattractive to some people, would be permanent.

CHAPTER 4

Consultation and Coordination

4.0 INTRODUCTION

This chapter details the consultation and coordination between Reclamation and other State, Federal, and local agencies; Native American tribes; and the public in preparation of the SDEIS and the draft EIS published in 1998, which this SDEIS updates and supplements. Throughout the EIS process dating back to 1990, input has been actively solicited from a broad range of public constituencies as part of the ongoing public involvement process. Comments and involvement in the planning for, and preparing of, the Narrows Project generally were sought through two broad efforts: communication and consultation with a variety of Federal, State, and local agencies; Native American tribes; and interest groups; and the formal SDEIS scoping process and comment process, both of which invited input from the general public.

4.1 SUMMARY OF INTERAGENCY COORDINATION 1996–2003

In 1996, Reclamation invited a number of State and Federal agencies to become cooperating agencies in preparation of the DEIS. The two agencies that agreed to become cooperating agencies for the EIS process, including this SDEIS, are the U.S. Department of Agriculture Forest Service and the U.S. Army Corps of Engineers. In addition to these two agencies, the following agencies had representation on the interdisciplinary team led by Reclamation that prepared the DEIS published in 1998:

- U.S. Fish and Wildlife Service
- U.S. Environmental Protection Agency
- Utah Division of Wildlife Resources
- Utah Division of Water Quality
- U.S. Department of the Interior, Office of the Solicitor
- Sanpete Water Conservancy District

Reclamation hosted periodic cooperating agency meetings and interdisciplinary team meetings throughout preparation of the DEIS and this SDEIS to ensure that all of the agencies were informed of, and involved in, the issues and analyses related to the SDEIS.

4.2 CONSULTATION

Consultation was conducted as needed with agencies or experts that provided information for preparation of the DEIS published in 1998 and the SDEIS.

4.2.1 Fish and Wildlife Coordination Act

Reclamation consulted with the Service on fish and wildlife resources and habitats that would be affected by the Narrows Project. A Fish and Wildlife Coordination Act Report was prepared by the Service. As a result of continued consultation regarding project impacts to fish and wildlife, Reclamation requested an updated Fish and Wildlife Coordination Act Report from the Service (appendix D). In 2006, the Service verified

that this report was still current and did not require updating.

4.2.2 Endangered Species Act of 1973

Reclamation consulted with the Service regarding potential project impacts to threatened and endangered species. A list of species that could occur in the project area was received from the Service. Reclamation submitted a biological assessment to the Service. The Service then issued a biological opinion. Consultation was re-initiated by Reclamation as a result of critical habitat designation. The Service then issued an amended biological opinion for the Narrows Project. Consultation was again re-initiated by Reclamation after the discovery of Colorado pikeminnow in the lower Price River. Subsequently, Reclamation submitted an amended biological assessment to the Service analyzing this new information. Reclamation received a biological opinion from the Service August 24, 2000.

4.2.3 National Historic Preservation Act

Reclamation consulted with the Utah SHPO on cultural resources that may be affected by the Narrows Project. A letter from Reclamation was sent to the SHPO on September 10, 1997, requesting a review of the cultural resource-related environmental commitments contained in the DEIS to determine the adequacy of the commitments in complying with Section 106 responsibilities. SHPO concurred with the adequacy of Reclamation's environmental commitments in a letter dated September 16, 1997 (appendix F).

4.2.4 Tribal Consultations

In (1996), Reclamation initiated consultation under various cultural resource laws, Executive orders, and regulations with the following tribes: the Southern Ute Tribe, the Ute Mountain Tribe, the Ute Tribe of the Uintah and Ouray Reservation, the Northwest Band Shoshone Tribe, the Wind River Shoshone Tribe, the Hopi Tribe, the Paiute Indian Tribe of Utah, the Kaibab Paiute Tribe, the Pueblo of Nambe, the Pueblo of Zia, the Pueblo of Laguna, and the Pueblo of Zuni. Consultation with interested tribes has been an ongoing process and included a briefing on the DEIS for the Ute Tribe of the Uintah and Ouray Reservation Business Council and a field visit with representatives of the Wind River Shoshone Tribe. None of the tribes expressed concerns regarding either traditional cultural properties or sacred sites within the area of potential effect.

4.3 Public Involvement and Scoping

The scoping process for this SDEIS was conducted by Reclamation beginning in November 2003 to provide the general public, organizations, State and local governments, and affected Federal agencies an opportunity to identify issues and concerns they believe should be studied early in preparation of the SDEIS. "Scoping" is the public involvement process required by the Council on Environmental Quality regulations to help Federal agencies determine issues and alternatives analyzed in the SDEIS. Results of the scoping meetings and comments received during the scoping process were used to establish the scope of the SDEIS and focus the environmental analysis on the important issues and concerns.

The original scoping process for the Narrows Project began with scoping meetings held at

Fairview and Price, Utah, on October 3 and 4, 1990, respectively. Notice of the scoping meetings was given through a *Federal Register* Notice dated September 7, 1990, and through a news release dated September 24, 1990. In addition, 32 letters were sent to State and Federal agencies and environmental groups giving notice of the meetings. Three newspapers—the Salt Lake Tribune, the Mt. Pleasant Pyramid, and the Sun Advocate—published articles regarding the project and the upcoming scoping meetings. Concerned citizens were encouraged to attend the scoping meetings or express their concerns in writing.

After the 1995 Record of Decision was rescinded, a new DEIS was prepared beginning in 1996 and was published in 1998. Comments were received on that DEIS (and public hearings were held to receive comments); those comments were analyzed and responded to, and the 1998 DEIS was revised based on input from those comments. Since a decision was made in 2003 to prepare this SDEIS in lieu of publishing a FEIS based on the 1998 DEIS, it should be noted that this SDEIS does capture revisions made earlier based on public comments and input.

After the decision was made to prepare this SDEIS, public meetings to inform the public and share information were held in Price and Manti, Utah, in September 2003. On November 25, 2003, a *Federal Register* Notice was published to serve official notice that Reclamation intended to prepare a supplemental draft environmental impact statement for the Narrows Project. Comments received in response to the *Federal Register* Notice were taken into consideration, along with all prior public comments related to this project in preparing the SDEIS.

Section 1.3 provides further information on the scoping process for this SDEIS.

4.4 DOCUMENT AVAILABILITY

Those who were on the mailing list for the 1998 DEIS, or who asked to be added to the mailing list in response to the November 2003 Notice of Intent to Prepare a SDEIS, will be provided with a copy of this document, along with other environmental groups; Federal, State, and local government agencies; and other interested parties. Approximately 425 notifications of the SDEIS have been mailed to interested agencies, organizations, and individuals. The SDEIS is available online at www.usbr.gov/uc/envdocs/index.html#eis.

CHAPTER 5

List of Preparers

This Narrows Project, Utah, Supplemental Draft Environmental Impact Statement was prepared by the Bureau of Reclamation, Upper Colorado Region, Provo Area Office. The names of persons who prepared various sections, provided extensive background information, or participated to a significant degree in preparing the present document are listed below. Immediately following is a listing of members of the Former Interdisciplinary Team who produced the 1998 *Draft Environmental Impact Statement, Narrows Project*.

Preparers of Current Supplemental Draft Environmental Impact Statement

U.S. Department of the Interior
Bureau of Reclamation
Provo Area Office
Provo, Utah

Name and Title	Education and Professional Experience	EIS Responsibility
Peter Crookston Environmental Protection Specialist	MS Wildlife Management BIS Zoology, Chemistry, Mathematics Federal Service: 19 Years	Environmental Impact Statement Team Leader
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Phil Greenland Civil Engineer	BS Civil Engineering Licensed Professional Engineer Federal Service: 27 Years	Public Safety, Access, and Transportation
Beverley Heffernan Supervisory Environmental Protection Specialist	AB History Federal Service: 23 Years	National Environmental Policy Act Compliance
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Brian Joseph Archaeologist	MA Anthropology/Archaeology Federal Service: 3 Years	Cultural Resources, Paleontological Resources, Native American Consultation
Rafael Lopez General Biologist	BA Biology BA Recreation Federal Service: 12 Years	Wetlands, Riparian

Preparers of Current Supplemental Draft Environmental Impact Statement (continued)

U.S. Department of the Interior
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Preparers of Current Supplemental Draft Environmental Impact Statement (continued)

Bureau of Reclamation
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Preparers of Current Supplemental Draft Environmental Impact Statement (continued)

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Name and Title	Education and Professional Experience	EIS Responsibility
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Former Narrows Project Interdisciplinary Team (1996–1998) DEIS

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Former Narrows Project Interdisciplinary Team (1996–1998) DEIS (continued)

Name and Title	Education and Professional Experience	EIS Responsibility
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Former Narrows Project Interdisciplinary Team (1996–1998) DEIS (continued)

Name and Title	Education and Professional Experience	EIS Responsibility
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CHAPTER 6

Bibliography, Glossary of Terms, and List of Acronyms and Abbreviations

6.0 BIBLIOGRAPHY

Abrahams, A.D., G. Li,, and J.F. Atkinson. 1995. "Step-pool streams: Adjustment to maximum flow resistance" in *Water Resources Research*, Vol. 31. p. 2593–2602.

Anderson, R.E. 1978. *Quaternary Tectonics Along the Intermountain Seismic Belt South of Provo, Utah*, Vol. 25, Part 1. Brigham Young University Geology Studies. Provo, Utah. p. 1–10.

Ashida, K., T. Takahashi, and T. Sawada. 1976. "Sediment yield and transport on a mountainous small watershed," *Bulletin of the Disaster Prevention Research Institute*, Vol. 26. p. 119–144.

Ashida, K., T. Takahashi, and T. Sawada. 1981. "Processes of sediment transport in mountain stream channels, in Erosion and sediment transport in pacific rim steeplands," in *International Association of Hydrological Sciences Publication 132*. p. 166–178.

Behle, W.H. 1985. Utah Birds: *Geographic Distribution and Systematics*. Utah Museum of Natural History. Salt Lake City, Utah.

Behnke, R.J., and D.E. Benson. 1983. *Endangered and Threatened Fishes of the Upper Colorado River Basin*. Extension Service Bulletin 503A, Colorado State University, Fort Collins, Colorado. 38 pp.

Bowman, D. 1977. "Stepped-bed morphology in arid gravelly channels," in *Geological Society of America Bulletin*, Vol. 88. p. 291–298.

Bureau of Reclamation (U.S. Department of the Interior). 1950. *Gooseberry Project Report, Utah*. Salt Lake City, Utah.

_____. 1984. *Computing Degradation and Local Scour, Technical Guideline for Bureau of Reclamation*. p. 3–4.

_____. 1987. *Design of Small Dams.* p. 557.

_____. 1998. *Draft Environmental Impact Statement, Narrows Project* (DES-98-10) published in March.

_____. 2005. *Quality of Water Colorado River Basin, Progress Report No. 22.* Salt Lake City, Utah.

Carlson, R.E. 1977. "A trophic state index for lakes," *Limnology and Oceanography*. 22:361-369.

Chin, A. 1989. "Step pools in stream channels," in *Progress in Physical Geography*, Vol. 13. p. 391–407.

Christopherson, K.D., and H. Judd. 1991. *Nonpoint Source Pollution and Fisheries in Scofield Reservoir, Carbon County, Utah (Draft)*. Utah Department of Natural Resources, Division of Wildlife Resources. Salt Lake City, Utah.

Cloward, Madden & Associates. 1991. *Scofield Eutrophication Study*. Provo, Utah.

Coffman, J.L., and C.A. von Hake. 1973. *Earthquake History of the United States*, Publication 41-1. National Oceanic and Atmospheric Administration.

Cook, K.L., and R.B. Smith. 1967. "Seismicity in Utah, 1850 through June 1965," *Seismological Society of America Bulletin*, Vol. 57, No. 4. p. 689–718.

Cornell, C.A., and E.H. Vanmarcke. 1969. "The Major Influences of Seismic Risk," *Proceedings of the 4th World Conference on Earthquake Engineering*, Vol. I. Santiago. p. 69–83.

Dames & Moore. 1979. *Report of Preliminary Stability Analysis*. April. Salt Lake City, Utah.

_____. 1979. *A Cultural Resource Survey of the Narrows Dam and Reservoir, Sanpete County, Utah*. University of Utah, Salt Lake City, Utah.

_____. 1979. *Report of Seismic Risk Study, Proposed Narrows Dam, Gooseberry Creek, Sanpete County, Utah*. October. Salt Lake City, Utah.

_____. 1984. *Environmental Baseline Report for the Proposed Narrows Dam and Reservoir Project, Sanpete County, Utah*. August. Salt Lake City, Utah.

_____. 1986. *Engineering Geology and Geotechnical Engineering Studies, Narrows Dam and Reservoir Near Fairview, Sanpete County, Utah*. December. Salt Lake City, Utah.

Donovan, N.C. 1973. "A Statistical Evaluation of Strong Motion Data, Including the February 9, 1971, San Fernando Earthquake," *Proceedings of the 5th World Conference on Earthquake Engineering*. Rome. p. 1252–1261.

Donovan N.C., and A.E. Bornstein. 1975. "A Review of Seismic Risk Applications," *2nd International Conference on Applications of Statistics and Probability in Soil Structural Engineering*. Vol. 1. Aachen. p. 265–280.

_____. 1977. *The Problems of Uncertainties in the Use of Seismic Risk Procedures,* American Society of Civil Engineers, October 19 convention.

Engineering Science. 1981. *Draft Loan Application Report Proposed Narrows Project Small Reclamation Projects Act (Public Law 84-984)*. June. Alpine, Utah.

_____. 1989. *Draft Narrows Project Description and Alternatives Aquatic and Wetland Resource Reports*. December. Alpine, Utah.

England, J. Lynn. 1991. *Social Assessment of the Narrows Project*. Provo, Utah.

Estate of Paul Steed vs. *New Escalante Irrigation Company*, 846 P.2d 1223 (Utah 1992) (Rehearing Denied 1993).

Fenneman, N.M. 1931. *Physiography of Western United States*. McGraw-Hill Books. New York, New York.

Franson Noble Engineering. 2006. Eutrophication Study – Flow and Phosphorus Impacts of Proposed Narrows Project on Scofield Reservoir. Unpublished Report. American Fork, Utah. 11 pp + appendices.

Grant, G.E., F.J. Swanson, and M.G. Wolman. 1990. "Pattern and origin of stepped-bed morphology in high-gradient streams in Western Cascades, Oregon," in *Geological Society of America Bulletin*, Vol. 102. p. 340–352.

Green, D.M., H. Kaiser, T F. Sharbel, J. Kearsley, and K.R. McAllister. 1997. "Cryptic species of Spotted Frogs, *Rana pretiosa* complex, in western North America," in *Copeia*. p. 1–8.

Griffiths, G.A. 1980. " Stochastic estimation of bed load yield in pool-and-riffle mountain streams," Water Resources Research, Vol. 16, p. 931–937.

Hill, R.W. 1994. *Consumptive Use of Irrigated Crops in Utah*, *Report No. 145*. Utah Agricultural Experiment Station Res., Utah State University, Logan, Utah. October. 370 pp. Revised and reprinted Feb. 1998. Access at: https://extension.usu.edu/files/publications/publication/ENGR_BIE_WM_28.pdf.

Hovingh, Peter. 1991. *Draft Report of Spotted Frog Populations on the Upper San Pitch River System*.

Hunt, C.B. 1956. *Cenozoic Geology of the Colorado Plateau*. U.S. Geological Survey, Professional Paper 279.

Judd, H. Lewis. 1992. *Scofield Reservoir Restoration Through Phosphorus Control*. Utah Department of Environmental Quality in cooperation with Southeastern Association of Local Governments and the U.S. Environmental Protection Agency. Salt Lake City, Utah.

Miller, W.H., D.A. Archer, J. Valentine, H.M. Tyus, R.A. Valdez, and L.R. Kaeding. 1982. *Final Report: Colorado River Fishery Project*. U.S. Fish and Wildlife Service and Bureau of Reclamation. Salt Lake City, Utah.

Montgomery, David R., and John M. Buffington. 1997. "Channel-reach morphology in mountain drainage basins" in *GSA Bulletin*; Vol. 109; No. 5. p. 596–611.

Mussetter, R.A. 1989. "Dynamics of Mountain Streams." Doctorate of Philosophy, Colorado State University.

Paxton, E.H., M.K. Sogge, T.C. Theimer, J. Girard, and P. Keim. 2008. *Using Molecular Genetic Markers to Resolve a Subspecies Boundary: the Northern Boundary of the Southwestern Willow Flycatcher in the Four-corner States*. U.S. Geological Survey Open File Report 2008-1117.

PEPG Engineering, L.L.C. 2008. *Wetland Re-verification Report for 349-Acre-Property*. Prepared for Richard M. Noble, P.E.. Sandy, Utah. October. 22 pp and 4 maps.

Questar Pipeline Company. 1990. *Mainline No. 41 Reroute at Skyline Mine Final Environmental Impact Statement*. Salt Lake City, Utah.

Robertson vs. *Methow Valley Citizens Council*, 490 U.S. 332 (1989).

Sanpete Water Conservancy District. 2009. *Effects of the Narrows Project on the Riparian Vegetation in Fish and Gooseberry Creeks*. Prepared by Franson Civil Engineers. January.

_____. 2008. *Final Report, Update to the Sanpete County Master Plan*. Prepared in cooperation with the Central Utah Water Conservancy District by CH2MHill. August 2008. Salt Lake City, Utah.

Sawada, T., K. Ashida, and T. Takahashi. 1983. "Relationship between channel pattern and sediment transport in a steep gravel bed river," in *Zeitschrift für Geomorphologie*, Supplement-band 46, p. 55–66.

Schmidt, K.-H., and P. Ergenzinger. 1992. "Bedload entrainment, travel lengths, step lengths, rest periods—Studied with passive (iron, magnetic) and active (radio) tracer techniques," in *Earth Surface Processes and Landforms*, Vol. 17. p. 147–165.

Shacklette, Hansford T., and Josephine G. Boerngen. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United State.* USGS Professional Paper 1270.

Sedgwick, Dr. Jim. 1999. Personal communication. Spring.

Sergent, Hoskins, & Beckworth. 1989. *Supplemental Field and Laboratory Evaluation of Proposed Construction Materials Report*. July.

Soil Conservation Service (U.S. Department of Agriculture). Not dated. *Soil Survey - Sanpete Valley Area and Parts of Utah and Sanpete Counties, Utah*. Prepared in cooperation with the Bureau of Land Management (U.S. Department of the Interior). Salt Lake City, Utah.

Soil Conservation Service. 1967. *Irrigation Water Requirements Technical Release No. 21*. April, revised September 1970.

State of Utah, Department of Environmental Quality, Division of Water Quality. 1994. *Nonpoint Source Water Pollution Control Plan for Hydrologic Modifications in Utah*, an addendum to the *Utah Nonpoint Source Management Plan*. June. Salt Lake City, Utah.

_____. 2000. *Scofield Reservoir TMDL.* Salt Lake City, Utah.

_____. 2006. *Utah 2006 Integrated Report, Volume I-305(b) Assessment*. Salt Lake City, Utah.

_____. 2008. *Lower Gooseberry Reservoir, Limnological Assessment of Water Quality*. March. Salt Lake City, Utah

State of Utah, Department of Health, Division of Environmental Health, Bureau of Water Pollution Control. 1983. *Scofield Reservoir Phase 1 Clean Lakes Study*. Salt Lake City, Utah.

State of Utah, Department of Natural Resources, Division of Parks and Recreation. 1992. *1992 Utah SCORP, Utah; State Comprehensive Outdoor Recreation Plan*. Salt Lake City, Utah.

State of Utah, Department of Natural Resources, Division of Water Resources. 1999. *Utah State Water Plan, Sevier River Basin*. June. Salt Lake City, Utah.

State of Utah, Department of Natural Resources, Division of Water Resources. *The Utah Water Data Book*. Salt Lake City, Utah.

Stene, E.A. 1995. The Scofield Project, Research on Historic Reclamation Projects, Bureau of Reclamation History Program, Denver, Colorado. Accessed at http://www.usbr.gov/projects/Project.jsp?proj_Name=Scofield%20Project&pageType=ProjectHistoryPage#Group338435.

Stephens, D. Not dated. *Why Scofield Reservoir Is Eutrophic, Effects of Nonpoint Source Pollutants on a Water Supply Reservoir in Utah*. U.S. Geological Survey. Salt Lake City, Utah.

University of Utah, Department of Anthropology. 1979. *A Cultural Resource Survey of the Narrows Dam and Reservoir, Sanpete County, Utah*. Prepared by Merrill Singer. Salt Lake City, Utah.

U.S. Environmental Protection Agency. 1985. *Compilation of Air Pollutant Emission Factor,* 4th edition of AP-42. Office of Air and Radiation, Office of Air Quality Planning and Standards.

USDA Forest Service. 1986. *Manti-La Sal National Forest Land and Resource Management Plan and Final Environmental Impact Statement*. Price, Utah.

USDA Forest Service. 1992. Personal communication, USDA Forest Service Supervisory Range Conservationist. Reverified by personal communication in 2003.

U.S. Fish and Wildlife Service (U.S. Department of the Interior). 1992. "Biological Opinion on the Proposed Narrows Project, Small Reclamation Project Act Loan." March. Salt Lake City, Utah.

_____. 2002. *Southwestern Willow Flycatcher Recoveyr Plan*. Albuquerque, New Mexico. i-ix + 210 pp., Appendices A-O.

U.S. Geological Survey (U.S. Department of the Interior). 1971. *Ground-Water Hydrology of the San Pitch River Drainage Basin, Sanpete County, Utah,* Geological Survey Water Supply Paper 1896. Prepared in cooperation with the Utah Department of Natural Resources. Salt Lake City, Utah.

_____. 2009. *Climate Change and Water Resources Management: A Federal Perspective*, Circular 1331, U.S. Geological Survey, Reston, Virginia. pg. 1.

Vanicek, C.D., and R.H. Kramer. 1969. "Life history of the Colorado squawfish (*Ptychocheilus lucius*) and the Colorado chub (*Gila robusta*) in the Green River in Dinosaur National Monument, 1964–1966," *Trans. American Fisheries Society*, 98(2).

Warburton, J. 1992. "Observations of bed load transport and channel bed changes in a proglacialmountain stream," in *Arctic and Alpine Research*, Vol. 24. p. 195–203.

Whittaker, J.G. 1987a. "Modeling bed-load transport in steep mountain streams," in R.L. Beschta, T. Blinn, G.E. Grant, G.G. Ice, and F.J. Swanson, eds., *Erosion and Sedimentation in the Pacific Rim*, International Association of Hydrological Sciences Publication 165, p. 319–332.

Whittaker, J.G. 1987b. "Sediment transport in step-pool streams," in C.R. Thorne, J.C. Bathurst, and R.D. Hey, eds., *Sediment Transport in Gravel-Bed Rivers*. John Wiley and Sons, Chichester, United Kingdom, p. 545–579.

Whittaker, J.G., and T.R.H. Davies. 1982. Erosion and sediment transport processes in steppool torrents in Walling, D. E., ed., Recent developments in the explanation and predictionof erosion and sediment yield: International Association of Hydrological Sciences Publication 137, p. 99–104.

Whittaker, J. G., and Jaeggi, M. N. R., 1982, Origin of step-pool systems in mountain streams: Journal of the Hydraulics Division: Proceedings of the American Society of Civil Engineers, v. 108, p. 99–104.

Woodward-Clyde Consultants. 1990. *Report of Reconnaissance Level Study, Narrows Dam and Reservoir Near Fairview, Utah*. December. Denver, Colorado.

Web Sites Referenced:

WWW.UTAHREC.COM

http://www.coloradoriverrecovery.org/general-information/about.html

http://www.usbr.gov/projects/ Project.jsp?proj_Name=Scofield%20Project&pageType=ProjectHistoryPage#Group338435

https://extension.usu.edu/files/publications/publication/ENGR_BIE_WM_28.pdf

http://www.ncdc.noaa.gov/oa/climate/research/cag3/ut.html

6.1 GLOSSARY OF TERMS

A

Acre-foot	A measure of water volume—1 foot of water covering an acre in area.
Active storage	That portion of a reservoir capacity from which releases are made.
Activity occasion	Any activity by an individual at a recreation area for any length of time.
Alluvium	A deposit of sand and gravel formed by flowing water.
Animal unit month (AUM)	The amount of feed necessary to support one cow and her unweaned calf or five sheep for 1 month.
Angler day	Any visit by an individual to a fishing area during any part or all of a 24-hour day.
Autotrophic	Organisms that are capable of producing organic substances from inorganic materials by means of energy received from outside the organism.

B

Bedrock	The solid rock that underlies soil, sand, clay, or other loose surface material.
Benthos	Organisms living in or on the bottom of a lake or stream.
Biomass	The amount of living matter in the form of one or more kinds of organisms present in a particular habitat.
Browse	Twigs, leaves, and young shoots of trees and shrubs on which animals feed; in particular, those shrubs that are utilized by big game animals for food.

C

Carrying capacity	The number of animals that can be maintained in a given habitat through the pinch-period—usually winter.
Celsius (Centigrade)	ºC = (ºF-32)5/9.
Coldwater fishery	Generally, a water or a water system that has an environment suitable for salmonoid fishes such as trout.

Cubic foot	A measure of a moving volume of water (cfs) per second.
Cultural resource	Any building, site, district, structure, or object significant in history, architecture, archeology, culture, or science.

D

Dead storage	That portion of a reservoir capacity that constitutes the minimum pool. Because this portion of a reservoir is below the outlet works, it cannot be released. It is used for the benefit of recreation, fishery habitat, and silt deposition.
Degradation	The geologic process wherein streambeds and flood plains are lowered in elevation by removing material. The opposite of aggradation.

E

Ecosystem	A complex system composed of a community of fauna and flora, taking into account the chemical and physical environment with which the system is interrelated.
Endangered species	A species that is in danger of extinction throughout all or a significant portion of its range.

F

Fahrenheit	ºF = (9/5 ºC) + 32.
Fault	A break in the rocks in which there has been unequal movement of the two sides relative to each other.
Fisherman day	An aggregate of 12 hours of fishing use by one or more individuals.
Fish stream improvement	Improving a stream channel to make a new fish habitat or to enhance an existing habitat.
Forb	An herb other than grass.
Fry	Fish between the egg and fingerling stage.

G

Game fish	Those species of fish classified and managed by the State for sport fishing or angling.
Gauging station	A location on a water channel where streamflows are recorded.

H

Habitat evaluation procedure (HEP)	"HEP" is a "species habitat" approach to impact assessment and habitat quality.
Head	The difference in elevation between two bodies of water.
Hectare	An area of land or water equal to 2.471 acres.
Hunting day	A visit by an individual to an area for the purpose of hunting during any portion or all of a 24-hour day.

I

Inactive storage	That portion of a reservoir's capacity that is neither dead storage nor active storage. It normally is not released because of the benefits to fish, recreation, and other uses; but it can be since it is above the outlet works in the reservoir's profile.
Invader plants	Species, often annuals, which are not part of the climax vegetation that invade land when there is little or no competition from other plant species.
Irrigation water management	The art of timing and regulating irrigation water applications in a way that will satisfy the water requirement of the crop with minimum waste of water, soil, or plant nutrients.

L

Lateral	A small ditch used to deliver water from a canal to irrigation lands.
Limnology	The scientific study of physical and chemical conditions in fresh waters.

M

Macro-invertebrates	Animals lacking a backbone and internal skeleton (i.e., insects, worms, and crayfish).

Mesophyte	A plant growing under medium condition of moisture.
Metabolism	The sum total of the chemical transformations occurring in the body of a living organism.
Minimum pool	The amount of inactive and dead storage in a reservoir.
Mitigation	Actions to avoid, minimize, reduce, eliminate, or rectify the impact of a management practice.

N

National Register of Historic Places (NRHP)	The federally maintained register of significant districts, sites, buildings, structures, architecture, archeology, and culture.
Nongame fish	Those species of fish not classified as sport fish by the State.

P

Palustrine	Living or thriving in a marshy environment.
Periphyton	Organisms that live attached to underwater surfaces.
Persons-at-one-time	A recreation capacity measurement term indicating the number of people who can use a facility or area at one time.
Phreatophyte	A deep-rooted plant that grows in riparian zones and obtains water from the water table or the soil just above it.
Phytoplankton	Passively floating plant life, primarily algae.
Pipelines	A means of conveying water from a water source to a farm or group of farms. They also are used to convey water between fields or to sprinkler laterals.

R

Reach	A finite length of a stream, river, or canal.
Recreation day	Twelve visitor hours, which may be aggregated continuously, intermittently, or simultaneously by one or more persons.
Recruitment	The increase in population caused by natural reproduction or immigration.

Redd	The spawning ground or nest of various fishes.
Riffle	A shallow water area across a streambed causing broken water.
Riparian (vegetation)	Living on the banks of a river or stream.
Riprap	Stones placed on the face of a dam or on streambanks or other land surfaces to protect them from erosion.

S

Salinity	A term referring to the quantity of dissolved mineral salts in solution.
Salmonid	Of or related to the Salmonidae, the family of fishes including trout.
Salt loading	Term used to express the amount of salt added to streams from any natural or manmade source.
Scoping	The public involvement process required by the Council on Environmental Quality regulations to help Federal agencies determine issues and alternatives analyzed in the SDEIS.
Sediment	Any usually finely divided organic and/or mineral matter deposited by water in nonturbulent areas.
Seismicity	The phenomenon of earth movement that usually results in an earthquake.
Sere	A series of ecological (vegetative) communities.
Sheep month	Utilization of forage by one mature ewe with lamb at side for 1 month. A sheep month equals 1/5 animal unit month.
Sprinkler irrigation	Application of water to the land surface by above ground sprinkler nozzles attached to either stationary, moving, or movable laterals.
Supplemental service land	Irrigated land that receives project water in addition to a previous allotment from another source.
Surface irrigation	Application of water to the land surface through the use of corrugations, furrows, graded borders, or level borders.

T

Taxon (plural taxa)	A group of genetically similar organisms.
Thermal stratification	A temperature gradient within a body of water caused by warmer water occupying the upper level of the water and colder, denser water occupying the lower level.
Threatened species	A species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
Trophic	Related to nutrition, particularly the types of food an organism requires.
Trophic level	Place of an organism in the food chain.
Trophy fish	In terms of trout, a fish that exceeds 14 inches.

V

Visitor day	An aggregate of 12 hours of recreation use by one or more individuals.

W

Water right	A legal permit issued by the State government that allows the holder to divert a specific amount of water for beneficial use.
Weighted usable area	An expression of the quantity of fish habitat in feet squared per 1,000 feet of river channel.
Wetland	An area characterized by periodic inundation or saturation, hydric soils, and vegetation adapted for life in saturated soil conditions.
Wildlife wetland habitat management	Retaining, creating, or managing wetland habitat for wildlife.
Winter range (big game)	An area of land that has suitable vegetation and topographic conditions to support big game animals during the winter months when snow depth restricts use in other areas.

6.2 LIST OF ACRONYMS AND ABBREVIATIONS

A

ACHP	Advisory Council on Historic Preservation
acre-ft/yr	acre-feet per year
ADT	average daily traffic
APE	area of potential effects
ATV	all terrain vehicle
AUM	animal unit months

B

BMP	best management practice

C

CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGIC	Cottonwood-Gooseberry Irrigation Company
CMP	corrugated metal pipe
CRSP	Colorado River Storage Project
CRSS	Colorado River Simulation System
CUP	Central Utah Project
CUPCA	Central Utah Project Completion Act
CUWCD	Central Utah Water Conservancy District

D

DEIS	draft environmental impact statement
DO	dissolved oxygen

E

ECC	Environmental Chemical Corporation

EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency

F

FDR	Forest Development Road
FEIS	final environmental impact statement
Forest Plan	1986 Forest Land and Resource Management Plan for the Manti-La Sal National Forest
ft^2/day	square feet per day

G

GPCD	gallons per capita per day

H

HEP	habitat evaluation procedures
HSI	Habitat Suitability Index
HU	habitat unit

I

IDC	interest during construction
IFIM	instream flow incremental methodology
IMPLAN	IMpact Analysis for PLANning
Interior	U.S. Department of the Interior
ITA	Indian trust assets

K

kg	kilogram
kg/yr	kilogram per year

L

lb/day	pound per day
LRMP	Land and Resource Management Plan

M

Master Plan	Sanpete County Water Resources Master Plan
MCE	maximum credible earthquake
M&I	municipal and industrial
meq/L	milliquivalent per liter
mg/L	milligram per liter
mm	millimeter
MOA	memorandum of agreement
MOU	memorandum of understanding
msl	mean sea level

N

NAAQS	National Ambient Air Quality Standards
Narrows Project	Narrows Project, Utah
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act of 1966
NOI	notice of intent
NRHP	*National Register of Historic Places*

O

O&M	operation and maintenance
ORV	Outstanding Remarkable Values

P

P&G	*Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*
PEM	palustrine emergent wetland cover (herbaceous wetlands)
ppm	parts per million
PM_{10}	Particulate matter of 10 microns in diameter or smaller.

PSS	palustrine scrub/shrub cover (shrubby wetlands)
PVC	polyvinyl chloride

R

Reclamation	Bureau of Reclamation
Recovery Program	Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin
Research Report 145	*Consumptive Use of Irrigated Crops in Utah*, October 1994
RIP	Recovery Implementation Program
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
ROW	rights-of-way
RPA	Reasonable and prudent alternatives
RVD	recreation visitor day

S

SCORP	1992 Utah State Comprehensive Recreation Plan
SDEIS	supplemental draft environmental impact statement
Service	U.S. Fish and Wildlife Service
SHPO	State Historic Preservation Office
SR	State Route
SRPA	Small Reclamation Projects Act
Stat.	Statute
SWCD	Sanpete Water Conservancy District
SWWF	southwestern willow flycatcher

T

TCP	traditional cultural properties
TDS	total dissolved solids
TMDL	total maximum daily load

Tripartite Agreement	The October 11, 1943, reconstruction and repayment contract on Scofield Reservoir between the Federal Government and local sponsors
TSI	Trophic State Index

U

UDEQ	Utah Department of Environmental Quality
UDOT	Utah Department of Transportation
UDWR	Utah Division of Wildlife Resources
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USDA Forest Service	U.S. Department of Agriculture Forest Service
USGS	U.S. Geological Survey
USHE	shrub cover

V

VMS	Visual Management System
VQO	Visual Quality Objective

W

WUA	weighted usable area

Y

YOY	young-of-the-year
1995 FEIS	January 1995 final environmental impact statement
1998 DEIS	*Draft Environmental Impact Statement, Narrows Project* (DES-98-10), published in March 1998
°C	degree Celsius
°F	degree Fahrenheit
<	less than
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter

%	percent
§	section

CHAPTER 7

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NARROWS PROJECT
SUPPLEMENTAL DRAFT
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

1984 COMPROMISE AGREEMENT

AGREEMENT

THIS AGREEMENT, made and entered into the 8th day of June, 1984, by and between the SANPETE COUNTY WATER CONSERVANCY DISTRICT, a Utah Water Conservancy District, herein referred to as "Sanpete" and the CARBON WATER CONSERVANCY DISTRICT, a Utah Water Conservancy District, and the PRICE RIVER WATER USERS ASSOCIATION, a Utah non-profit corporation, collectively herein referred to as "Carbon".

W I T N E S S E T H :

WHEREAS, there has been a long standing controversy concerning the building of storage and diversion works on the Price River System for transmountain diversion of Gooseberry Creek water to the San Pitch River System; and

WHEREAS, the parties hereto desire to compromise and settle the controversy and their respective claims to such water.

NOW, THEREFORE, in consideration of the mutual covenants herein contained, IT IS AGREED:

I

DEFINITIONS

A. "Scofield" means the Scofield Reservoir near Scofield, Utah.

B. "Tripartite Contract" means that contract dated October 11, 1943 among the Carbon Water Conservancy District, the Price River Water Conservation District, and the United States of

America, relating to the reconstruction of Scofield Dam and describing the Gooseberry Plan. The Price River Water Users Association is successor to the Price River Water Conservation District.

C. The expression "prior water rights" as used in this Agreement means the right to the use of the water of the Price River System having priorities earlier than September 6, 1941.

D. "Narrows Site" means the approximate location for a proposed dam to be constructed on Gooseberry Creek, the center of which is located:

North 625 feet and East 1200 feet from the West Quarter corner of Section 19, Township 13 South, Range 6 East, SLB&M.

E. "Narrows Project" means a successor project to the Gooseberry Plan and constitutes a substitute for the allocation of water for the Gooseberry Plan as mentioned in the Tripartite Contract. The Narrows Project is the project proposed by this Agreement and contemplates the building of storage and diversion works at or above the location of the Narrows Site, to store Gooseberry Creek water for transmountain diversion to the San Pitch River System.

F. "Tunnel" means that transmountain diversion tunnel located in Section 24, Township 13 South, Range 5 East, SLB&M which diverts water from the Price River System to the San Pitch River System.

II

WATER RIGHT FILINGS

A. Price River Water Users Association covenants and represents that it is the owner of the following water applications on file in the office of the Utah State Engineer for the diversion, storage, and use of Price River System water:

APPLICATION NO.	CLAIMED DATE OF PRIORITY	NATURE AND AMOUNT OF CLAIMED RIGHT
1035 (91-2)	Aug. 30, 1906	Storage 12,020 acre-feet
8989a (91-78)	Oct. 11, 1937	Storage 17,980 acre-feet
13334 (91-126)	Feb. 13, 1940	Direct Flow 50 second-feet

B. Sanpete covenants and represents that it is the owner of record of the following water applications on file in the office of the Utah State Engineer for the diversion, storage and use of Price River System water, subject to the Assignment Agreement dated July 22, 1975, between Sanpete and the United States of America:

APPLICATION NO.	CLAIMED DATE OF PRIORITY	NATURE AND AMOUNT OF CLAIMED RIGHT
14025 (91-130)	Jan. 16, 1941	Storage 30 second feet
Change Application a-9237		
14026 (91-131)	Jan. 16, 1941	Storage 17,000 acre-feet
Change Application a-9236		
14477 (91-132)	Sept. 6, 1941	Storage 130 second feet
Change Application a-9238		

C. Sanpete covenants and represents that it is the owner of the following application on file in the office of the Utah State Engineer for the diversion, storage, and use of Price River System water:

APPLICATION NO.	CLAIMED DATE OF PRIORITY	NATURE AND AMOUNT OF CLAIMED RIGHT
9593 (91-87)	Oct. 12, 1937	Storage 15,000 acre-feet

III

SUBORDINATION OF WATER RIGHTS

The Price River Water Users Association water rights, evidenced by Application Numbers 1035 (91-2), 8989a (91-78), and 13334 (91-126), shall be subordinated, to the extent hereinafter provided, to the Sanpete water rights evidenced by Application Number 14025 (91-130), Change Application a-9237; Application Number 14026 (91-131), Change Application a-9236; and Application Number 14477 (91-132), Change Application a-9238, to divert and store on a first priority basis in each year all water of Gooseberry Creek and its tributaries arising above the Narrows Site, and to the extent provided in Article IV, paragraph A (3) the waters from Brooks and Cabin Hollow Creeks, and to convey by transmountain diversion up to 5,400 acre-feet of water from storage at the Narrows Site each year for use in the San Pitch River System, subject to the rights of the Cottonwood Gooseberry Irrigation Company for Fairview Lakes.

IV

DISTRIBUTION OF WATER

A. NARROWS PROJECT

1. The active capacity of the reservoir for the Narrows Project shall not exceed 10,000 acre-feet to provide for the transmountain diversion to the San Pitch River System. If requirements are made of Sanpete to release or bypass water for minimum streamflow purposes in Gooseberry Creek below the Narrows Site the active storage capacity of the reservoir for such purposes may be increased as necessary, but shall not exceed 4,500 acre-feet of additional storage capacity. The total active storage capacity shall not exceed 14,500 acre-feet.

2. The 5,400 acre-feet of water to be diverted to the San Pitch River System as provided in Article III shall be measured at the outlet of the tunnel, without deduction for reservoir evaporation, seepage, or storage losses, provided however, that any seepage that would have been intercepted by the tunnel before construction of the Narrows Project shall not be charged against the 5,400 acre-feet. Any additional seepage water resulting from the construction of the Narrows Project shall be charged against the said 5,400 acre-feet.

3. Water from Brooks Canyon and Cabin Hollow Creeks may be diverted, stored and used to provide minimum streamflows in Gooseberry Creek below the Narrows Site.

B. SCOFIELD

1. Application Number 14683 (91-135) in the name of the United States of America, Bureau of Reclamation shall be approved to permit Carbon to use the additional storage capacity of 35,000 acre-feet of water in Scofield Reservoir in addition to the

present storage rights evidenced by Application Numbers 1035 (91-2), and 8989a (91-78).

2. Carbon shall release from storage in Scofield Reservoir water sufficient to satisfy prior water rights, which otherwise would be impaired by the diversion and storage by the Narrows Project. Any and all water stored in the active capacity of Scofield Reservoir shall be subject to such release. The total active capacity of Scofield Reservoir would have to be depleted, and all direct flow water passed through the reservoir to satisfy prior water rights, before any call could be made upon Sanpete to pass through the direct flow waters originating above the Narrows Site. Such releases shall be in such quantity and at such times as may be required to satisfy prior water rights as determined by the Utah State Engineer.

3. Storage releases from Scofield shall be limited to 30,000 acre-feet annually for use by Carbon, exclusive of replacement waters needed to supply prior water rights interfered with by Sanpete's diversion and use of water for the Narrows Project.

V

APPROVALS, WITHDRAWALS, AND REJECTION OF APPLICATIONS

A. The United States of America shall withdraw Application Number 9594 (91-88).

B. The State Engineer shall approve Application Number 14683 (91-135).

C. Within thirty (30) days of approval of this Agreement by the United States of America, the State Engineer may reject the Price River Water Improvement District's Application Number 38882 (91-3557).

D. Sanpete shall within thirty (30) days of approval of this Agreement by the United States of America, withdraw Application Number 9593 (91-87).

E. The parties agree that no protest shall be filed to any of the foregoing approvals, withdrawals, rejections, dismissals or assignments or to any further change applications or permits from any state or federal agencies necessary to carry out the purpose and intent of this Agreement.

VI

DISMISSAL OF PENDING SUIT

Carbon shall file a Motion for Voluntary Dismissal, with prejudice, within thirty (30) days of approval of this Agreement by the United States of America, of the lawsuit entitled Price River Water Users Association, et al, vs United States, et al, Civil No. C-83-0407W, now pending in the United States District Court for the District of Utah, Central Division, upon the grounds that the issues have been settled by this Agreement, and to seek joinder in the motion by other plaintiffs to said case.

VII

MEASURING DEVICES AND OUTLET STRUCTURES

The parties hereto shall install and maintain outlet structures and measuring devices to measure and deliver water in accordance with this Agreement. The expense of such installation and maintenance, as part of the Narrows Project, shall be borne by Sanpete. Such devices shall be approved as to location, type, size and quality by the Utah State Engineer. Each party reserves the right to inspect and test at their own expense, at any reasonable time, any and all facilities for the measurement and delivery of water.

VIII

AGREEMENTS NOT SUPERSEDED OR AMENDED

This Agreement shall not supersede, amend or otherwise modify the rights of the United States of America under the Tripartite Contract, except the Narrows Project shall be substituted for the Gooseberry Plan as mentioned therein; nor shall it amend the repayment contract dated February 28, 1944, between the United States of America and the Carbon Water Conservancy District involving Scofield Reservoir and the Assignment Agreement dated July 22, 1975, between Sanpete and the United States of America.

IX

ADMINISTRATION

All waters stored and diverted pursuant to this Agreement shall be administered by the Utah State Engineer.

X

SUCCESSORS BOUND

This agreement shall be binding upon the parties hereto and upon the successors and assigns of the parties.

XI

INCORPORATION BY REFERENCE

The parties agree that the terms and conditions of this Agreement may be incorporated, by reference, in and made a specific part of the State Engineer's Memorandum Decisions on Sanpete's Application Numbers 14025 (91-130), 14026 (91-131) and

14477 (91-132), as amended, and the Application of the United States of America, Number 14683 (91-135).

XII

APPROVAL OF THE UNITED STATES

This Agreement is subject to the approval of the United States of America.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement the day and year first above written.

SANPETE COUNTY WATER
CONSERVANCY DISTRICT

By: _____

Its: Chairman

ATTEST:

_____
Secretary

CARBON WATER CONSERVANCY DISTRICT

By: _____

Its: President

ATTEST:

_____
Secretary

PRICE RIVER WATER USERS ASSOCIATION

By: Lyle B Bayner

Its: President

ATTEST:

Ann B. O'Brien

Secretary

The foregoing Agreement is approved this 28 day of June, 1984.

UNITED STATES OF AMERICA

By: [illegible]

Title

W R McCrakin

R E S O L U T I O N

BE IT AND IT IS HEREBY RESOLVED by the Board of Directors of the SANPETE WATER CONSERVANCY DISTRICT, at a meeting held on the 7th day of June, 1984, that the President and Secretary of said District be, and they are hereby authorized and empowered to execute on behalf of the District an Agreement with the CARBON WATER CONSERVANCY DISTRICT and the PRICE RIVER WATER USERS ASSOCIATION bearing the above date settling controversies between Carbon County water users and Sanpete County water users on the terms and conditions set out in said agreement presented and considered at this meeting.

C E R T I F I C A T I O N

I, Janice Petersen, Secretary of SANPETE WATER CONSERVANCY DISTRICT, hereby certify that the foregoing is a true and correct copy of a resolution adopted by the directors of the said District at a regular meeting of the SANPETE WATER CONSERVANCY DISTRICT held on the 7th day of June, 1984.

_____
Janice Petersen, Secretary
SANPETE WATER CONSERVANCY DISTRICT

EXHIBIT "B"

JUL 11 1984

WATER RIGHTS

RESOLUTION

BE IT AND IT IS HEREBY RESOLVED by the Board of Directors of the PRICE RIVER WATER USERS ASSOCIATION, at a meeting held on the 8th day of June, 1984, that the President and Secretary of said association be, and they are hereby authorized and empowered to execute on behalf of the Association an Agreement with the SANPETE COUNTY WATER CONSERVANCY DISTRICT bearing the above date settling controversies between Carbon County water users and Sanpete County water users on the terms and conditions set out in said agreement presented and considered at this meeting.

CERTIFICATION

I, ANN B. O'BRIEN, Secretary of PRICE RIVER WATER USERS ASSOCIATION, hereby certify that the foregoing is a true and correct copy of a resolution adopted by the directors of the said District at a special meeting of the PRICE RIVER WATER USERS ASSOCIATION held on the 8th day of June, 1984.

Ann B. O'Brien

ANN B. O'BRIEN, Secretary
PRICE RIVER WATER USERS ASSOCIATION

EXHIBIT "C"

JUL 11 1984

WATER RIGHTS

RESOLUTION

BE IT AND IT IS HEREBY RESOLVED by the Board of Directors of the CARBON WATER CONSERVANCY DISTRICT, at a meeting held on the 8th day of June, 1984, that the President and Secretary of said District be, and they are hereby authorized and empowered to execute on behalf of the District an Agreement with the SANPETE COUNTY WATER CONSERVANCY DISTRICT bearing the above date settling controversies between Carbon County water users and Sanpete County water users on the terms and conditions set out in said agreement presented and considered at this meeting.

CERTIFICATION

I, the undersigned Secretary of the CARBON WATER CONSERVANCY DISTRICT, hereby certify that the foregoing is a true and correct copy of a resolution adopted by the directors of the said District at a special meeting of the CARBON WATER CONSERVANCY DISTRICT held on the 8th day of June, 1984.

Secretary

EXHIBIT "D"

NARROWS PROJECT
SUPPLEMENTAL DRAFT
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B

IDENTIFICATION AND EVALUATION OF POTENTIAL DAM SITES

FRANSON-
NOBLE & ASSOCIATES, INC. CONSULTING ENGINEERS

July 25, 1996

To: Files

From: Richard Noble

Subject: Identification and Evaluation of Potential Dam Sites in Sanpete Valley

This document describes a process that was used to identify and evaluate potentially practicable dam sites in north Sanpete Valley. USGS 7.5 minute quadrangle maps were used to identify potentially suitable sites. The goal of this initial search was to find sites that would serve as alternatives to the Narrows Reservoir site and that could create reservoirs with a minimum storage capacity of 5,400 acre-feet, either individually or collectively. Attached is a map showing the location of the 10 sites identified and considered. Following is a tabulation of data related to the sites:

Site	Area (sq. ft.)	Average Depth (ft.)	Max Volume (AF)	Dam Ht (ft.)	Length (ft.)	Max Elevation (ft.)
1	9,728,000	40	8,933	120	2900	6600
2	11,392,000	120	31,383	240	4800	6600
3	40,601,600	20	18,642	50	3000	6280
4	2,560,000	100	5,877	300	1400	7200
5	7,680,000	300	52,893	450	2000	7200
6	1,177,600	40	1,081	90	800	6520
7	5,939,200	40	5,454	120	2800	6400
8	3,840,000	60	5,289	140	1500	6200
9	4,275,200	120	11,777	240	2200	6600
10	2,432,000	120	6,700	240	1200	7200

Site 8 would require pumping from the reservoir to service much of the project area. Those reservoirs with elevations greater than 7000 would need to have a diversion structure and pipeline constructed approximately 2 miles up Cottonwood Canyon to be supplied by gravity flow. This may be infeasible because of the geologic instability of the canyon. Sites 1,2 and 9 would require a diversion approximately 3/4 miles up Cottonwood Canyon.

Initial screening of the above sites resulted in two sites being investigated further. Screening criteria was based on location, dam height and length, and ability of the site

P.O. BOX 606, AMERICAN FORK, UTAH 84003 (801) 756-0309 FAX (801) 756-0481

to delivery project water with minimal or no pumping. Based on initial screening, sites 1,2,4,6,7,8,9 and 10 were eliminated from further consideration. Preliminary dam height versus capacity curves were developed for sites 3 and 5 to determine the dam height necessary to develop 5,400 acre-feet of storage. Four feet of freeboard is assumed for this more detailed analysis.

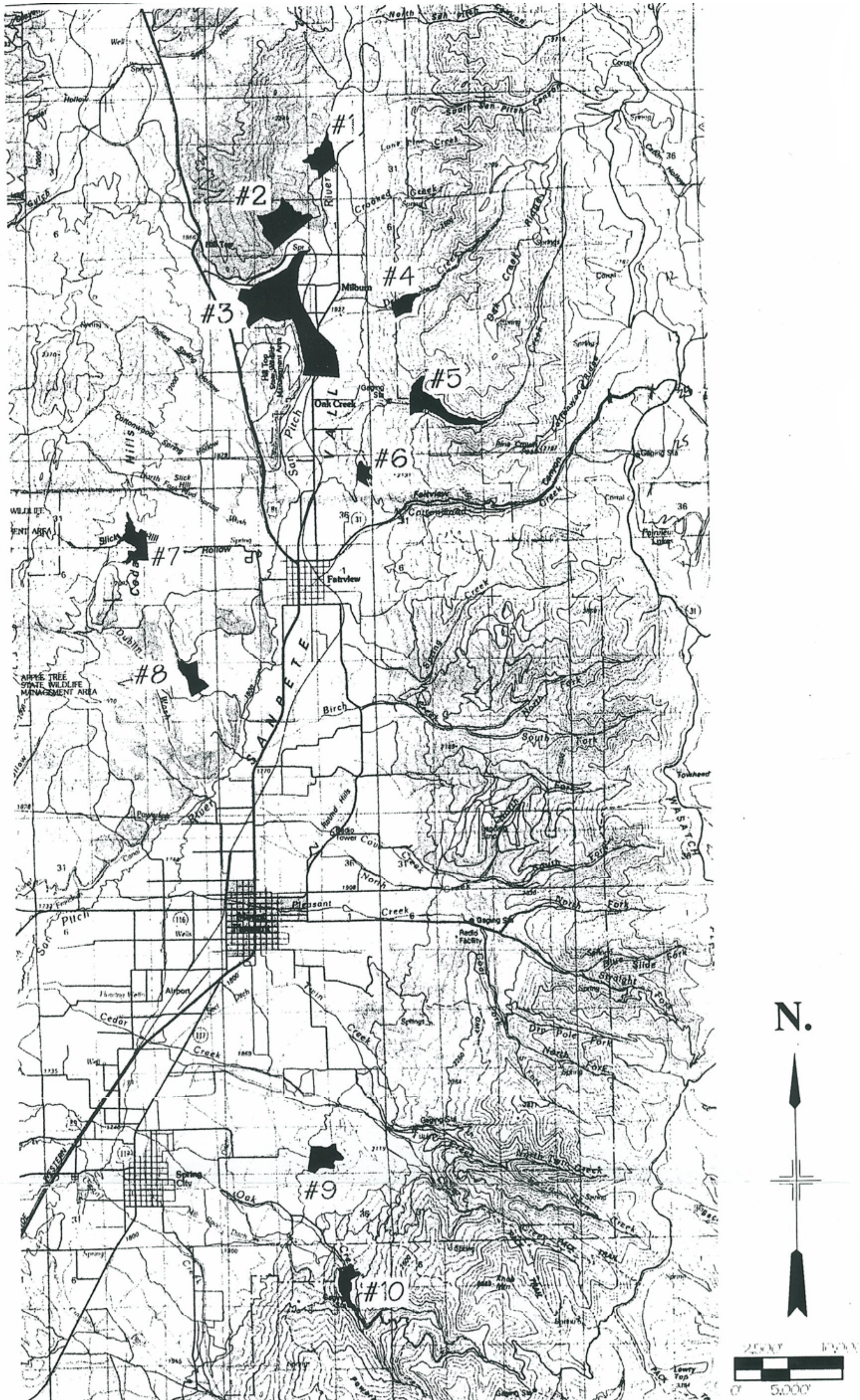
Site 3 would require a dam height of 64 feet and a length of 2,185 feet to develop 5,400 acre-feet. Reconnaissance level cost estimate for constructing a dam at Site 3 is $9.5 million. It would also require annual pumping costs of $95,000 to service project lands and approximately 6,000 feet of additional pipeline to connect the reservoir to the Oak Creek Pipeline at an estimated cost of $1.3 million. The county road would also need to be rerouted around the reservoir. It is estimated that this cost would be comparable to relocation of the highway for Narrows Dam, which is $1 million.

Site 5 would require a dam height of 185 feet and a length of 1,190 feet and would cost approximately $91 million. Site 5 would have the additional cost of one mile of additional pipeline in Cottonwood Canyon and an another mile of pipeline from the Oak Creek Pipeline to the proposed site. The cost for these additional pipelines is estimated to be $2.2 million.

The Oak Creek Pipeline would need to be enlarged from 10 inch PVC to 27 inch concrete pipe to carry the East Bench water with both Site 3 and Site 5. This additional cost is estimated to be $2,5 million. Computations for these estimates are on file.

The total cost of the Site 3 alternative is $14.3 million with annual pumping costs of $95,000 compared to Narrows Dam costs of $7.2 million with no pumping costs. The total cost for Site 5 is $95 million. Clearly, these most reasonable two sites of the ten identified in Sanpete Valley are much more costly than the proposed Narrows Dam.

Richard M Noble



Sanpete Valley Dam Site Alternatives

Narrows Project

July 1996

NARROWS PROJECT
SUPPLEMENTAL DRAFT
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C

BIOLOGICAL OPINION FOR THE PROPOSED NARROWS PROJECT – A SMALL RECLAMATION PROJECT ACT (SRPA) LOAN

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
FWS/R6
ES

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

August 24, 2000

Memorandum

To: Area Manager, Upper Colorado Region
Bureau of Reclamation
Provo, Utah

From: Regional Director, Region 6
U.S. Fish and Wildlife Service
Denver, Colorado

Subject: Biological Opinion for the Proposed Narrows Project - A Small Reclamation Project Act Loan

In accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), and the Interagency Cooperation Regulations (50 CFR Part 402), this transmits the Fish and Wildlife Service's biological opinion on the proposed Narrows Project and its effects on the endangered Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), humpback chub (*Gila cypha*), and bonytail (*Gila elegans*).

This Opinion is the result of reinitiation of an extended consultation including two biological opinions (March 1992, January 1995), one amended biological opinion (October 1995), the original biological assessment (October 1991), and three amended biological assessments (July 1994, March 1997, February 1999), the Draft Environmental Impact Statement (DEIS, March 1998), and the Price River Cumulative Hydrology Study (November 1998). We also considered other materials on file such as technical memoranda, project plans, various reports, and other relevant information. A complete administrative record of this consultation is on file in this office.

The reinitiation of consultation and resultant issuance of this Opinion was prompted by the most recent two amended biological assessments. The first of these was received on March 7, 1997, based on new information on the status of Colorado pikeminnow in the Lower Price River. The second amended biological assessment dated February 5, 1999, was based on the presence of willow flycatcher (*Empidonax traillii* sp.) preliminarily identified as the endangered subspecies of southwestern willow flycatcher (*E. t. extimus*) (Service memorandum dated October 13, 1998) in the proximity of the proposed Project.

We concur that the project as proposed is not likely to adversely affect the bald eagle for reasons described by the Bureau of Reclamation in the biological assessments and EIS for the proposed Project, and is likely to adversely affect the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail.

Based on more recent information which has become available on the subspecies of willow flycatcher found within the affected project area, at this time we do not believe this willow flycatcher to be the endangered subspecies, the southwestern willow flycatcher. Therefore no discussion is offered specifically in reference to the endangered subspecies, *E. t. extimus* in this Opinion. The basis for this finding follows.

In an October 13, 1998, memorandum, we notified Reclamation that State of Utah surveys had discovered the endangered southwestern willow flycatcher present in the proximity of the Narrows Project, and that an amendment to the biological assessment would be necessary. The memorandum further stated that genetic and vocal sampling was being conducted to verify the willow flycatcher subspecies. To date, we have the following preliminary information of subspecies identification.

- The willow flycatcher subspecies inhabiting the riparian corridor in the Project proximity is located at the extreme northern boundary of *E. t. extimus* but within the range of *E. t. adastus, an unlisted subspecies*. Experts suggest that the central part of the State of Utah is more likely an area of intergradation between *E. t. adastus* and *E. t. extimus* (Behle 1985).

- Genetic analysis to date has shown that the willow flycatcher population does not have the genetic markers of *E. t. extimus* and is more closely related to *E. t. adastus* (Memorandum from Evan Paxton and Dr. Mark Sogge, Biological Resources Division, October 1, 1999). A final report is expected on this analysis.

- Vocalization analysis has determined the population to be *E. t. adastus* (Dr. Jim Sedgwick, USGS, Midcontinent Ecological Science Center, Ft. Collins, pers. comm; Spring 1999). However, these results have yet to be published or peer-reviewed.

Therefore, the following Opinion only addresses the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail. If further analysis determines that the willow flycatcher subspecies population is the *E. t. extimus* subspecies or some significant intercross gradation between *E. t. adastus* and *E. t. extimus,* reinitiation of formal consultation will be required and a new biological opinion which includes the southwestern willow flycatcher will be issued. This opinion does, however, include recommendations to protect the willow flycatcher subspecies population in the Project proximity because of our interest in neo-tropical migratory birds as a

trust resource and because of the potential for identifying a biologically significant intercross gradation between *E. t. extimus* and *E. t. adastus* in the Project proximity. Protection of the riparian habitats within the project area could also be important to assist in recovery of *E. t. extimus*.

CONSULTATION HISTORY

We have been involved with Reclamation in an extended consultation on the proposed Project. The following documents the consultation history.

- October 1991 - We receive the first biological assessment on the proposed Narrows Project from Reclamation.

- March 25, 1992 - We issue the initial biological opinion.

- July 7, 1994 - Reclamation requests reinitiation of consultation based on an anticipated increase in average annual depletion and based on newly designated critical habitat for the four endangered Colorado River fish species.

- January 9, 1995 - We issue a second biological opinion on the proposed Project.

- July 18, 1995 - Reclamation provides information to us on capture of one juvenile Colorado pikeminnow in the Price River but indicates that reinitiation of formal consultation may not be necessary.

- October 5, 1995 - We concur that formal consultation is not necessary but amend the January 1995 biological opinion with an additional reasonable and prudent alternative to avoid jeopardy to the Colorado pikeminnow. This reasonable and prudent alternative calls for a 2-year study of fish composition and water quality in the Price River to assess the recovery potential of the Price River.

- We also recommend the Price River be prioritized within the Recovery Implementation Program for Upper Colorado River basin endangered fish species (RIP) Recovery Action Plan (RIPRAP).

- March 7, 1997 - Reclamation issues an amendment to the biological assessment for the proposed Narrows Project which describes new-found information on the status of Colorado pikeminnow and suggests specific items to be included into the RIPRAP. These items include: 1) the RIP depletion charge be applied to the Narrows Project, 2) additional years of study to identify year-round use of the Price River by Colorado pikeminnow, and 3) legal protection of instream flows. This letter also requested reinitiation of consultation.

- October 13, 1998 - We identify southwestern willow flycatcher as an additional endangered species present in the proximity of the proposed Project and advise Reclamation to provide an amendment to the biological assessment addressing southwestern willow flycatcher.

- February 5, 1999 - Reclamation provides an amended biological assessment that includes southwestern willow flycatcher.

BIOLOGICAL OPINION

I. DESCRIPTION OF PROPOSED ACTION

The Sanpete Water Conservancy District has applied to Reclamation for a Small Reclamation Project Act loan to help finance construction of the proposed Narrows Project. Such loans are made available by Reclamation to assist with construction of non-Federal projects. The Sanpete Water Conservancy District has also applied to use lands for the Narrows Project that were withdrawn from the public domain by Reclamation. The proposed Narrows Project would include a 120-foot high dam and 7,900 acre-foot total storage capacity reservoir to be constructed on Gooseberry Creek, a tributary to Fish Creek in the Price River drainage (there are no threatened or endangered species in this drainage). This proposed Project would also include a trans-basin diversion of water through an existing tunnel that would be rehabilitated (3,100 feet in length; 36 inch diameter; 60 cfs capacity) into Cottonwood Creek in the San Pitch/Sevier River drainage. The proposed Narrows Project will result in an average annual depletion of 5,717 acre-feet of water in the Price River. The Narrows Dam and Reservoir site are located approximately 9 miles northeast of the town of Fairview, Utah. Affected downstream water storage projects include the existing Lower Gooseberry Reservoir (small pass-through reservoir) approximately 5 miles downstream and the existing Scofield Dam and Reservoir (approximately 45,000 acre-foot total storage capacity) approximately 20 miles downstream of the proposed Narrows Project site.

The proposed Narrows Project would involve construction of features and facilities to develop a supplemental water supply to be used on presently irrigated lands and by municipal water users in the north part of Sanpete County, Utah. The proposed Project would divert water from Gooseberry Creek in the upper Price River drainage through an existing tunnel to Cottonwood Creek in the San Pitch/Sevier River drainage for delivery to lands and water users in the Sanpete Valley area surrounding Fairview, Utah. Water stored in the Narrows Reservoir would be diverted and delivered trans-basin through the existing Narrows Tunnel to Cottonwood Creek. The Narrows Tunnel would be rehabilitated as part of the proposed Project. Proposed Project water would then be diverted from Cottonwood Creek to a pipeline delivery system constructed as part of the project. This pipeline would then deliver the proposed Project water to existing water distribution systems in northern Sanpete County where it would be used by agricultural and municipal water users. Recreation facilities would be developed at Narrows Reservoir and a 2,500 acre-foot minimum pool for a reservoir fishery would be established. Specific mitigation measures would be implemented to offset wetland, terrestrial wildlife and stream fishery impacts.

Water conservation measures would be implemented as part of the proposed Project (BOR 1998).

Operation of the Narrows Project would affect stream flows in Gooseberry Creek, Fish Creek, Price River, and that portion of the Green River downstream of its confluence with the Price River within the Colorado River Basin, and would also affect stream flow in Cottonwood Creek within the San Pitch/Sevier River Basin. The proposed Project water supply would come from upper Gooseberry Creek and its tributaries. Impacts to lower Gooseberry Creek and Fish Creek would occur primarily during the spring snow melt period as water is stored in the Narrows Reservoir for release later in the summer. Impacts to Scofield Reservoir would be reduced inflows, resulting in lowering of reservoir storage. Impacts downstream of Scofield Dam would include reduced spring peak flows and overall water depletions affecting approximately 130 to 150 miles of the Price River as it flows between Scofield Dam and the Price/Green River confluence and an overall depletion from the Green River. Scofield Dam would spill less frequently and for shorter durations, lowering the volume of peak flows in the Price River below the dam and in the Green River below the mouth of the Price River (138 miles upstream of the Green/Colorado rivers confluence). Depletions to the Price River drainage would average 5,717 acre-feet per year. This amount consists of 5,324 acre-feet of trans-basin diverted water and 393 acre-feet of increased evaporation.

II. BASIS FOR BIOLOGICAL OPINION

The biological opinion addresses an average annual depletion of approximately 5,717 acre-feet from the Upper Colorado River basin. Water depletions in the Upper Basin have been recognized as a major source of impact to endangered fish species. Continued water withdrawal has restricted the ability of the Colorado River system to produce flow conditions required by various life stages of the fishes.

Critical habitat has been designated for the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker within the 100-year flood plain in portions of their historic range (59 FR 13374). Destruction or adverse modification of critical habitat is defined in 50 CFR 402.02 as a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. In considering the biological basis for designating critical habitat, we focused on the primary constituent elements that are essential to the conservation of the species without consideration of land or water ownership or management. We have identified water, physical habitat, and biological environment as the primary constituent elements. This includes a quantity of water of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species. Water depletions reduce the ability of the river system to provide the required water quantity and hydrologic regime necessary for survival and recovery of the fishes. The physical habitat includes areas of the Colorado River system that are inhabited or potentially inhabitable for use in spawning and feeding, as a nursery, or serve as corridors between these

areas. In addition, oxbows, backwaters, and other areas in the 100-year flood plain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats.

III. STATUS OF THE SPECIES/CRITICAL HABITAT

Information on Colorado pikeminnow, razorback sucker, humpback chub, and bonytail presented in this Opinion are considered the best scientific and commercial biological information available on these species. Sources of information include previous biological opinions concerning these species, technical reports, published scientific manuscripts, unpublished data, and working knowledge of the species. The most comprehensive compilation of information on these species to date was conducted by the Flaming Gorge Technical Team in their efforts to develop Green River and Flaming Gorge flow recommendations to benefit endangered fishes. The team consists of Reclamation and Service personnel and technical experts from Argonne National Laboratory (contracted through Western Area Power Administration) and Colorado State University Larval Fish Laboratory. Although the report from which this information was taken is in draft form and not approved for citation, the biological information is considered the most recently compiled and accurate comprehensive review of the status and biology of the endangered Colorado River fish species and is therefore used in this Opinion.

COLORADO PIKEMINNOW

A. Species description

The Colorado pikeminnow evolved as the dominant predator in the Colorado River system. Historically, adult Colorado pikeminnow attained lengths in excess of one meter and individuals in excess of 20 kg were common (Minckley 1973; Tyus 1991a). Individuals in excess of 0.8 meter in length and 10 kg in weight are now very uncommon and are likely older than 40 years (Tyus 1991a; Osmundson et al. 1997). Habitat of adult Colorado pikeminnow consists of deep, low-velocity eddies, pools, and runs, or seasonally flooded lowlands (Tyus 1990; Tyus 1991a). Adults mature at total lengths exceeding 400 mm and at 5 to 7 years of age (Vanicek and Kramer 1969; Hamman 1981; Tyus 1991a).

Based on early fish collection records, on archaeological finds, and on other observations, the Colorado pikeminnow was once found throughout warm water reaches of the entire Colorado River Basin, including reaches of the upper Colorado River and its major tributaries, the Green River and its major tributaries, and the Gila River system in Arizona (Seethaler 1978). Colorado pikeminnow apparently were never found in colder, headwater areas. Seethaler (1978) indicates that the species was abundant in suitable habitat throughout the entire Colorado River Basin prior to the 1850's. Historically, Colorado pikeminnow have been collected in the upper Colorado River as far upstream as Parachute Creek, Colorado (Kidd 1977).

A marked decline in Colorado pikeminnow populations can be closely correlated with the construction of dams and reservoirs between the 1930's and the 1960's, with introduction of nonnative fishes, with overwhelming water pollution, and with removal of water from the

Colorado River system. Behnke and Benson (1983) summarized the decline of the natural ecosystem. They pointed out that dams, impoundments, and water use practices are probably the major reasons for drastically modified natural river flows and channel characteristics in the Colorado River Basin. Dams on the mainstream essentially have segmented the Colorado River system, blocking Colorado pikeminnow spawning migrations and drastically changing river characteristics, especially flows and temperatures.

In addition, major changes in species composition were caused by introduction of nonnative fishes, many of which have thrived as a result of changes in the natural riverine system (i.e., flow and temperature regimes). The decline of endemic Colorado River fishes seems to be at least partially related to competition or other behavioral interactions with nonnative species, which have perhaps been exacerbated by alterations in the natural fluvial environment. In addition, water pollution, which went virtually unchecked until passing of environmental legislation in the 1960's and 1970's, could in extreme cases cause fish kills. The extent to which pollution affected the status of Colorado River fish is unknown but one example of water pollution noted in a 1953 Utah Fish and Game Bulletin which cited 'heavy losses of fish, particularly Colorado River salmon (*Ptychocheilus lucius*)' suggests impacts may have been spatially and temporally devastating to Colorado pikeminnow populations.

Throughout most of the year, juvenile, subadult, and adult Colorado pikeminnow utilize relatively deep, low-velocity habitats that occur in nearshore areas of main river channels (Tyus 1991a). In spring, however, when discharge is high due to snow-melt runoff, Colorado pikeminnow adults utilize flood plain wetlands, flooded tributary mouths, flooded side canyons, and eddy habitats that are accessible only during high flows (Tyus 1990). Such environments may be particularly beneficial for Colorado pikeminnow because other riverine fishes gather in flood plain habitat to exploit food and temperature resources, and may serve as prey for all life stages. Such low-velocity environments may also serve as resting areas for Colorado pikeminnow.

B. Life history

Adults undergo spawning migrations that may involve long-distance movements. Round-trip distances of over 500 miles (Irving and Modde in press) have been reported and individuals may migrate to natal areas using cues that were imprinted during the larval stage (Tyus 1985; Tyus 1990; Irving and Modde in press). As an integral part of the natural flow regime, peak spring flows aid formation of habitat for all life stages of Colorado pikeminnow and may also provide an important cue to prepare adults for migration. Other factors such as water temperature, photoperiod, and conspecific odors may also be important to cue reproduction (Nesler et al. 1988; Tyus and Karp 1989; Tyus and Karp 1991; Bestgen et al. 1998). Environmental cues used by the fish to complete their life cycle are needed in all areas occupied by adults including tributaries and the mainstem Green River.

Colorado pikeminnow reproduce during late spring and summer after discharge from snow-melt runoff peaks and when water temperatures are increasing and generally greater than 16° C

(Haynes et al. 1984; Tyus 1990; Tyus 1991a; Bestgen et al. 1998). Following spawning, most adults return by late August or September to home ranges occupied the previous spring (Tyus 1990; Irving and Modde in press).

Although direct observation of Colorado pikeminnow spawning is not possible in the Green and Yampa rivers because of high turbidity, radiotelemetry indicates spawning occurs over cobble-bottomed riffles (Tyus 1990). If adhesive eggs are deposited in interstitial spaces of spawning substrate they likely require clean cobble surfaces for secure attachment (Hamman 1981; Tyus and Karp 1989).

Laboratory studies suggested that wild embryos may incubate in the spawning substrate for 4–7 days, with duration inversely related to water temperature (Hamman 1981; Marsh 1985; Bestgen and Williams 1994). Temperatures from 18° to 26° C produced similar and relatively high rates of hatching (54–79 percent) and survival to 7 days posthatch (52–88 percent). Survival was only 13 percent at 30° C, which may be near the upper lethal limit for embryos. Hatching success at 16° C, the lowest temperature at which Colorado pikeminnow were known to spawn in the wild (Bestgen et al. 1998), is unknown. Hatching success averaged about 10 percent higher in fluctuating (5° C diel range) than in constant temperatures (18° to 26° C).

Eggs deposited in spawning gravel hatch within 5–7 days, and larvae swimup 5–7 days later. At swimup, larvae are 6–9 mm (implied total length) and are immediately swept downstream, sometimes long distances, from spawning areas (Hamman 1981; Haynes et al. 1984; Nesler et al. 1988; Bestgen and Williams 1994; Bestgen et al. 1998). Larvae drift to relatively low-gradient river reaches where low-velocity, shallow, channel-margin habitats (e.g., backwaters) are common, and they remain there throughout the summer (Vanicek and Kramer 1969; Tyus and Haines 1991; Muth and Snyder 1995).

The exact mechanism by which Colorado pikeminnow larvae drift downstream and inhabit backwater habitat is not completely understood. Larvae are probably carried near shorelines by prevailing river currents and eventually encounter backwaters with a probability that depends on availability of such habitat. Because swimming in relatively swift main-river currents is energetically costly and mortality risks are high, larvae that quickly encounter a suitable backwater are more likely to survive. Based on tests of swimming performance in a velocity tube, larvae of a size typically captured in drift nets (8–10 mm) were often capable of maintaining position for nearly 30 seconds in water flowing 15 cm/s (K. Bestgen, unpublished data). Thus, active locomotion may play an important role when Colorado pikeminnow larvae move from the main channel into backwaters.

Early life stages of Colorado pikeminnow in backwaters feed on a variety of small invertebrates, of which chironomids are particularly important (Muth and Snyder 1995). As in other fishes, the growth rate of Colorado pikeminnow is dependent on food abundance and water temperature (Bestgen 1996). Seasonal food abundance in Green River backwaters is most likely a function of backwater stability, nutrient levels, primary production, and "maturity", which affects the time

invertebrates have to colonize and build populations. Benthic assemblages may be an even more important food source for early life stages of fishes in the Green River (Muth and Snyder 1995).

Nighttime temperature fluctuations may cool backwaters to well below 22° C and create sub-optimal growth conditions. In a laboratory study, growth of Colorado pikeminnow larvae was optimal at 31° C and high at all temperature treatments that were 22° C or warmer (Bestgen 1996). At the highest food abundance, growth of Colorado pikeminnow larvae was 36 percent less at 18° C compared to that observed at 22° C (Bestgen 1996). In the wild, Colorado pikeminnow may move to acquire more optimal habitat. For example, Tyus (1991b) found that early life stages of Colorado pikeminnow moved out of backwaters at night, presumably in response to water temperatures that were colder than the main channel, and moved back in as temperatures warmed during the day. Such a strategy would allow Colorado pikeminnow to maximize degree-day accumulation and growth in a diel period.

The abundant nonnative fishes that co-occur with Colorado pikeminnow in backwaters are potential predators on fish larvae. Of particular concern is the most abundant species, red shiner, a known predator on fish larvae in the wild (Ruppert et al. 1993). In laboratory tests, red shiners averaging about 60 mm were able to capture and consume Colorado pikeminnow as large as 22 mm (Bestgen et al. 1997). Larger Colorado pikeminnow were not vulnerable to red shiners because they could not be physically ingested.

Energy reserves, particularly lipids, are thought to influence overwinter survival of age-0 fish (Thompson et al. 1991). Because lipid stores are generally positively correlated with body size and condition of fish, biotic and abiotic conditions in summer and autumn that affect growth may influence overwinter survival. Thompson et al. (1991) found that smaller Colorado pikeminnow with lower amounts of lipid were in poorer condition and survived at lower rates than larger fish over a simulated winter period in the laboratory, and they concluded that overwinter survival of wild fish may be size-dependent.

Comparison of catch-effort data collected in fall and then again in spring from 1979 to 1988 showed negligible overwinter mortality of age-0 Colorado pikeminnow relative to other seasons (Tyus and Haines 1991). However, other studies in other years (Converse et al. 1998b) or those using capture-recapture estimation techniques (Haines et al. 1998) have demonstrated substantial overwinter mortality, especially for small-bodied Colorado pikeminnow. Converse et al. (1998b) suggested that size-dependent overwinter mortality was important in some years, but in others, abundance of Colorado pikeminnow in spring was mostly a function of autumn abundance. Haines et al. (1998) reported overwinter survival of 56 to 62 percent in three estimates but only 6 percent overwinter survival of a cohort in the Green River that had small body size. They suggested that low overwinter survival in that high flow year was partially due to lack of energy reserves.

Juveniles also occupy backwaters and other low-velocity nearshore areas; older and larger subadults tend to use habitat similar to that of adults. Subadults then disperse and recruit to upstream reaches where they establish home ranges (Osmundson et al. 1998).

The ability to feed in turbid waters of the Colorado River system and lack of teeth in jaws are unusual features of piscivorous Colorado pikeminnow. Colorado pikeminnow less than 50 mm eat primarily invertebrates, the diet of those between 50 and 200 mm is a combination of invertebrates and fish, and those greater than 200 mm are mainly piscivorous (Vanicek and Kramer 1969; Muth and Snyder 1995). Large adults also occasionally consume other vertebrates including birds and mammals (Tyus 1991a).

C. Population Dynamics

All life stages of Colorado pikeminnow in the Green River demonstrate wide variations in abundance at seasonal, annual, or longer time scales, but reasons for shifts in abundance are poorly understood. The population structure of the Colorado pikeminnow is thought to resemble a metapopulation in that several somewhat spatially distinct populations are centered around specific spawning locations; however some interchange of individuals between populations occurs (Gilpin 1993). Colorado pikeminnow occupy life-stage specific habitats that are distributed over a broad spatial scale in the Green River system. Adults migrate to canyon-bound spawning areas distant from home ranges, embryos incubate and hatch in spawning gravel, newly emerged larvae drift downstream and into low-velocity nursery habitats, and subadults move back upstream.

In alluvial valley reaches of the Green River where most nursery habitat occurs, age-0 and age-1 Colorado pikeminnow occupy shallow, channel-margin backwaters. Juveniles and adults eventually disperse from nursery-habitat areas and into tributaries or the mainstem Green River up- or downstream of spawning localities. Because factors that affect survival of various Colorado pikeminnow life stages are imposed over a spatially extensive area, a variety of biological and physical factors may interact to influence recruitment success of individual year classes.

A. Status and distribution

The endangered Colorado pikeminnow is endemic to the Colorado River basin and was formerly widespread and abundant in warmwater streams and rivers (Jordan and Evermann 1896). Historic accounts suggest that Colorado pikeminnow were especially abundant in the lower Colorado River basin downstream of Lee's Ferry, Arizona (Minckley 1973; Tyus 1991a; Maddux et al. 1993). Lower basin populations remained abundant until the 1930's (Miller 1961) but declined soon thereafter presumably due to the combined effects of river regulation by dams and introduced fishes (Minckley and Deacon 1968; Minckley 1973). The last Colorado pikeminnow collected in the Gila River system was in 1950; scattered individuals were captured in the lower mainstem Colorado River and reservoirs in the 1960's (Minckley 1973), but by the early 1970's the species was extirpated from the lower Colorado River basin (Tyus 1991a).

In the upper Colorado River basin, historic accounts also report the presence of large populations of Colorado pikeminnow (Tyus 1991a; Quarterone 1993). Populations persist in all three major river and tributary systems of the upper Colorado River basin (i.e., San Juan, Colorado, and Green river systems), but they are severely reduced in all but the latter (Platania et al. 1991; Tyus 1991a; Osmundson and Burnham 1996). There may be less than 100 wild adult Colorado pikeminnow remaining in the San Juan River system based on the few recent captures and relatively high recapture rates (D. Propst, New Mexico Department of Game and Fish, personal communication). Osmundson and Burnham (1996) recently estimated that about 600 to 650 adult Colorado pikeminnow occur in the Colorado River upstream of the Green River confluence. Although no abundance estimates have been calculated, populations in the Green River system are thought to be substantially larger than those in the Colorado River based on relative capture-rate data collected annually in the Interagency Standardized Monitoring Program (ISMP) and capture rates of marked fish (Tyus 1991a; McAda et al. 1994a, 1994b, 1995, 1996, 1997).

Although historic accounts are sketchy, most described Colorado pikeminnow as widespread and abundant in the Green River system (Tyus 1991a; Quarterone 1993). Based on those accounts and habitat tolerances described in more recent studies, it is reasonable to assume that Colorado pikeminnow were found throughout lower reaches of most tributary streams in warm and cool water, and extended far upstream in the mainstem Green River to near Green River, Wyoming (Ellis 1914; Baxter and Simon 1970). In the vicinity of the Flaming Gorge Dam site, an aggregation of ripe male Colorado pikeminnow was discovered in early August 1961 (Vanicek et al. 1970), suggesting that this area once supported a reproducing population.

By the time the first comprehensive surveys were conducted during 1967–1973 (Holden and Stalnaker 1975a, 1975b), the Colorado pikeminnow was considered rare and endangered throughout the upper Colorado River basin, including the Green River system. Holden and Stalnaker (1975a) identified the lower Yampa River in Yampa Canyon and the middle and lower Green River as potential spawning areas based on aggregations of ripe adults and presence of early life stages. These inferences later proved mostly correct as spawning areas have been found in the lower Yampa River and Green River in Gray Canyon (Haynes et al. 1984; Tyus 1990; Tyus and Haines 1991; Bestgen et al. 1998).

The Colorado pikeminnow currently occupies approximately 1,100 river miles in the Colorado River system (25 percent of its original range) and is presently found only in the upper Colorado River basin above Glen Canyon Dam. The Colorado pikeminnow inhabits about 390 miles of the mainstem Green River from its confluence with the Colorado River upstream to the Gates of Ladore (Kevin Bestgen pers.comm.). Colorado pikeminnow have also been observed in the lower 49 miles of the Duchesne River and the lower 88.5 miles of the Price River. The Colorado pikeminnow's range also extends 160 miles up the Yampa River and 104 miles up the White River, the two largest tributaries of the Green River. In the mainstem Colorado River, it is currently found from Lake Powell extending about 201 miles upstream to Palisade, Colorado

(Tyus et al. 1982), and in the lower 60 miles of the Gunnison River, a tributary to the mainstem Colorado River (Burdick 1995).

During most of the year, distribution patterns of adults in the Green River system are stable, and from late summer to the following spring, adults are widely distributed and thought to occupy distinct home ranges (Tyus 1990; Tyus 1991a; Irving and Modde in press). Distribution of adults changes in late spring and early summer when most mature fish migrate to spawning areas in the lower Yampa River in Yampa Canyon and the lower Green River in Gray Canyon (Tyus and McAda 1984; Tyus 1985; Tyus 1990; Tyus 1991a; Irving and Modde in press). Those fish remain in spawning areas for 3–8 weeks before returning to their individual home ranges. Some radio-tagged fish did not migrate to spawning areas each year. These may have been immature or non-spawning individuals, or fish that moved to other areas for spawning (Tyus 1990). Although additional spawning sites may exist (Tyus 1990), recent movement patterns of adults (Irving and Modde in press) and capture rates of larvae at drift-net sites downstream of principal spawning areas (Bestgen et al. 1998) suggest that other sites are rarely used.

Historically, Echo and Island parks in the upper Green River supported nursery habitat for Colorado pikeminnow (Vanicek et al. 1970; Holden and Stalnaker 1975a; Holden and Crist 1981). Early life stages of Colorado pikeminnow in that area remain rare (Holden and Crist 1981; Tyus and Haines 1991; Bestgen and Crist 1998). No larvae or juveniles of Colorado pikeminnow have been collected from the Green River upstream of the Yampa River confluence since initial post-impoundment studies of Flaming Gorge Dam ended in 1966 (Vanicek and Kramer 1969; Vanicek et al. 1970; Holden and Crist 1981; Bestgen and Crist 1998; Bestgen et al. 1998).

Presently, there are two primary reaches of Colorado pikeminnow nursery habitat in the Green River system. One occurs in the middle Green River from near Jensen, Utah, downstream to the Duchesne River confluence. The other is in the lower Green River from near Green River, Utah, downstream to the Colorado River confluence (Tyus and Haines 1991; McAda et al. 1994a; McAda et al. 1994b-1997). The reach of the Green River defined mostly by Desolation and Gray canyons also provides nursery habitat for Colorado pikeminnow (Tyus and Haines 1991; Day et al. 1999).

Juvenile Colorado pikeminnow 80–400 mm have the most restricted distribution of any life stage in the Green River system. Juveniles are most common in the lower portion of the Green River, downstream of Green River, Utah, with fewer in the middle Green River (McAda et al. 1994a). Juveniles are found in the White River and other tributaries (McAda et al. 1994b, 1995, 1996, 1997; Cavalli 1998), but few have ever been caught in the Yampa River upstream of Yampa Canyon. A few age-0 and juvenile Colorado pikeminnow were captured in recent years from the lower Yampa River and the Green River in the Island-Rainbow Park reach (Bestgen and Crist 1998; K. R. Bestgen, unpublished data).

The Colorado pikeminnow was listed as endangered on March 11, 1967. Full protection under the Endangered Species Act of 1973, as amended, occurred on January 4, 1974.

Critical Habitat Description for Colorado pikeminnow

Critical habitat, as defined in section 3(5)(A) of ESA, means: "(i) the specific areas within the geographical area occupied by the species at the time it is listed in accordance with section 4 of the Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by a species at the time it is listed in accordance with section 4 of the Act, upon a determination by the Secretary that such areas are essential for the conservation of the species."

Critical habitat was designated for four endangered Colorado River fishes on March 21, 1994, including the Colorado pikeminnow. Designated critical habitat for the endangered Colorado River fishes includes those portions of the 100-year flood plain that contain constituent elements. The constituent elements are those physical and biological features that the Service considers essential for the conservation of the species and include, but are not limited to, the following items: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally (5) habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distributions of the species.

The primary constituent elements determined necessary for the survival and recovery of four endangered Colorado River fishes include (59 FR 13374), but are not limited to:

(1) Water

A quantity of water of sufficient quality (i.e., temperature, dissolved oxygen, lack of contaminants, nutrients, turbidity, etc.) that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species;

(2) Physical Habitat

Areas of the Colorado River system that are inhabited or potentially habitable by fish for use in spawning, nursing, feeding, and rearing, or corridors between these areas. In addition to river channels, these areas also include bottom lands, side channels, secondary channels, oxbows, backwaters, and other areas in the 100-year flood plain, which when inundated provide spawning, nursery, feeding, and rearing habitats, or access to these habitats;

(3) Biological Environment

Food supply, predation, and competition are important elements of the biological environment and are considered components of this constituent element. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation and competition,

although considered normal components of this environment, are out of balance due to introduced nonnative fish species in many areas.

Destruction or adverse modification of critical habitat is defined at 50 CFR 402.02 as a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. In evaluating actions, we consider the action's impact on factors used to determine critical habitat of the Colorado River endangered fishes. These factors include the primary constituent elements of water, physical habitat, and biological environment. The ability of an area to provide these constituent elements into the future and the reaches' capability to contribute to the recovery of the species will also be considered.

Activities which may disturb or remove the primary constituent elements within designated critical habitat include, among others, actions that would reduce the volume and timing of water, destroy or block off spawning and nursery habitat, prevent recruitment, adversely impact food sources, contaminate the river, or increase predation by and competition with nonnative fish. Examples of activities that may destroy or adversely modify critical habitat are listed at 59 FR 13387, and include construction and operation of hydroelectric facilities, irrigation, flood control, bank stabilization, oil and gas drilling, mining, grazing, stocking or introduction of nonnative fishes, municipal water supplies, and resort facilities.

Critical habitat has been designated within the 100-year flood plain of the Colorado pikeminnow's historical range in the following sections of the Upper Basin and the San Juan River (59 FR 13374).

Colorado, Moffat County. The Yampa River and its 100-year flood plain from the State Highway 394 bridge in T. 6 N., R. 91 W., section 1 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah, Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties; and Colorado, Moffat County. The Green River and its 100-year flood plain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (Salt Lake Meridian).

Colorado, Rio Blanco County; and Utah, Uintah County. The White River and its 100-year flood plain from Rio Blanco Lake Dam in T. 1 N., R. 96 W., section 6 (6th Principal Meridian) to the confluence with the Green River in T. 9 S., R. 20 E., section 4 (Salt Lake Meridian).

Colorado, Delta and Mesa Counties. The Gunnison River and its 100-year flood plain from the confluence with the Uncompahgre River in T. 15 S., R. 96 W., section 11 (6th Principal Meridian) to the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).

Colorado, Mesa and Garfield Counties; and Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year flood plain from the Colorado River Bridge at exit 90 north off Interstate 70 in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to North Wash, including the Dirty Devil arm of Lake Powell up to the full pool elevation, in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).

New Mexico, San Juan County; and Utah, San Juan County. The San Juan River and its 100-year flood plain from the state route 371 bridge in T.29N., R.13W., section 17 (New Mexico Meridian) to Neskahai Canyon in the San Juan Arm of Lake Powell in T. 41 S., R. 11 E., section 26 (Salt Lake Meridian) up to the full pool elevation.

RAZORBACK SUCKER

A. Species description

The razorback sucker is a member of the sucker family, *Catostomidae,* and is endemic and unique to the Colorado River system. Females are larger than males of the same age. The moderate sized ventral mouth has a cleft lower lip, with lateral margins continuous and rounded. Razorback sucker coloration ranges from dark brown to olive dorsally and yellow to white ventrally, but color and morphology differ due to a sexual dimorphism that is especially obvious during reproductive seasons.

Adults are distinguished by a pronounced bony dorsal keel ("razor") arising immediately posterior to the occiput and may attain maximum total length of about one meter (commonly 400 -700 mm), weigh 5-6 kg (commonly less than 3 kg), and exceed 40 years of age (Minckley 1983; McCarthy and Minckley 1987). Larvae are generally 7-9 mm at hatching, 9-11 mm at swimup, and consume most of their yolk and begin exogenous feeding by 10-11 mm (Minckley and Gustafson 1982; Marsh and Langhorst 1988; Papoulias and Minckley 1990; Snyder and Muth 1990). Transition to the juvenile period (sensu Snyder 1976) occurs at 27-30 mm (Snyder and Muth 1990), and, generally, fish greater than 350 mm are sexually mature (Minckley 1983; Hamman 1985).

B. Life History and population dynamics

The razorback sucker is adapted to the various habitats and greatly fluctuating, unpredictable hydrologic conditions of the pristine Colorado River system (Minckley 1973, 1983; Holden and Stalnaker 1975a; Behnke and Benson 1983; Carlson and Muth 1989; Lanigan and Tyus 1989; Bestgen 1990; Minckley et al. 1991a) and apparently has a life strategy that includes use of inundated flood plain habitats as growth and conditioning areas (Tyus 1987; Tyus and Karp 1989, 1990, 1991; Modde 1996, 1997; Modde et al. 1995, 1996; Wydoski and Wick 1998). The razorback sucker has a multi-phase life cycle, with larvae and early juveniles representing several life-intervals that are morphologically and ecologically distinct from each other and from later juvenile and adult stages (Snyder and Muth 1990).

Habitats used by adult razorback suckers in rivers of the upper Colorado River basin include deeper runs, eddies, backwaters, and, at higher discharges, flooded off-channel environments in spring (the latter apparently including movements from the colder main channel into warmer habitats, a behavior called "staging", before spawning); runs and pools often in shallow water associated with submerged sandbars in summer; and low-velocity runs, pools, and eddies in winter (Tyus 1987; Osmundson and Kaeding 1989a; Valdez and Masslich 1989; Tyus and Karp 1990; Modde 1997; Modde and Wick 1997; Modde and Irving 1998). Young razorback suckers require nursery environments with quiet, warm, shallow water such as tributary mouths, backwaters, or inundated flood plain habitats in rivers (Smith 1959; Taba et al. 1965; Gutermuth et al. 1994; Modde 1996, 1997; Muth et al. 1998) and coves or shorelines in reservoirs (Minckley et al. 1991a). The diet of all life stages is varied and includes insects, zooplankton, phytoplankton, algae, and detritus (Taba et al. 1965; Vanicek 1967; Hamman 1987; Marsh 1987; Marsh and Langhorst 1988; Muth et al. 1998). Growth to adult size is rapid in warm, food-rich environments (Osmundson and Kaeding 1989b; Minckley et al. 1991a; Mueller 1995).

Minckley (1973) stated that razorback suckers in riverine environments make annual spawning runs to specific river areas. Razorback suckers in the Green River system spawn over bars of cobble, gravel, and sand substrates during spring-runoff flows at widely ranging discharges and water temperatures (McAda and Wydoski 1980; Tyus 1987; Tyus and Karp 1989, 1990; Muth et al. 1998). Reproduction in the lower Colorado River basin generally occurs during January through April (Medel-Ulmer 1983; Minckley 1983; Langhorst and Marsh 1986; Mueller 1989) but may extend from November into May (Bozek et al. 1991). Estimates of the total fecundity of wild females ranged up to 144,000 ova/fish (Minckley 1983). Presumably, long life and high fecundity allow the species to persist through several consecutive seasons of no or low reproduction and recruitment (Bestgen 1990).

Direct observation of spawning behavior and release of gametes in the Green River is prevented by high water turbidity (Tyus 1987; Tyus and Karp 1990). However, Mueller (1989) observed razorback suckers spawning in the clear Colorado River downstream of Hoover Dam, Arizona-Nevada, and reported behavior similar to that reported for populations in lower Colorado River basin reservoirs. In Lake Mohave, spawning groups of one female and several male razorback suckers congregate over coarse cobble in water 0.5-5 m deep. The males press against the female, and spawning convulsions (a few seconds in duration) sweep the substrate clear of fine materials and create depressions 20 cm or more deep. Individual females have been observed spawning hourly and daily on successive days within a week. The number of eggs released by a female with each spawning act is apparently only a small fraction of her total complement (Minckley et al. 1991a). McAda and Wydoski (1980) estimated the total fecundity of 10 razorback suckers (446-534 mm) caught in the Green River during autumn at 27,614 to 76,576 ova/fish, whereas estimates of total fecundity for five razorback suckers (391-570 mm standard length) collected from Lake Mohave during spring ranged from 74,600 to 144,000 ova/fish (Minckley 1983).

Incubation time and hatching success of razorback sucker embryos are temperature dependent. Marsh (1985) evaluated the effects of temperatures ranging from 5° to 30° C on incubation and hatch of captive razorback sucker embryos acclimated at 18° C. Among his treatments, total mortality of embryos occurred at 5°, 10°, and 30° C. Of those treatments with surviving embryos, hatch duration was longest (204 h) and percent hatch was highest (35 percent) at 20° C, hatch duration was shortest (96 h) at 25° C, and percent hatch was lowest (19 percent) at 15° C. Bozek et al. (1990) reported that hatching success of captive razorback sucker embryos acclimated to experimental temperatures ranged from 22 to 57 percent at 10° C, 32 to 65 percent at 15° C, and 34 to 65 percent at 20° C; total mortality occurred at 8° C. They concluded that optimal hatching temperatures were 12°-20° C. Hatching time for 50 percent of the eggs was 420-556 h at 10° C, 256-298 h at 15° C, and 15-168 h at 20° C.

Haines (1995) evaluated the effects of temperature (12°, 16°, and 20° C) on the developmental rate and hatching success of captive embryos of razorback and flannelmouth suckers. Mean number of days between fertilization and peak hatch decreased as temperature increased for both species and ranged from 6.5 to 12.5 days for razorback sucker and 6.0 to 16.5 days for flannelmouth sucker. The period from first to last hatch averaged 2.0 days longer for razorback sucker than for flannelmouth sucker over all temperatures. Percent hatch of flannelmouth embryos was independent of temperature and, at each temperature, was greater (83-91 percent) than for razorback sucker embryos (48-67 percent); hatching success of razorback sucker embryos increased as temperature increased.

Several factors may limit the survival of razorback sucker embryos in the Green River system. These factors include reduced water temperatures caused by operation of Flaming Gorge Dam (Tyus and Karp 1991), sedimentation of cobble and gravel spawning substrates associated with high releases from Flaming Gorge Dam occurring too early in the spring-runoff period (Wick 1997), predation on eggs by nonnative fishes (Hawkins and Nesler 1991; Lentsch et al. 1996c; Tyus and Saunders 1996), and selenium contamination of adults and embryos (Hamilton and Waddell 1994).

Before 1992 (Muth et al. 1998), direct evidence of reproduction by razorback suckers in the Upper Colorado River basin or information on the species' natural early life history in riverine environments were limited to those larvae collected by Tyus (1987) and captures of a few early juveniles from backwaters (e.g., Smith 1959; Taba et al. 1965; Gutermuth et al. 1994). However, diagnostic characters for distinguishing larval razorback suckers from larvae of sympatric suckers were only recently developed (Snyder and Muth 1990) and previous sampling for riverine razorback suckers did not target early life stages. Razorback sucker larvae are generally 7-9 mm at hatching and 9-11 mm at swimup; at 15° C, larvae swimup 13 days after hatching (Minckley and Gustafson 1982; Marsh 1985; Snyder and Muth 1990; R. T. Muth, personal observation). In rivers, larval razorback suckers presumably enter the drift after emerging from spawning substrates (Mueller 1989; Paulin et al. 1989) and are transported downstream into off-channel nursery environments with quiet, warm, shallow water (e.g., tributary mouths, backwaters, and inundated flood plain habitats).

Food-limited growth and survival of razorback sucker larvae has been postulated as contributing to the low or nonexistent recruitment (Minckley 1983; Marsh and Langhorst 1988; Papoulias and Minckley 1990, 1992; Modde 1997). Muth et al. (1998) reported that mean and maximum total length of larval razorback suckers in collections from the middle or lower Green River generally increased as sampling progressed each year, and approximately 20 percent of all larvae captured were larger than 12 mm; the two largest specimens were 20 and 24 mm. They estimated that mean daily growth (posthatching) of larvae less than 35 days old collected from either river section during 1993-1996 was lowest in 1994 (0.31 and 0.27 mm TL/d for the middle and lower Green River, respectively) and greatest in 1996 (0.35 and 0.33 mm TL/d). Over all years, specimens from the middle Green River grew 6-21 percent faster than those from the lower Green River.

Muth et al. (1998) noted that, although food abundance in existing Green River nursery habitats appeared adequate to meet the minimum nutritional requirements for larval survival, growth of razorback sucker larvae was not optimal. Relatively minor differences in growth rates can be biologically significant if size-dependent processes, such as predation by small, gape-limited predators, are important regulators of larval survival. Predation by adult red shiners on larvae of native catostomids in flooded and backwater habitats of the Yampa, Green, or Colorado rivers was documented by Ruppert et al. (1993) and Muth and Wick (1997). Horn (1996) concluded that although nutritional limitations in Lake Mohave may directly contribute to the high mortality of larval razorback suckers, a greater problem is reduced growth, which keeps larvae at a size vulnerable to predation for a longer period of time. He further stated that apparently all razorback sucker larvae in Lake Mohave, starving or not, are consumed by nonnative fish predators.

Predation by nonnative fishes on young razorback suckers is considered a serious threat to populations (Bestgen 1990; Minckley et al. 1991a; Horn 1996; USFWS 1998). Ruppert et al. (1993) and Wydoski and Wick (1998) reported that because razorback suckers in the Green River system spawn on the ascending limb of the hydrograph and their larvae disperse into low-velocity habitats during May and June when invertebrate numbers are low in riverine nursery habitats, razorback sucker larvae would be highly susceptible to predation by nonnative fishes at that time because other food organisms are scarce. Extremely low survival of larval razorback suckers in the Green River during 1992-1996 was suggested by Muth et al. (1998) based on the apparent disappearance of larvae from nursery habitats by early or mid-July each year. Thus it appears that low survival of early life stages is responsible for the low or nonexistent recruitment in wild populations.

Historically, flood plain habitats inundated and connected to the main channel by overbank flooding during spring-runoff discharges would have been available as nursery areas for young razorback suckers in the Green River. Tyus and Karp (1990) associated low recruitment with reductions in flood plain inundation since 1962, and Modde et al. (1996) associated years of high spring discharge and flood plain inundation in the middle Green River (1983, 1984, and 1986) with subsequent suspected recruitment of young adult razorback suckers. Flood plain habitats are typically warmer and substantially more productive than the adjacent river and have abundant

vegetative cover (Mabey and Shiozawa 1993; Wolz and Shiozawa 1995; Modde 1997; Wydoski and Wick 1998). Spawning at increasing and highest runoff flows provides drifting razorback sucker larvae maximum access to flooded habitats, and enhanced growth of larvae in those habitats may increase overall survival by shortening the period of vulnerability to predation (Lentsch et al. 1996b).

Little is known about the biology of juvenile razorback suckers, but the few collected from rivers were found in quiet-water habitats. In 1950, about 6,600 larval or early juvenile razorback suckers were seined along warm, shallow margins of the Colorado River at Cottonwood Landing, Nevada (Sigler and Miller 1963). Smith (1959) caught two juveniles (both about 38 mm long) in the Glen Canyon area of the Colorado River before inundation by Lake Powell, one from a backwater and one from a flooded tributary mouth. Taba et al. (1965) collected eight razorback sucker juveniles (90–115 mm long) from backwaters on the Colorado River near Moab, Utah, 1962–1964. The digestive tracts of those fish contained "algae and bottom ooze." Juvenile razorback suckers have been caught in lateral canals off the lower Colorado River (Marsh and Minckley 1989; Maddux et al. 1993), and stocked, hatchery-produced young have been observed along shorelines, in embayments, along sandbars, or in tributary mouths, eventually moving into river channels or larger backwaters (Minckley et al. 1991a).

Outside the breeding season, adult razorback suckers tend to utilize deeper eddies, backwaters, and pool-type habitats (Minckley et al. 1991a), and their movements are generally reduced (Tyus 1987; Tyus and Karp 1990). Summer or autumn habitat use in rivers of the upper Colorado River basin includes submerged mid-channel sandbars, pools, eddies, and runs (Tyus 1987; Osmundson and Kaeding 1989a; Modde and Wick 1997). Tyus (1987) reported that Green River fish during summer occupied uneven mid-channel sandbars in water less than 2 m deep with an mean velocity of 0.5 m/s. Habitat use in the middle Green River during spring and summer 1993 included runs, eddies, or run-eddy interfaces in water 1–3 m deep over sand, cobble, and gravel substrates (Modde and Wick 1997; Modde and Irving 1998). Although turbulent canyon reaches are not considered preferred habitat for razorback suckers (Tyus 1987; Lanigan and Tyus 1989; Minckley et al. 1991a), Modde and Wick (1997) and Modde and Irving (1998) reported that six radio-tagged adults moved into or near the vicinity of Split Mountain Canyon (Reach 2) during summer or autumn in 1993 and 1994, and possibly remained there over winter. Ryden and Pfeifer (1998) reported that large juvenile and adult razorback suckers stocked in the San Juan River, New Mexico-Utah, preferred fast, mid-channel habitats during the summer–autumn base-flow period.

C. Status and distribution

The endangered razorback sucker is an endemic catostomid of the Colorado River basin (Miller 1959; Minckley et al. 1986) and was once widely distributed in warmwater reaches of larger rivers from Mexico to Wyoming (Jordan and Evermann 1896; Minckley 1973; Behnke and Benson 1983; Bestgen 1990; USFWS 1994). Historic records indicate that the lower Colorado River basin supported the largest numbers of razorback sucker; the species was most abundant in the mainstem Colorado River downstream of present-day Lake Mead, the Salton Sea area, and the lower Gila River drainage in Arizona (Kirsch 1888; Gilbert and Scofield 1898; Minckley

1973, 1983; Bestgen 1990; Minckley et al. 1991a). In the upper Colorado River basin, razorback suckers historically occurred in the Colorado, Green, and San Juan river drainages but apparently were common only in calm, flat-water reaches of the mainstem Colorado and Green rivers and lower sections of their major tributaries (Jordan 1891; Evermann and Rutter 1895; Ellis 1914; Simon 1946; Hubbs and Miller 1953; Koster 1960; Sigler and Miller 1963; Baxter and Simon 1970; Vanicek et al. 1970; Holden and Stalnaker 1975a, 1975b; Wiltzius 1978).

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

Declines in the abundance and distribution of razorback suckers were first noted in the early 1940's (Dill 1944; Wiltzius 1978). Today, the species is one of the most imperiled fishes in the Colorado River basin and exists naturally as only a few disjunct, aging populations or scattered individuals (Minckley et al. 1991a). Although there is evidence of reproduction in the two largest extant populations, natural survival of fish beyond the larval period appears low or nonexistent. Wild stocks are primarily composed of older fish and continue to decline in abundance (Lanigan and Tyus 1989; Marsh and Minckley 1989). Lack of recruitment sufficient to sustain populations has been mainly attributed to the cumulative effects of habitat loss and modification (including reductions in river-flood plain connectivity) caused by water and land development, and predation on early life stages by nonnative fishes (Tyus and Karp 1990; Hawkins and Nesler 1991; Modde et al. 1995; Horn 1996; Lentsch et al. 1996c; Tyus and Saunders 1996; Hamilton 1998; USFWS 1998a).

Remaining wild populations of razorback sucker are in serious jeopardy. The largest extant population is found above Davis Dam in Lake Mohave on the lower mainstem Colorado River, Arizona-Nevada, but little or no natural recruitment has occurred since completion of the dam in 1954 (McCarthy and Minckley 1987; Minckley et al. 1991a). Estimated numbers of adult razorback suckers in Lake Mohave declined 68 percent (from 73,500 to 23,000) during 1980–1993 (Marsh 1994), and further steep declines in the population are expected within the next decade (Minckley et al. 1991a; Mueller 1995). Most razorback suckers occupying exclusively riverine habitat are now limited to the upper Colorado River basin and populations are small. Lanigan and Tyus (1989) estimated that from 758 to 1,138 razorback suckers inhabit the upper Green River. More recent studies of this Green River population of razorback suckers indicate that this population consists of a precariously small but dynamic population that appears to be stable or declining slowly and may consist only of about 500 individuals (Modde et al. 1996). In the Colorado River, most razorback suckers occur in the Grand Valley area near Grand

Junction, Colorado; however, they are increasingly rare. Osmundson and Kaeding (1991) report that the number of razorback sucker captures in the Grand Junction area has declined dramatically since 1974. Modde et al. (1996) characterized the middle Green River population as "precariously" small but dynamic, with at least some recruitment.

In the San Juan River subbasin, small concentrations of razorback suckers have been reported at the inflow area in the San Juan arm of Lake Powell, Utah and one specimen was captured in the San Juan River near Bluff, Utah in 1988 (Platania 1990, Platania et al. 1991). In Bestgen (1990) additional captures of small numbers of razorback suckers were reported from the Dirty Devil and Colorado River arms of Lake Powell.

The razorback sucker was listed as endangered, pursuant to the Act, on October 23, 1991.

Critical habitat description for Razorback sucker

Critical habitat has been designated within the 100-year flood plain of the razorback sucker's historical range in the following sections of the Upper and Lower Basin and the San Juan River (59 FR 13374). The critical elements are the same as those listed above under Colorado pikeminnow.

Colorado, Moffat County. The Yampa River and its 100-year flood plain from the mouth of Cross Mountain Canyon in T. 6 N., R. 98 W., section 23 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah, Uintah County; and Colorado, Moffat County. The Green River and its 100-year flood plain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to Sand Wash in T. 11 S., R. 18 E., section 20 (6th Principal Meridian).

Utah, Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties. The Green River and its 100-year flood plain from Sand Wash at river mile 96 at T. 11 S., R. 18 E., section 20 (6th Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (6th Principal Meridian).

Utah, Uintah County. The White River and its 100-year flood plain from the boundary of the Uintah and Ouray Indian Reservation at river mile 18 in T. 9 S., R. 22 E., section 21 (Salt Lake Meridian) to the confluence with the Green River in T. 9 S., R 20 E., section 4 (Salt Lake Meridian).

Utah, Uintah County. The Duchesne River and its 100-year flood plain from river mile 2.5 in T. 4 S., R. 3 E., section 30 (Salt Lake Meridian) to the confluence with the Green River in T. 5 S., R. 3 E., section 5 (Uintah Meridian).

Colorado, Delta and Mesa Counties. The Gunnison River and its 100-year flood plain from the confluence with the Uncompahgre River in T. 15 S., R. 96 W., section 11 (6th Principal Meridian) to Redlands Diversion Dam in T. 1 S., R. 1 W., section 27 (Ute Meridian).

Colorado, Mesa and Garfield Counties. The Colorado River and its 100-year flood plain from Colorado River Bridge at exit 90 north off Interstate 70 in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to Westwater Canyon in T. 20 S., R. 25 E., section 12 (Salt Lake Meridian) including the Gunnison River and its 100-year flood plain from the Redlands Diversion Dam in T. 1 S., R. 1 W., section 27 (Ute Meridian) to the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).

Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year flood plain from Westwater Canyon in T. 20 S., R. 25 E., section 12 (Salt Lake Meridian) to full pool elevation, upstream of North Wash, and including the Dirty Devil arm of Lake Powell in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).

New Mexico, San Juan County; and Utah, San Juan County. The San Juan River and its 100-year flood plain from the state route 371 bridge in T. 29 N., R. 13 W., section 17 (New Mexico Meridian) to Neskahai Canyon in the San Juan Arm of Lake Powell in T. 41 S., R. 11 E., section 26 (Salt Lake Meridian) up to the full pool elevation.

Arizona, Cococini and Mohave Counties; and Nevada, Clark County. The Colorado River and its 100-year flood plain from the confluence with the Paria River in T. 40 N., R. 7 E., section 24 (Gila and Salt River Meridian) to Hoover Dam in T. 30 N., R. 23 W., section 3 (Gila and Salt River Meridian) including Lake Mead to full pool elevation.

HUMPBACK CHUB

A. Species description

The humpback chub is endemic to the Colorado River Basin and is part of a native fish fauna traced to the Miocene epoch in fossil records (Miller 1955, Minckley et al. 1986). Humpback chub remains have been dated to about 4000 B.C., but the fish was not described as a species until the 1940's (Miller 1946), presumably because of its restricted distribution in remote white water canyons (USFWS 1990a). Because of this, its original distribution is not known.

The humpback chub is a relatively large North American minnow reaching a maximum length of 480 mm and a weight of 1,165 g (Valdez and Ryel, 1995). Humpback chub have a laterally-compressed and tapering fusiform body, short narrow caudal peduncle with deeply forked tail fin, and large falcate paired fins. Adults have a narrow flattened head, with small eyes and a long fleshy snout and inferior subterminal mouth. Subadults are olivaceous above with silvery sides fading to a creamy-white belly, while adults are light olivaceous and slate-gray dorsally and laterally, with a white belly tinged with light orange and yellow (Valdez and Ryel, 1995).

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

B. Life history

The humpback chub evolved in seasonally warm and turbid water and is highly adapted to the unpredictable hydrologic conditions that occurred in the pristine Colorado River system. It is extraordinarily specialized for life in torrential water, with an enlarged stabilizing nuchal hump and large falcate fins (Minckley 1991). Although not strong swimmers (Bulkley et al. 1982), humpback chubs are apparently so well adapted to canyon environments that populations appear to have always occupied a specialized niche in canyon-bound segments of the river system (Carlson and Muth 1989) where individual adults exhibit high fidelity to particular locales (Valdez and Clemmer 1982; Valdez and Ryel 1995).

Little is known about the specific spawning requirements of the humpback chub. The fish is known to spawn soon after the highest spring flows when water temperatures approach 20° C (Kaeding et al. 1990, Karp and Tyus 1990a, USFWS 1990b). The collection of ripe and spent fish indicated that spawning occurred in Black Rocks during June 2-15, 1980, at water temperatures of 10° to 15° C; in 1981, spawning occurred on May 15-25 at water temperatures of approximately 15° C (Valdez et al. 1982b). Humpback chub spawned in Black Rocks on the Colorado River in 1983 when maximum daily water temperatures were between 12° and 17° C (Archer et al. 1986).

The humpback chub is an obligate warmwater fish that requires relatively warm temperatures for spawning, egg incubation, and survival of larvae. Optimum growth temperatures range from 16° to 22° C (Hamman 1982; Lechleitner 1992). Little else is known about reproduction except that spawning occurs on the descending limb of annual spring hydrographs, most likely over gravel substrates (Valdez and Clemmer 1982; Valdez et al. 1982; Kaeding and Zimmerman 1983; Tyus and Karp 1989; Valdez and Ryel 1995).

Unlike larvae of Colorado pikeminnow and razorback sucker, emerging larval humpback chubs do not appear to drift extensively and remain in the general vicinity of spawning areas. Extensive sampling for larvae and young-of-year immediately downstream of Black Rocks and Westwater Canyon yielded very low numbers of young humpback chubs (Valdez et al. 1982; Chart and Lentsch 1999a). Robinson et al. (1998) documented drift of larval humpback chubs from the Little Colorado River and into the mainstem Colorado River in Grand Canyon; they noted lower abundance at more downstream stations, which suggested that humpback chub larvae may drift shorter distances than speckled dace, bluehead sucker, and flannelmouth sucker. Young-of-year fish in the Little Colorado River were noted to distribute themselves downstream in the main Colorado River within several months of hatching, however it is not known if this emigration is passive or active (Valdez and Ryel 1995).

Backwaters, eddies, and runs have been reported as common capture locations for young-of-year humpback chub (Valdez and Clemmer 1982). These data indicate that in Black Rocks and Westwater Canyon, young utilize shallow areas. Habitat suitability index curves developed by Valdez et al. (1990) indicate young-of-year prefer average depths of 2.1 feet with a maximum of 5.1 feet. Average velocities were reported at 0.2 feet per second. Subadult humpback chub (under 200 mm) occupied shoreline habitats within two meters of the shore and were specifically more abundant in talus and vegetated shorelines which provided more cover compared to sand or cobble bars in the Grand Canyon (Converse et al. 1998a). Humpback chubs mature in 2-3 years at approximately 200 mm and may live 20-30 years (Valdez et al. 1992; Hendrickson 1993).

Adults are thought to be negatively phototactic and are more active in turbid water or at night (Valdez et al. 1992; Valdez and Ryel 1995, 1997). Valdez et al. (1982b) and Wick et al. (1981) found adult humpback chub in Black Rocks and Westwater Canyons in water averaging 50 feet in depth with a maximum depth of 92 feet. In these localities, humpback chub were associated with large boulders and steep cliffs. In Grand Canyon, adult humpback chub were specifically associated with geomorphic reaches of the river characterized by large eddy hydraulic habitat. Humpback chub appear to have a high fidelity for particular eddies in some reaches of the river (Valdez and Ryel 1995).

Generally, humpback chub show fidelity for canyon reaches and move very little (Miller et al. 1982c, Archer et al. 1985; Burdick and Kaeding 1985, Kaeding et al. 1990). Movements of adult humpback chub in Black Rocks on the Colorado River were essentially restricted to a 1-mile reach. These results were based on the recapture of Carlin-tagged fish and radiotelemetry studies conducted from 1979 to 1981 (Valdez et al. 1982) and 1983 to 1985 (Archer et al. 1986; Kaeding et al. 1990).

Diet of humpback chubs in the upper Colorado River basin has not been described. In Grand Canyon, humpback chubs primarily consumed aquatic invertebrates (e.g., midges, blackflies, and amphipods), green algae, terrestrial invertebrates, and occasionally fish and reptiles (Kaeding and Zimmerman 1983; Kubly 1990; Valdez and Ryel 1997). Tyus and Minckley (1988) reported that migrating Mormon crickets (*Anabrus simplex*) were an important food source for humpback chubs in the Green and Yampa rivers.

Two species of non-indigenous parasites infect humpback chubs; the external parasitic copepod (*Lernaea cyprinacea*) has been reported from all populations (Valdez et al. 1982) and the internal Asian tapeworm (*Bothriocephalus acheilognathi*) is found in humpback chubs of Grand Canyon (Brouder and Hoffnagle 1997; Clarkson et al. 1997). Infection by the Asian tapeworm may cause stress or death to the host and widespread infestation during periods of stress. This parasite can complete its life cycle only where water temperatures are greater than 20° C but is apparently able to survive in a fish host at colder temperatures.

C. Status and distribution

The humpback chub is endemic to the Colorado River basin, with ancestral fossil evidence of a *Gila* complex dating back to the Miocene epoch (Miller 1955). *Gila cypha* is believed to be a more recent, specialized derivative that evolved in response to conditions in large, erosive Colorado River habitats during the mid-Pliocene and early Pleistocene epochs, 3–5 million years ago (Minckley et al. 1986). Skeletal remains of humpback chubs were found in 4,000-year-old flood deposits in Stanton's Cave in Marble Canyon, Arizona, as well as at an archeological site in Catclaw Cave, now inundated by Lake Mead (Miller 1955).

Records documenting distribution and abundance of the species in modern time are incomplete, and factors associated with its decline are scarce or poorly understood (Tyus 1998). The lack of early information on humpback chub is due to several factors. Humpback chubs occur primarily in remote canyon areas and apparently were rare in most early collections because of inaccessibility and difficulty in sampling these areas (Tyus 1998). In addition, there has been some uncertainty over nomenclature and taxonomy of species in the genus *Gila*. For example, during the 1950's, two forms of bonytail (a common name for morphotypes of the Colorado River *Gila* complex) were taxonomically recognized as subspecies, roundtail chub *Gila robusta robusta* and bonytail chub *Gila robusta elegans*.

A third form, the humpback chub *Gila cypha*, was described by Miller (1946) and was not universally recognized as a valid taxon (Holden and Stalnaker 1970; Holden 1991). Although many researchers recognized the presence of morphological variants, a common nomenclature has not been accepted. As a result, many early fish surveys of the Colorado River system assigned the vernacular "bonytail" to all three closely-related *Gila* species (*G. cypha*, *G. elegans*, and *G. robusta*), thereby confounding confirmation of humpback chub localities prior to approximately 1970 (Banks 1964; Vanicek and Kramer 1969; Holden and Stalnaker 1970; Valdez and Clemmer 1982; Douglas et al. 1989; Rosenfeld and Wilkinson 1989; Minckley 1991; Dowling and DeMarais 1993; Quartarone 1993).

Despite sparse historic records and taxonomic confusion, strong evidence exists that the historic range of the humpback chub included most canyon-bound reaches of the Colorado River system. Known historic distribution of humpback chubs includes portions of the mainstem Colorado River and four of its tributaries: the Green, Yampa, White, and Little Colorado rivers (USFWS 1990a). However, the species may have been extirpated from some river reaches, in both the lower and upper Colorado River basins, as a result of water development and other human-related alterations prior to complete documentation of its range.

Description of the present distribution of humpback chubs in the Colorado River basin is based on collection records from widely separated locations since approximately 1980. The Humpback Chub Recovery Plan (USFWS 1990a) described the present distribution of the species as:

1. Little Colorado River, Arizona, from its mouth to 13 km upstream;
2. Colorado River in Marble and Grand canyons, Arizona;
3. Colorado River in Cataract Canyon, Utah;

4. Colorado River in Black Rocks, Colorado, and Westwater Canyon, Utah;
5. Green River in Desolation and Gray canyons, Utah;
6. Green River in Whirlpool and Split Mountain canyons, Dinosaur National Monument, Colorado and Utah; and
7. Yampa River in Yampa Canyon, Dinosaur National Monument, Colorado.

The largest and most stable humpback chub population is presently thought to reside in the Little Colorado River and Colorado River near their confluence in Marble and Grand canyons, Arizona (1 and 2 from list above). Valdez and Ryel (1995) estimated that 3,750 adult humpback chubs larger than 200 mm occurred in the mainstem river during 1990–1993, and Douglas and Marsh (1996) reported 4,346 humpback chubs larger than 150 mm in the Little Colorado River in 1992. In addition, several other aggregations of humpback chub are found in the Grand Canyon, always in association with reaches characterized by large eddy complexes. In one aggregation at approximately river mile 30 in Grand Canyon, larval humpback chub were identified in association with springs expressed from local limestone geology; however it is not believed that any recruitment occurs as a result of this spawning activity. Rather the aggregation appears to be a relict group from the pre-dam era, that are prompted to spawn by relatively warmer spring water compared to the cold hypolimnetic river water (Valdez and Ryel 1995).

Of the five locations in the upper Colorado River basin (3–7 from list above), self-sustaining populations occur in Cataract Canyon (Valdez 1990; Valdez and Williams 1993), Black Rocks (Kaeding et al. 1990), Westwater Canyon (Chart and Lentsch 1999a), Desolation and Gray canyons (Chart and Lentsch 1999b), and Yampa Canyon (Karp and Tyus 1990b). A few humpback chubs also have been reported from the Green River in Dinosaur National Monument, primarily in Whirlpool Canyon (Holden and Stalnaker 1975a; Karp and Tyus 1990b) and Split Mountain Canyon (Vanicek 1967; Holden and Stalnaker 1975). Estimates of humpback chub population size in the Green and Colorado rivers have been difficult to obtain because of low numbers of fish and low recapture rates. Chart and Lentsch (1999a) sampled for humpback chubs at three locations in Westwater Canyon and derived abundance estimates ranging from 572 to 5,880 individuals larger than 175 mm; however, confidence intervals about the estimates were typically greater than the estimate means due to low recapture rates. Catch rates of humpback chubs in Black Rocks indicate a relatively large concentration (Maddux et al. 1993), but no abundance estimates have been attempted.

The humpback chub was included in the first List of Endangered Species issued by the Office of Endangered Species on March 11, 1967 (32 FR 4001). The humpback chub was classified as endangered because of declines in distribution and abundance throughout its range. It was afforded full protection under ESA of 1973, as amended.

Critical Habitat for humpback chub

Critical habitat has been designated within the humpback chub's historical range in the following sections of the Upper Basin (59 FR 13374):

Colorado, Moffat County. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah, Uintah County; and Colorado, Moffat County. The Green River from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the southern boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).

Utah, Uintah and Grand Counties. The Green River (Desolation and Gray Canyons) from Sumners Amphitheater in T. 12 S., R. 18 E., section 5 (Salt Lake Meridian) to Swasey's Rapid in T. 20 S., R. 16 E., section 3 (Salt Lake Meridian).

Utah, Grand County; and Colorado, Mesa County. The Colorado River from Black Rocks in T. 10 S., R. 104 W., section 25 (6th Principal Meridian) to Fish Ford in T. 21 S., R. 24 E., section 35 (Salt Lake Meridian).

Utah, Garfield and San Juan Counties. The Colorado River from Brown Betty Rapid in T. 30 S., R. 18 E., section 34 (Salt Lake Meridian) to Imperial Canyon in T. 31 S., R. 17 E., section 28 (Salt Lake Meridian).

Bonytail

A. Species description, life history and distribution

Bonytail have an elongated fusiform body, small flattened head with small eyes, subterminal mouth, long slender caudal peduncle, and large deeply forked tail fin. Subadults are olivaceous above with silvery sides fading to creamy-white belly, while adults are greenish to gray dorsally and laterally, with a white belly and irregular black lateral spots (Valdez and Ryel 1995).

Formerly reported as widespread and abundant in mainstem rivers (Jordan and Evermann 1896), bonytail populations have been greatly reduced. The fish is presently represented in the wild by a low number of old adult fish in Lake Mohave and perhaps other lower Colorado River basin reservoirs (USFWS 1990a). The last known riverine area where bonytail were common was the Green River in Dinosaur National Monument, where Vanicek (1967) and Holden and Stalnaker (1970) collected 91 specimens during 1962-1966.

From 1977 to 1983, no bonytail were collected from the Colorado or Gunnison rivers in Colorado or Utah (Wick et al.1981; Valdez et al. 1982). However, in 1984, a single bonytail was collected from Black Rocks on the Colorado River (Kaeding et al. 1986). Several suspected bonytail were captured in Cataract Canyon in 1985-1987 (Valdez 1990). Researchers continue to capture suspected bonytail individuals or potential hybrid combinations of bonytail, roundtail chub and humpback chub; however it is difficult to determine the extent of hybridization in the

Field or if certain individuals represent the bonytail species because of the complexity of *Gila* morphometric.

The bonytail is considered a species that is adapted to mainstem rivers, where it has been observed in pools and eddies (Vanicek 1967,Minckley 1973). Spawning of bonytail has never been observed in a river, but ripe fish were collected in Dinosaur National Monument during late June and early July suggesting that spawning occurred at water temperatures of about l7° C (Vanicek and Kramer 1969).

Early stocking efforts which placed hatchery-raised adult bonytail into the Green River at Split Mountain and near the Jensen, Utah area proved unsuccessful. Currently, the State of Utah has an experimental stocking progmm in place through which thousands of subadult bonytail have been stocked into the Colorado River in the Moab area in the past 5 years. This experimental stocking also includes investigations into muscle fitness of stocked fish (Lentsch et al. 1996a).

The bonytail is the rarest native fish in the Colorado River. Fewer than 10 individuals have been caught in the upper Colorado River basin in the last decade and small numbers of adults persist in Lake Mohave, Nevada-Arizona (Kaeding et al. 1986). Bonytail was listed as an endangered species in 1980.

Critical llabitat for Bonytail

Critical habitat has been designated within the bonytail's historical range in the following sections of the Upper Basin (59 FR 13374):

Colorado. Moffat County. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T.7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah, Uintah County; and Colorado, Moffat County. The Green River from the confluence with the Yampa River in T.7 N., R. 103 W., section 28 (6th Principal Meridian) to the boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).

Utah, Uintah and Grand Counties. The Green River (Desolation and Gray Canyons) from Sumner's Amphitheater (river mile 85) in T. 12 S., R. 18 E., section 5 (Salt Lake Meridian) to Swasey's Rapid (river mile 12) in T.20 S., R. 16 E., section 3 (Salt Lake Meridian).

Utah, Grand County; and Colorado, Mesa Countv. The Colorado River from Black Rocks in T. 10 S., R. 104 W., section 25 (6th Principal Meridian) to Fish Ford in T. 21 S., R. 24 E., section 35 (Salt Lake Meridian).

Utah, Garfield and San Juan Counties. The Colorado River from Brown Betty Rapid in T. 30 S., R. 18 E., section 34 (Salt Lake Meridian) to Imperial Canyon in T. 31 S., R. 17 E., section 28 (Salt Lake Meridian.

E. Analysis of the species/critical habitat likely to be affected

It is anticipated that the Colorado pikeminnow that occupy 88.5 miles of the Price River will be directly affected, as will their habitat, by flow depletions and instream habitat modifications. In addition, flow depletions in the Price River will deplete flows in the Green and Colorado rivers and affect critical habitat for the four endangered fish species from the confluence of the Price and Green rivers downstream to Lake Powell. Depletions on Green and Colorado rivers within the affected area are herein considered in accumulation with other small tributary depletions as a net change to the sediment and flow regimes and lost potential for creation and maintenance of habitat characteristics crucial to various life-stages of these fish. For example, lower peak flows prevent interconnection of the 100-year flood plain and flood plain inundation and also decreases capacity for creation of backwaters in downstream reaches. Lower peak flows may also affect Colorado pikeminnow spawning habitat in Gray Canyon and other species spawning habitat as yet unidentified.

IV. ENVIRONMENTAL BASELINE

A. Status of the species within the action area

Colorado pikeminnow are found in the Price River from Farnham Diversion near Wellington at river mile 88.5 down to the confluence of the Price and Green rivers. Wellington is located approximately 50 to 70 miles downstream of the proposed Narrows Dam.

The collection of 21 Colorado pikeminnow in the Price River and seven additional individuals positively identified but not captured during a 2-year seasonal study indicates that some suitable habitat for juvenile and adult Colorado pikeminnow is available during April through September although the quality or quantity is unknown. No data has been collected during late fall or winter, so it is not known whether the Price River is used by Colorado pikeminnow during those seasons.

Although spawning of the Colorado pikeminnow has not been documented in the Price River, the potential for Colorado pikeminnow spawning in the Price River is unknown. The Price River warms earlier than the Green River which may attract Colorado pikeminnow from the Green River that are searching for suitable spawning and/or feeding areas in the spring. A ripe male Colorado pikeminnow was captured at river mile 10.5, which suggests that the fish may attempt to spawn in the Price River, however one ripe male may also be anomalous. The availability and quality of spawning habitat is unknown other than observation of some riffle habitat in the canyon reaches. Minimal quality and quantity of nursery habitat (defined as low-velocity shoreline pockets or backwaters) has been noted within the Price River. The nursery habitat present within the Price River is suspected to be completely dewatered during low water periods. It is not clear if the year-round flow and sediment regimes are adequate to maintain spawning or nursery habitat.

Despite anecdotal accounts of abundant Colorado pikeminnow in the early part of the century (Hardy 1964 in reference to early 1900s), most biologists including biologists from the State of Utah Division of Wildlife Resources (UDWR) did not believe Colorado pikeminnow occupied the Price River at any appreciable level before recent findings from surveys in 1996 and 1997. In fact, McAda et al. (1977) reported that no endangered species were identified at any of three locations within the Price River; however this survey represented minimal effort during 1 year, which happened to be a severe drought year.

It is possible that Colorado pikeminnow have been present in the Price River at varying or low densities but only recently detected, or Colorado pikeminnow may have only recently recolonized the Price River. In either case, juvenile and adult Colorado pikeminnow appear to use as much of the Price River that is available (88.5 miles from the confluence of the Price and Green rivers to the Farnham Diversion, an upstream barrier to fish movement) at least from April through September. In contrast, if Colorado pikeminnow were in fact, locally extirpated, recent note of more than twenty juveniles and adults in the Price River may indicate that Colorado pikeminnow are recolonizing the Price River after years of absence. Recolonization of tributaries may exemplify an increasing trend for Colorado pikeminnow in the Green River system.

The Price River may play an important role to the overall Green River system both biologically and physically. The proportion of native species is much higher in the Price River than in the Green River, and the number of nonnative predators and competitors, such as channel catfish and green sunfish, in the Price River is relatively low. The dominant native fish community in the Price River may be one reason why Colorado pikeminnow are found there. Water temperatures within the Price River warm earlier than the Green River, which may attract the endangered fish from the Green River searching for suitable spawning and/or feeding areas (Cavalli 1999). The Price River may also provide better growing conditions, food supply, and nutrients needed by the endangered fishes; however, further studies are needed to determine the importance of these relationships to the overall recovery of the species in the upper Colorado River basin.

Outside of the Price River basin, Colorado pikeminnow, humpback chub, razorback sucker and to some extent, bonytail, are present and utilize the Green River from the confluence of the Price and Green rivers downstream to Lake Powell; this area will be affected by depleted flows in the Price River. Various life-stages of these species occur within this area including: 1) spawning adult Colorado pikeminnow, humpback chub and most likely razorback sucker; 2) young-of-year Colorado pikeminnow, humpback chub and razorback sucker; 3) juvenile Colorado pikeminnow, humpback chub and razorback sucker; and 4) migrating and feeding adults of all four species. In addition, the critical habitat that is affected by the proposed Project is within several areas of focus for recovery efforts for these species. Any factor detrimentally affecting these species is expected to hinder recovery efforts to some unknown extent.

B. Factors affecting species environment within the action area

The Colorado pikeminnow, razorback sucker, humpback chub, and bonytail are adversely affected by the following project activities or consequences:

1. Depletions to instream flows and resultant degradation of instream habitat as well as direct influences on various life-stages and the food-base of Colorado pikeminnow within 88.5 miles of occupied habitat in the Price River.

2. Depletions to the Green River and Colorado River basin including direct impacts on all four endangered fish species and their critical habitat, cumulative depletion impacts on the sediment and flow regimes, and adverse modification of habitat downstream from the confluence of the Price and Green rivers to Lake Powell.

V. EFFECTS OF THE ACTION

A. Factors to be considered

Water depletions in the upper Colorado River basin have been long recognized as a major source of impact to the endangered fish species native to this basin. Continued water withdrawal has restricted the ability of the Colorado River system to produce flow conditions required to create and maintain habitat for various life stages of these species. Impoundments and diversions, like the proposed Narrows Project, have substantially reduced peak discharges in the Colorado River basin while increasing base flows in some reaches. These depletions along with a number of other factors have resulted in such drastic reductions in the populations of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker that the Service has listed these species as endangered and has implemented programs to prevent extinction and recover the species. Both direct and indirect effects of depletions that will occur as a result of the proposed Narrows Project as well as cumulative effects within the Price River drainage were considered in the formulation of this Opinion.

The fact that the project depletes flows during peak runoff period is of concern to us because this hydrologic characteristic is geomorphically and ecologically significant to the endangered fish species. Spring runoff is the most extreme parameter of the hydrologic cycle, and it precedes and influences the very critical spawning period of the endangered fishes. Observations clearly demonstrate that migration and spawning activities of these fishes are synchronized with and undoubtedly influenced by the runoff period (Archer et al. 1986; Archer and Tyus 1984). The Service further believes that peak spring flows are crucial for creating and maintaining in-channel habitats, such as spawning habitat and backwaters, and for providing access to off-channel habitats, such as inundated floodplains.

Also, we are generally concerned about the base-flow condition. Minimum instream flows have not been identified or secured for the Price River. It is not clear what minimum flows and what time of year such flows would be required to protect and maintain habitat for endangered fish species. Further depletions from the system could affect the base-flow condition which would impact instream habitat quality and quantity.

B. Analysis for effects of the action

The Price River is a tributary to the Green River that drains approximately 1,892 square miles of southeastern Utah. Past and ongoing impacts to the Price River include water development projects for irrigation, industrial, and culinary purposes. Two existing Federal projects impact the Price River Basin. The Price-San Rafael River Salinity Control Project results in an annual depletion of 25,310 acre-feet, and diversions associated with Scofield Reservoir were reported to have an annual depletion of approximately 55,345 acre-feet (based on 63 percent consumptive use) for an average water year (19,161 acre-feet for a dry year and 55,703 acre-feet for a wet year) (Bureau of Reclamation 1998). Appendix A (Tables 1.1 to 1.4) summarizes the cumulative hydrology study.

The historical volume of water available in the Price River was estimated to be approximately 157,249 acre-feet (Bureau of Reclamation 1998). Depletions resulting from the two existing Federal projects have been estimated to be approximately 82,412 AF, resulting in a flow volume that is approximately 47.6 percent of historical flows. Much of the Price River has been channelized for highway and railroad construction. As a result of instream flow and physical channel modifications, instream habitat has shifted from a pool, riffle, run complex to extensive reaches of homogeneous habitat (riffles with large substrates or runs with fine substrates depending on gradient), although some reaches of the lower Price River retain elements of the natural physical habitat.

Subtracting the annual depletion of the Price-San Rafael River Salinity Control Project and Scofield Reservoir Project (82,412 AF) from historic flows (157,249 AF), results in the existing condition or average monthly flows without the Narrows Project of 74,837 AF (Table 1.4). Subtracting the depletion for the Narrows Project (5,717 AF) results in 69,120 AF of water remaining in the Price River. The overall depletion of all Federal projects including the proposed Narrows project will be 88,129 AF. This is a depletion of 56% of historic flows.

C. Species' response to the proposed action

It is expected that the proposed action would detrimentally impact Colorado pikeminnow and result in a decline in the number of individuals using the Price River or possibly inhibiting use altogether. Also, the unknown importance of the Price River as winter or spawning habitat prevents protection of these important life-history elements, if, in fact, they are present. Furthermore, adverse modification of critical habitat for all four endangered fish species from the confluence of the Price and Green rivers downstream to Lake Powell is expected to result in detriment and overall harm to the populations, thereby offsetting recovery efforts elsewhere in the basin.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future Federal actions

that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

We are not aware of any known cumulative effects at this time.

VII. CONCLUSION

The Narrows Project, in association with existing Federal projects, will further reduce peak discharge within the Price River. Annual depletions of the Narrows Project is 5,717 AF. Total depletion within the Price River Basin is 88,129 AF. It is our biological opinion that the effects of the Narrows Project, as proposed, are likely to jeopardize the continued existence of the Colorado pikeminnow, humpback chub, razorback sucker, and bonytail through water depletions from the Green and Colorado rivers and is likely to destroy or adversely modify designated critical habitat in the Green and Colorado rivers from the confluence of the Price and Green rivers downstream to Lake Powell. In addition, the proposed Narrows Project is likely to jeopardize Colorado pikeminnow currently occupying the Price River and detrimentally impact instream habitat conditions of the Price River.

VIII. REASONABLE AND PRUDENT ALTERNATIVES

Regulations (50 CFR 402.02) implementing section 7 of ESA define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technologically feasible; and (4) would, we believe, avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

On January 21-22, 1988, the Secretary of the Interior; Governors of Wyoming, Colorado, and Utah; and the Administrator of the Western Area Power Administration were cosigners of a Cooperative Agreement to implement the RIP (USFWS, 1987). An objective of the RIP was to recover the listed species while providing for new water development in the Upper Colorado River Basin.

In order to further define and clarify processes outlined in sections 4.1.5, 4.1.6, and 5.3.4 of the RIP, a section 7 agreement and a RIPRAP was developed (USFWS 1993). The agreement establishes a framework for conducting all future section 7 consultations on depletion impacts related to new projects and all impacts associated with historic projects in the Upper Basin. Procedures outlined in the agreement will be used to determine if sufficient progress is being accomplished in the recovery of endangered fishes to enable the RIP to serve as a reasonable and prudent alternative to avoid jeopardy. The RIPRAP was finalized on October 15, 1993, and has been reviewed and updated annually.

In accordance with the agreement, the Service assesses the impacts of projects that require section 7 consultation and determines if progress toward recovery has been sufficient for the RIP to serve as a reasonable and prudent alternative. If sufficient progress is being achieved, biological opinions are written to identify activities and accomplishments of the RIP that support it as a reasonable and prudent alternative. If sufficient progress towards the recovery of the endangered fishes has not been achieved by the RIP, actions from the RIPRAP are identified which must be completed to avoid jeopardy to the fishes. For historic projects, these actions serve as the reasonable and prudent alternative as long as they are completed according to the schedule identified in the RIPRAP. For new projects, these actions serve as the reasonable and prudent alternative as long as they are completed before the impact of the project occurs.

In determining if sufficient progress has been achieved, the Service considers: (a) actions which result in a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction; (b) status of fish populations; (c) adequacy of flows; and (d) magnitude of the project impact. In addition, we consider 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 fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction. We evaluate progress separately for the Colorado River and the Green River sub-basins; however, we gives due consideration to progress throughout the Upper Basin in evaluating progress towards recovery.

In the amended Biological Assessment from Reclamation to the Service (March 7, 1997), Reclamation suggested the following actions be developed into RIPRAP items to offset the proposed Narrows Project impacts to the Price River and endangered fish species:

1) 'Project sponsors . . . pay the depletion charge for the entire depletion caused by the Narrows Project.'

2) 'The Recovery Program would agree to provide funding for the continuance of the [Price River endangered fish] study for . . . additional . . . year(s) . . . this study could include . . . data . . . to provide a better understanding of the year-round utilization of the Price River by Colorado squawfish (sic); . . . identifying flow needs and potential sources of water . . . for in stream flows needed by endangered fish [in the Price River].'

3) 'The Recovery Program would secure water rights on the Price River that could be used to maintain instream flows during critical times of the year for squawfish (sic) in the Price River.'

The Service agrees that these activities will assist in providing the necessary protection and conservation of listed fishes in the Price River. These items have been incorporated into the following reasonable and prudent alternative and have been identified in the FY2001 RIPRAP finalized March 8, 2000.

The purpose of the following reasonable and prudent alternative is to avoid the likelihood of jeopardy to listed species and destruction or adverse modification of their critical habitats while also allowing the proposed Narrows Project to be constructed and operated for its purposes including water development.

The Service has determined, based on the analysis of the hydrological and biological information that currently exists, that if Reclamation and the Sanpete Water Conservancy District, in cooperation with RIP participants and responsible Federal agencies, agree to carry out all the following elements then these actions will avoid the likelihood of jeopardizing the continued existence of endangered fishes and avoid the likelihood of destruction or adverse modification of critical habitats for the proposed Project.

The following items, numbers 1, 2 and 3 combined, will serve as the reasonable and prudent alternative for the proposed Narrows Project:

1) The following excerpts are pertinent to the consultation because they summarize portions of the RIP that address depletion impacts, section 7 consultation, and project proponent responsibilities:

> "All future section 7 consultations completed after approval and implementation of this program (establishment of the Implementation Committee, provision of congressional funding, and initiation of the elements) will result in a one-time contribution to be paid to the Service by water project proponents in the amount of $10.00 per acre-foot based on the average annual depletion of the project . . . . This figure will be adjusted annually for inflation [the current figure is $14.36 per acre-foot] . . . . Concurrently with the completion of the Federal action which initiated the consultation, e.g., . . . issuance of a 404 permit, 10 percent of the total contribution will be provided. The balance . . . will be . . . due at the time the construction commences . . . ." (Specific figures are listed below)

It is important to note that these provisions of the RIP were based on appropriate legal protection of the instream flow needs of the endangered Colorado River fishes. The RIP further states:

> ". . . it is necessary to protect and manage sufficient habitat to support self-sustaining populations of these species. One way to accomplish this is to provide long term protection of the habitat by acquiring or appropriating water rights to

> ensure instream flows . . . . Since this program sets in place a mechanism and a commitment to assure that the instream flows are protected under State law, the Service will consider these elements under section 7 consultation as offsetting project depletion impacts."

The Sanpete Water Conservancy District has applied to Reclamation for a Small Reclamation Project Act loan to help finance construction of the proposed Narrows Project. Such loans are made available by Reclamation to assist with construction of non-federal projects. The Sanpete Water Conservancy District has also applied to use lands for the Narrows Project that were withdrawn from the public domain by Reclamation. Reclamation has a regulatory responsibility to comply with the National Environmental Policy Act and requirements of the Small Reclamation Project Act. A repayment contract and a Management Agreement between Reclamation and the Sanpete Water Conservancy District will include any stipulations to meet environmental commitments of the project including those contained in this biological opinion.

Thus, we have determined that project depletion impacts, which the Service has consistently maintained are likely to jeopardize the listed fishes, can be offset by (a) the water project proponent's one-time contribution to the RIP in the amount of $14.13 per acre-foot of the project's average annual depletion, (b) appropriate legal protection of instream flows pursuant to State law, and (c) accomplishment of activities necessary to recover the endangered fishes as specified under the RIP RAP. We believe it is essential that protection of instream flows proceed expeditiously, before significant additional water depletions occur.

With respect to (a) above (i.e., depletion charge), the Sanpete Water Conservancy District will make a one-time payment which has been calculated by multiplying the project's average annual depletion of 5,717 acre-feet by the depletion charge in effect at the time payment is made. For Fiscal Year 2000 (October 1, 1999, to September 30, 2000), the depletion charge is $14.36 per acre-foot for the average annual depletion which equals a total payment of $82,096.12 for this project. We will notify the Sanpete Water Conservancy District of any change in the depletion charge by September 1 of each year. Ten percent of the total contribution, $8,210, or total payment, will be provided to our designated agent, the National Fish and Wildlife Foundation (Foundation), at the time of issuance of any funding or authorization from Reclamation. The balance will be due at the time the construction commences. The payment will be included by Reclamation as a stipulation in any agreement or authorization provided by Reclamation to the District. All payments should be made to the Foundation at the following address:

> National Fish and Wildlife Foundation
> 1120 Connecticut Avenue, N.W.
> Suite 900
> Washington, D.C. 20036

In a letter dated November 11, 1999, the Sanpete Water Conservancy District agreed to this payment (Appendix B). They also noted that on July 13, 1995, the Sanpete Water Conservancy District sent a check for $7,063 to the National Fish and Wildlife Foundation to cover what was then 10 percent of the depletion charge. As soon as Reclamation approves the loan for the proposed Project, the Sanpete Water Conservancy District will send an additional $1147.00 to bring the contribution up to 10 percent of the current depletion charge (Appendix B).

Payment is to be accompanied by a cover letter that identifies the project and biological opinion that requires the payment, the amount of payment enclosed, check number, and any special conditions identified in the biological opinion relative to disbursement or use of the funds (there are none in this instance). The cover letter also shall identify the name and address of the payor, the name and address of the Federal agency responsible for authorizing the project, and the address of our office issuing the biological opinion. This information will be used by the Foundation to notify the payor, the lead Federal agency, and us that payment has been received. The Foundation is to send notices of receipt to these entities within 5 working days of its receipt of payment.

2) An objective of the RIP is to quantify and provide a process for the legal protection of instream flows pursuant to State law, and accomplish activities necessary to recover the endangered fishes as specified under the RIPRAP. To date, flow requirements have not been determined although a RIPRAP item has been developed specifically for the Price. Currently the RIP is evaluating tributary importance and overall contribution to the Green River and Colorado River system and the recovery of its endangered fish species. As part of the RPA to offset impacts from the proposed narrows project, the RIP will fund a study to determine the following:

- Seasonal endangered fish use in the Price River, particularly winter.

- Recommendation of year-round, instream flows requirements for Colorado pikeminnow.

The following background information provides a rationale for this element of the RPA. Historically, the Price River was inhabited by large numbers of native fish including Colorado pikeminnow, flannelmouth suckers, bluehead suckers, speckled dace, roundtail chubs, and possibly razorback suckers (Cavalli, 1999). However, due to impacts resulting from development (i.e., dams, water diversions, highways, railroads, etc.), habitat for the endangered Colorado River fishes now appears to be limited. The channel has been altered and instream habitat is structurally less complex; in addition, flows are substantially lower than historical flows with some periods of complete dewatering in parts of the system. The extent of these instream habitat and flow alterations are not well understood, nor is the effect on fish populations.

Fish surveys from the late 1970's indicated that no endangered fish occupied the Price River. Overall, most biologists familiar with the system believed that endangered fish had been

completely extirpated from this river. In 1995, Trout Unlimited sponsored a single, 5-day sampling trip which resulted in the capture of one juvenile Colorado pikeminnow 2.2 miles above the confluence of the Green River. With pending water development projects, it became important to determine the extent of endangered fish use of the Price River. The single capture in 1995 was enough to prompt an additional 2 year study directed at determining endangered fish use of the Price River and examining potential habitat conditions in the lower 50 miles.

The 2-year study, conducted from April through October in 1996 and 1997, unexpectedly showed that the Price River is utilized by juvenile and adult Colorado pikeminnow. Over 20 Colorado pikeminnow were captured ranging in size from under 200 mm to nearly 600 mm. One large adult was captured (and several others were reported to be caught by anglers) at the most upstream possible point for fish movement, at the base of a diversion structure 88.5 miles above the confluence of the Price and Green rivers. These findings suggest the Price River may be hydrologically and biologically important to the Green River and the overall recovery and persistence of Colorado pikeminnow populations in the Upper Colorado River Basin.

The Price River system appears to be important not only in providing an additional 88.5 miles of occupied habitat to Colorado pikeminnow but also in its abundance and high percentage of natives in the fish community. The plentiful forage available in flannelmouth and bluehead suckers may attract the predaceous Colorado pikeminnow. It is unclear whether Colorado pikeminnow have been present in the Price River since the late 1970's but simply elusive to capture. Alternatively, recolonization of the Price River in the recent decade may represent a response to a recovering and increasing metapopulation in the main Green River system.

In the most dire case, the Price River may only provide seasonal, sub-optimal habitat for foraging adults. However, it may not be entirely serendipitous that the presence of Colorado pikeminnow in the Price River represent a recent range expansion in light of the extensive recovery efforts and environmental protection occurring throughout the last three decades. If newly located tributary occupation of Colorado pikeminnow is a response to recovery efforts, it is crucial to document and understand the role of tributaries to overall system recovery and persistence. In either case, 88.5 miles of river occupation by this endangered species should be better understood before it is dismissed and possibly lost during this time of great recovery strides.

In particular, it is important to know if Colorado pikeminnow use the Price River year-round and potentially spawn, thereby comprising a possibly new, contributing population. Instream flow requirements should be identified that will protect this enclave through upcoming water development. Although the 2-year Price River study provided a wealth of new and important information, it was not sufficient to determine year-round or accurate seasonal instream flow requirements. Some cursory data are available from the 2-year study; however, this information contains crucial gaps and does not sufficiently describe the potential for spawning activity and habitat use or year-round use of the river by Colorado pikeminnow (Cavalli 1999).

3) The discharge gage station located at Woodside in the lower Price River will be recommissioned so that flows in the lower river can be evaluated and instream flows can be identified and monitored.

Based on newly acquired and past information, we and Reclamation should determine the flows needed to maintain or improve the biological requirements of the Colorado pikeminnow in the Price River by the year 2003. This field effort should be closely monitored by the Utah Field Office to ensure that study objectives and data collected allow development of flow recommendations and understand year-round use. Funding for these actions should be the responsibility of the RIP and not Reclamation or the Sanpete Water Conservancy District.

INCIDENTAL TAKE STATEMENT

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

We do not anticipate the proposed action will incidentally take any endangered Colorado River fishes by construction of the proposed Project and water depletion from the Price, Green or Colorado rivers. As such, no incidental take is authorized.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

A. Conservation Recommendations for Willow Flycatcher subspecies.

As previously stated the Service has not included the endangered subspecies southwestern willow flycatcher (*Empidonax traillii extimus*) in this Opinion. However, further analysis may

determine that the willow flycatcher population affected by the proposed Narrows Project is *E. t. extimus* or some significant intercross gradation between *E. t. extimus* and *E. t. adastus* (a non-endangered subspecies of willow flycatcher) in which case Reclamation may need to reinitiate formal consultation. Because proposed Project impacts on riparian vegetation cannot be anticipated, and considering the unknown information regarding the status of the flycatcher population in the project area, the following conservation actions are recommended to provide a basis for determining impacts of the project and developing mitigation strategies for riparian vegetation and willow flycatcher subspecies.

1) Develop and implement, in coordination with us and the UDWR: a) a monitoring plan for willow flycatcher subspecies in the proposed Project area, surrounding drainages and mitigation sites; and b) a habitat analysis plan of current and potential willow habitat for the project area, surrounding drainages and mitigation sites.

    A) Develop and implement, in coordination with us and UDWR, a monitoring plan that estimates willow flycatcher subspecies populations and habitat availability.

        A qualified biologist with appropriate training and permits should conduct willow flycatcher surveys following the most recent protocol within the project area, surrounding drainages, and mitigation sites for breeding flycatchers, territories, nest locations, and habitat availability.

        Establish a database for the Narrows Project area and surrounding area and update the database annually.

        Determine pre-project willow flycatcher population levels that will help to detect any post-project changes in populations and willow habitat.

        Maintain records for each nest site or territory habitat patch, the location, size, structure, vegetative species composition, hydrology, and vulnerability to erosion.

        Record the use of newly established willow habitats developed as a result of the proposed Project for nesting and report this information to us and UDWR.

    B) Develop and implement, in coordination with us and UDWR, a habitat analysis plan of riparian habitats that includes specific monitoring of suitable nesting habitat. In general, the habitat analysis plan should be designed to detect changes in suitable nesting habitat quantity and quality. The level of detail of suitable nesting habitat monitoring should be commensurate with the population of willow flycatchers determined by initial surveys.

The habitat analysis plan should include an initial inventory of pre-project suitable nesting habitat patches and post-construction monitoring of suitable nesting habitat patches, both pre-project and newly established.

Information that should be collected includes location, size, structure, vegetative species composition, and hydrology of pre-project and established habitat patches. Changes in these characteristics should also be monitored.

Hydrology analysis should determine the importance of spring run-off, inundation frequency, inundation intervals, groundwater influences, beaver activity, and standing water to the willow regeneration process and willow habitat.

2) Develop and implement, in coordination with us and the UDWR, a contingency plan for full replacement of willow habitat suitable for nesting if monitoring reveals that habitat is being impacted or full replacement of this habitat is not occurring at mitigation sites.

    A) Develop and implement, in coordination with us and the UDWR, a technically and economically feasible contingency plan to replace willow habitat and reduce delays in establishing lost habitat later if it becomes necessary to do so.

3) Project mitigation measures for lost sport fish included 300 AF of water that could be used for stream flow maintenance. Develop and implement, in coordination with us and the UDWR, a hydrology plan that includes the 300 AF of sport fish mitigation water to be used in conjunction with natural spring flows to support riparian habitat suitable for willow flycatcher subspecies.

    A) Develop and implement, in coordination with us and the UDWR, a hydrology plan that includes the 300 AF of sport fish mitigation water to be used in conjunction with natural spring flows to support potential riparian or willow habitat. The plan should include measures to store and use this water approximately every four or five years or in conjunction with wet year flows to increase the spring peak flows to inundate more riparian habitat to help regeneration of willows.

4) Coordinate on a regular basis with us on willow flycatcher subspecies plans, monitoring, and study results.

    A) Annual reports for Terms and Conditions 1 - 3 listed above should be submitted to the Service detailing monitoring and study results. Impacts of the project and future measures that would be needed to avoid or reduce impacts to the willow flycatcher should be determined and monitored.

5) A qualified biologist with southwestern willow flycatcher survey certification should conduct nest monitoring to determine nest success and presence of cowbird parasitism.

6) If Reclamation documents cowbird parasitism higher than 50 percent on willow flycatchers, it will initiate a cowbird trapping program within the immediate nesting area. Cowbird trapping will be conducted until the larger issues of cowbird presence (i.e., local foraging sites and concentration areas) are identified and addressed.

7) Reclamation should evaluate livestock concentration sites within and adjacent to the project area that may act as likely foraging sources of cowbirds. Once these sources have been identified, Reclamation should work to eliminate or manage these sites administratively to limit their benefits to cowbirds.

REINITIATION NOTICE

This concludes formal consultation of the action outlined in the Draft Environmental Impact Statement, biological assessment, three amended biological assessments, Price River Cumulative Hydrology Study, and the accompanying request for formal consultation. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action specifically if new information indicates that the subspecies of willow flycatcher present near the proposed Project site is the endangered southwestern willow flycatcher subspecies. In instances where the amount or extent of incidental take is exceeded, any operations causing such take use cease pending reinitiation.

We appreciate the assistance and cooperation of your staff throughout this consultation process and your interest in conserving threatened and endangered species. If you have any questions regarding this biological opinion or would like to discuss it in more detail, please call Reed Harris, Field Supervisor, Utah Ecological Services Field Office, at 801-524-5001.

Sincerely,

Ralph O. Morgenweck

Regional Director

LITERATURE CITED

Archer, D.L., and H.M. Tyus. 1984. Colorado squawfish spawning study, Yampa River. U.S. Fish and Wildlife Service, Salt Lake City, Utah. 32 pp.

Archer, D.L., H.M. Tyus, and L.R. Kaeding. 1986. Colorado River fishes monitoring project, final report. U.S. Fish and Wildlife Service, Colorado River Fishery Project, Lakewood. 64 pp.

Banks, J. L. 1964. Fish species distribution in Dinosaur National Monument during 1961 and 1962. Master's Thesis. Colorado State University, Fort Collins.

Baxter, G. T., and J. R. Simon. 1970. Wyoming fishes. Bulletin 4, Wyoming Game and Fish Department, Cheyenne.

Behle, W.H. 1985. Utah birds: geographic distribution and systematics. Utah Museum of Natural History Occasional Paper, 5:1-147.

Behnke, R.J., and D.E. Benson. 1983. Endangered and threatened fishes of the Upper Colorado River Basin. Ext. Serv. Bull. 503A, Colorado State University, Fort Collins. 38 pp.

Bestgen, K. R. 1996. Growth, survival, and starvation resistance of Colorado squawfish larvae. Environmental Biology of Fishes 46:197–209.

Bestgen, K.R. 1990. Status Review of the Razorback Sucker, Xyrauchen texanus. Larval Fish Laboratory #44. Colorado State University, Ft. Collins.

Bestgen, K. R., D. W. Beyers, G. B. Haines, and J. A. Rice. 1997. Recruitment models for Colorado squawfish: tools for evaluating relative importance of natural and managed processes. Final Report of Colorado State University Larval Fish Laboratory to U.S. National Park Service Cooperative Parks Study Unit and U.S. Geological Survey Midcontinent Ecological Science Center, Fort Collins, Colorado.

Bestgen, K. R., and L. W. Crist. 1998. Restoration potential of the fish community of the Green River upstream of the Yampa River. Draft Report of Colorado State University Larval Fish Laboratory to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Bestgen, K. R., R. T. Muth, and M. A. Trammell. 1998. Downstream transport of Colorado squawfish larvae in the Green River drainage: temporal and spatial variation in abundance and relationships with juvenile recruitment. Final Report of Colorado State University Larval Fish Laboratory to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Bestgen, K. R., and M. A. Williams. 1994. Effects of fluctuating and constant temperatures on early development and survival of Colorado squawfish. Transactions of the American Fisheries Society 123:574–579.

Bozek, M. A., L. J. Paulson, and G. R. Wilde. 1990. Effects of ambient Lake Mohave temperatures on development, oxygen consumption, and hatching success of the razorback sucker. Environmental Biology of Fishes 27:255–263.

Bozek, M. A., L. J. Paulson, G. R. Wilde, and J. E. Deacon. 1991. Spawning season of the razorback sucker, *Xyrauchen texanus* in Lake Mohave, Arizona and Nevada. Journal of Freshwater Ecology 6:61–73.

Brouder, M. J., and T. L. Hoffnagle. 1997. Distribution and prevalence of the Asian tapeworm, *Bothriocephalus acheilognathi*, in the Colorado River and tributaries, Grand Canyon, Arizona, including two new host records. Journal of Helminthological Society of Washington 64:219–226.

Bulkley, R. V., C. R. Berry, R. Pimental, and T. Black. 1982. Tolerance and preferences of Colorado River endangered fishes to selected habitat parameters. Pages 185–241 *in* Colorado River Fishery Project, Final Report, Part 3. U.S. Fish and Wildlife Service and Bureau of Reclamation, Salt Lake City, Utah. 185-241.

Burdick, B. D. 1995. Ichthyofaunal studies of the Gunnison River, Colorado, 1992–1994. Final Report of U. S. Fish and Wildlife Service, Grand Junction, Colorado, to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Burdick, B.D. 1997. Minimum flow recommendations for passage of Colorado squawfish and razorback sucker in the Lower Gunnison River: Redlands Diversion Dam to the Colorado confluence. Final Report prepared for the Recovery Implementation Program for Endangered Fishes in the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Colorado River Fishery Project. Grand Junction, Colorado. 39pp + appendices.

Bureau of Reclamation. 1998. Price river cumulative hydrology study. Unpublished Report. Provo, Utah.

Carlson, C.A. and R.T. Muth. 1989. Colorado River: lifeline of the American southwest. Canadian Special Publication of Fisheries and Aquatic Sciences. 106:202-239.

Cavalli, PA. 1999. Fish community investigations in the lower Price River, 1996-1997. Final Report prepared for the Recovery Implementation Program for Endangered Fishes in the Upper Colorado River Basin. Project No. 78.

Chart, T. E., and L. D. Lentsch. 1999a. Flow effects on humpback chub *Gila cypha* populations in Westwater Canyon. Draft Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Chart, T. E., and L. D. Lentsch. 1999b. Reproduction and recruitment of *Gila* Spp. and Colorado pikeminnow (*Ptychocheilus lucius*) in the middle Green River 1992–1996. Report C *in* Flaming Gorge Studies: Reproduction and Recruitment of *Gila* spp. and Colorado Pikeminnow (*Ptychocheilus lucius*) in the Middle Green River. Draft Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Clarkson, R. W., A. T. Robinson, and T. L. Hoffnagle. 1997. Asian tapeworm (*Bothriocephalus acheilognathi*) in native fishes from the Little Colorado River, Grand Canyon, Arizona. Great Basin Naturalist 57:66–69.

Converse, Y. K, C. P. Hawkins, and R. A. Valdez. 1998a. Habitat relationships of subadult humpback chub in the Colorado River through Grand Canyon: spatial variability and implications of flow regulation. Regulated Rivers 14:267–284.

Converse, Y. K., L. D. Lentsch, and R. A. Valdez. 1998b. Evaluation of size dependent overwinter growth and mortality of age-0 Colorado squawfish. Draft Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Day, K. S., K. D. Christopherson, and C. Crosby. 1999. Backwater use by young-of-the-year chub (*Gila* sp.) and Colorado pikeminnow (*Ptychocheilus lucius*) in Desolation and Gray canyons of the Green River, Utah. Report B *in* Flaming Gorge Studies: Reproduction and Recruitment of *Gila* spp. and Colorado Pikeminnow (*Ptychocheilus lucius*) in the Middle Green River. Draft Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Dill, W. A. 1944. The fishery of the lower Colorado River. California Fish and Game 30:109–211.

Douglas, M . E., and P. C. Marsh. 1996. Population estimates/population movements of *Gila cypha*, an endangered cyprinid fish in the Grand Canyon region of Arizona. Copeia 1996:15–28.

Douglas, M. E., W. L. Minckley, and H. M. Tyus. 1989. Qualitative characters, identification of Colorado River chubs (Cyprinidae: Genus *Gila*) and the "Art of Seeing Well". Copeia 1989:653–662.

Dowling, T. E., and B. D. DeMarais. 1993. Evolutionary significance of introgressive hybridization in cyprinid fishes. Nature 1993:444–446.

Ellis, N.M. 1914. Fishes of Colorado. University of Colorado Studies. Vol. 11(1).

Evermann, B. W., and C. Rutter. 1895. The fishes of the Colorado Basin. U.S. Fish Commission Bulletin 14(1894):473–486.

Gilbert, C. H., and N. B. Scofield. 1898. Notes on a collection of fishes from the Colorado Basin in Arizona. Proceedings of the U.S. National Museum 20:181–192.

Gilpin, M. 1993. A population viability analysis of the Colorado squawfish from the upper Colorado River Basin. Report of University of San Diego, Department of Biology, to U.S. Fish and Wildlife Service, Denver.

Gutermuth, F.B., L.D. Lentsch and K.R. Bestgen. 1994. Collection of age-0 razorback suckers (Xyrauchen texanus) in the lower Green River, Utah. Southwestern Naturalist 39:389-391.

Haines, G. B. 1995. Effects of temperature on hatching success and growth of razorback sucker and flannelmouth sucker. Final Report of U.S. Fish and Wildlife Service, Vernal, Utah, to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Haines, G. B., D. W. Beyers, and T. Modde. 1998. Estimation of winter survival, movement, and dispersal of young Colorado squawfish in the Green River, Utah. Final Report of U.S. Fish and Wildlife Service, Vernal, Utah, to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Hamilton, S. J., and B. Waddell. 1994. Selenium in eggs and milt of razorback sucker (*Xyrauchen texanus*) in the middle Green River, Utah. Archives of Environmental Contamination and Toxicology 27:195–201.

Hamman, R. L. 1981. Spawning and culture of Colorado squawfish in raceways. Progressive Fish-Culturist 43:173–177.

Hamman, R. L. 1982. Spawning and culture of humpback chub. Progressive Fish-Culturist 44:213–216.

Hamman, R. L. 1985. Induced spawning of hatchery-reared razorback sucker. Progressive Fish-Culturist 47:187–189.

Hamman, R. L. 1987. Survival of razorback sucker cultured in earthen ponds. Progressive Fish-Culturist 49:187–189.

Hawkins, J. A., and T. P. Nesler. 1991. Nonnative fishes of the upper Colorado River basin: an issue paper. Final Report of Colorado State University Larval Fish Laboratory and Colorado Division of Wildlife to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Hardy, H. 1964. A cabin on the Price River. True West. November-December 1964. Pp 26-27, 40,44,46.

Haynes, C. M., T. A. Lytle, E. J. Wick, and R. T. Muth. 1984. Larval Colorado squawfish (*Ptychocheilus lucius*) in the upper Colorado River basin, Colorado, 1979–1981. Southwestern Naturalist 29:21–33.

Haynes, C.M., R.T. Muth, and T.P. Nesler. 1985. Identification of habitat requirements and limiting factors for Colorado squawfish and humpback chub. Final Report, Federal Aid in Fish and Wildlife Restoration, Project SE-3-4. Colorado Division of Wildlife, Denver. 62 pp.

Hendrickson, D. A. 1993. Progress report on a study of the utility of data obtainable from otoliths to management of humpback chub (*Gila cypha*) in the Grand Canyon. Arizona Game and Fish Department, Phoenix.

Holden, P. B. 1991. Ghosts of the Green River: Impacts of Green River poisoning on management of native fishes. Pages 43–54 *in* W. L. Minckley and J. E. Deacon, editors. Battle against extinction: native fish management in the American Southwest. University of Arizona Press, Tucson.

Holden, P. B., and L. W. Crist. 1981. Documentation of changes in the macroinvertebrate and fish populations in the Green River due to inlet modification of Flaming Gorge Dam. Final Report PR-16-5 of BIO/WEST, Inc., Logan, Utah.

Holden, P. B., and C. B. Stalnaker. 1975a. Distribution and abundance of fishes in the middle and upper Colorado River basins, 1967–1973. Transactions of the American Fisheries Society 104:217–231.

Holden, P. B., and C. B. Stalnaker. 1975b. Distribution of fishes in the Dolores and Yampa River systems of the upper Colorado River basin. The Southwestern Naturalist 19:403–412.

Horn, M. J. 1996. Nutritional limitation of recruitment in the razorback sucker (*Xyrauchen texanus*). Doctoral Dissertation. Arizona State University, Tempe.

Hubbs, C. L., and R. R. Miller. 1953. Hybridization in nature between the fish genera *Catostomus* and *Xyrauchen*. Papers of the Michigan Academy of Sciences, Arts, and Letters 38:207–233.

Irving, D., and T. Modde. In press. Home-range fidelity and use of historical habitat by adult Colorado squawfish *(Ptychocheilus lucius)* in the White River, Colorado and Utah. Great Basin Naturalist.

Jordan, D.S. 1891. Report of exploration in Colorado and Utah during the summer of 1889, with an account of the fishes found in each or the rivers examined. U.S. Fish Commission Bulletin 9(1889):1-40.

Jordan, D. S., and B. W. Evermann. 1896. The fishes of North and Middle America. Bulletin of the U.S. National Museum 47(1):1–1240.

Joseph, T.W., J.A. Sinning, R.J. Behnke, and P.B. Holden. 1977. An evaluation of the status, life history, and habitat requirements of endangered and threatened fishes of the upper Colorado River system. U.S. Fish and Wildlife Service, Office of Biological Services, Fort Collins, Colorado. 183 pp.

Kaeding, L.R., B.D. Burdick, P.A. Schrader, and W.R. Noonan. 1986. Recent capture of a bonytail (Gila elegans) and observations on this nearly extinct cyprinid from the Colorado River. Coopeia 1986(4):1021-1023.

Kaeding, L. R., B. D. Burdock, P. A. Schrader, and C. W. McAda. 1990. Temporal and spatial relations between the spawning of humpback chub and roundtail chub in the upper Colorado River. Transactions of the American Fisheries Society 119:135–144.

Kaeding L. R., and M. A. Zimmerman. 1983. Life history and ecology of the humpback chub in the Little Colorado and Colorado rivers of the Grand Canyon. Transactions of the American Fisheries Society 112:577–594.

Karp, C. A., and H. M. Tyus. 1990a. Behavioral interactions between young Colorado squawfish and six fish species. Copeia 1990:25–34.

Karp, C. A., and H. M. Tyus. 1990b. Humpback chub (*Gila cypha*) in the Yampa and Green Rivers, Dinosaur National Monument, with observations on roundtail chub (*G. robusta*) and other sympatric fishes. Great Basin Naturalist 50:257–264.

Kidd, G. 1977. An investigation of endangered and threatened fish species in upper Colorado River as related to Bureau of Reclamation Projects. Final Report, Bureau of Reclamation, Salt Lake City, Utah. 36 pp.

Kirsch, P. H. 1888. Notes on a collection of fishes obtained in the Gila River at Fort Thomas, Arizona, Lieut. W. L. Carpenter, U.S. Army. Proceedings of the U.S. National Museum 11:555–558.

Koster, W. J. 1960. *Ptychocheilus lucius* (Cyprinidae) in the San Juan River, New Mexico. Southwestern Naturalist 5:174–175.

Kubly, D. M. 1990. The endangered humpback chub *Gila cypha* in Arizona: a review of past and suggestions for future research. Arizona Game and Fish Department, Phoenix.

Langhorst, D. R., and P. C. Marsh. 1986. Early life history of razorback sucker in Lake Mohave. Final Report of Arizona State University to U.S. Bureau of Reclamation, Tempe, Arizona.

Lanigan, S.H., and H.M. Tyus. 1989. Population size and status of the razorback sucker in the Green River basin, Utah and Colorado. North American Journal of Fisheries Management 9:68-73.

Lechleitner, R. A. 1992. Literature review of the thermal requirements and tolerances of organisms below Glen Canyon Dam. Draft Report submitted to Glen Canyon Environmental Studies, Bureau of Reclamation, Flagstaff, Arizona.

Lentsch, L. D., Y. K. Converse, P.D. Thompson, T. A. Crowl and C. A. Toline. 1996a. Bonytail Reintroduction Plan for the Upper Colorado River Basin. Utah Division of Wildlife Resources Publication number 96-8. Salt Lake City, UT. pp.46.

Lentsch, L. D., T. A. Crowl, P. Nelson, and T. Modde. 1996b. Levee removal strategic plan. Utah State Division of Wildlife Resources Publication 96-6, Salt Lake City.

Lentsch, L. D., R. T. Muth, P. D. Thompson, B. G. Hoskins, and T. A. Crowl. 1996c. Options for selective control of nonnative fishes in the upper Colorado River basin. Utah State Division of Wildlife Resources Publication 96-14, Salt Lake City.

Mabey, L. W., and D. K. Shiozawa. 1993. Planktonic and benthic microcrustaceans from flood plain and river habitats of the Ouray Refuge on the Green River, Utah. Department of Zoology, Brigham Young University, Provo, Utah.

Maddux, H. R., L. A. Fitzpatrick, and W. R. Noonan. 1993. Colorado River endangered fishes critical habitat biological support document. U.S. Fish and Wildlife Service Utah/Colorado Field Office, Salt Lake City, Utah.

Marsh, P. C. 1985. Effect of incubation temperature on survival of embryos of native Colorado River fishes. Southwestern Naturalist 30:129–140.

Marsh, P. C. 1987. Food of adult razorback sucker in Lake Mohave, Arizona-Nevada. Transactions of the American Fisheries Society 116:117–119.

Marsh, P. C. 1994. Abundance, movements, and status of adult razorback sucker, *Xyrauchen texanus* in Lake Mohave, Arizona and Nevada. Proceedings of the Desert Fishes Council 25:35.

Marsh, P. C., and D. R. Langhorst. 1988. Feeding and fate of wild larval razorback sucker. Environmental Biology of Fishes 21:59–67.

Marsh, P.C., and W.L. Minckley. 1989. Observations on recruitment and ecology of razorback sucker: lower Colorado River, Arizona-California. Great Basin Naturalist 49(1):71-78.

McAda, C.W., C. Philips, C. R. Berry and R. S. Wydoski. 1977. A survey of threatened and endangered fish in southeastern Utah streams. A study funded by Utah Division of Wildlife Resources, Salt Lake City, Contract 77-8236. 245pp.

McAda, C.W. 1987. Status of the razorback sucker Xyrauchen texanus in the Colorado River upstream from Lake Powell. Proceedings of the Desert Fishes Council 17(1985):185.

McCarthy, C.W., and W.L. Minckley. 1987. Age estimation for razorback sucker (Pisces: Catostomidae) from Lake Mohave, Arizona and Nevada. Journal Arizona-Nevada Academy of Science 21:87-97.

McAda, C.W. and L.R. Kaeding. 1991. Movements of adults Colorado squawfish during the spawning season in the Upper Colorado River. Transactions of the American Fisheries Society 120:1339-1345.

McAda, C. W., J. W. Bates, J. S. Cranney, T. E. Chart, W. R. Elmblad, and T. P. Nessler. 1994a. Interagency Standardized Monitoring Program: summary of results, 1986–1992. Final Report, Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado

McAda, C. W., J. W. Bates, J. S. Cranney, T. E. Chart, M. A. Trammell, and W. R. Elmblad. 1994b. Interagency Standardized Monitoring Program: summary of results, 1993. Annual Report, Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

McAda, C. W., T. E. Chart, M. A. Trammell, K. S. Day, P. A. Cavalli, and W. R. Elmblad. 1996. Interagency Standardized Monitoring Program: summary of results, 1995. Annual Report, Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

McAda, C. W., W. R. Elmblad, T. E. Chart, K. S. Day, and M. A. Trammell. 1995. Interagency Standardized Monitoring Program: summary of results, 1994. Annual Report, Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

McAda, C. W., W. R. Elmblad, K. S. Day, M. A. Trammell, and T. E. Chart. 1997. Interagency Standardized Monitoring Program: summary of results, 1996. Final Report, Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

McAda, C.W., and R.S. Wydoski. 1980. The razorback sucker, Xyrauchen texanus, in the upper Colorado River basin, 1974-76. U.S. Fish and Wildlife Service Technical Paper 99. 50 pp.

Medel-Ulmer, L. 1983. Movement and reproduction of the razorback sucker (*Xyrauchen texanus*) inhabiting Senator Wash Reservoir, Imperial County, California. Proceedings of the Desert Fishes Council 12:106.

Milhous, R.T. 1982. Effect of sediment transport and flow regulation on the ecology of gravel-bed rivers. In Hey, R.D., J.C. Bathwist, and C.R. Thorne, eds. Gravel-bed rivers. John Wiley and Sons, New York.

Miller, R. R. 1946. *Gila cypha*, a remarkable new species of cyprinid fish from the Colorado River in Grand Canyon, Arizona. Journal of the Washington Academy of Science 36:409–415.

Miller, R. R. 1955. Fish remains from archaeological sites in the lower Colorado River basin, Arizona. Papers of the Michigan Academy of Science, Arts and Letters 40:125–126.

Miller, R.R. 1961. Man and the changing fish fauna of the American southwest. Papers of the Michigan Academy of Science, Arts, and Letters. 46:365-404.

Miller, W.H., D.L. Archer, J. Valentine, H.M. Tyus, R.A. Valdez, and L.R. Kaeding. 1982. Colorado River Fishery Project Final Report Summary. U.S. Fish and Wildlife Service, Salt Lake City, Utah. 42 pp.

Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix.

Minckley, W.L. 1983. Status of the razorback sucker, Xyrauchen texanus (Abbott), in the lower Colorado River basin. Southwestern Naturalist 28(2):165-187.

Minckley, W. L. 1991. Native Fishes of the Grand Canyon: an obituary? *In* Colorado River Ecology and Dam Management. Proceedings of Symposium, May 24–25, 1990, Sante Fe, New Mexico. National Academy Press, Washington, DC.

Minckley, W. L., and J. E. Deacon. 1968. Southwestern fishes and the enigma of "endangered species". Science 159:1424–1433.

Minckley, W. L., D. A. Hendrickson, and C. E. Bond. 1986. Geography of western North America freshwater fishes: description and relationships to intracontinental tectonism. Pages

519–613 *in* C. H. Hocutt and E. O. Wiley, editors. The zoogeography of North American freshwater fishes. Wiley-Interscience, New York.

Minckley, W.L., P.C. Marsh, J.E. Brooks, J.E. Johnson, and B.L. Jensen. 1991. Management toward recovery of the razorback sucker. Pages 305-357, *In*: W.L. Minckley and J.E. Deacon (editors). Battle against extinction: native fish management in the American southwest. University of Arizona Press. Tucson, AZ. 517 pp.

Modde, T. 1996. Juvenile razorback sucker (*Xyrauchen texanus*) in a managed wetland adjacent to the Green River. Great Basin Naturalist 56:375–376.

Modde, T. 1997. Fish use of Old Charley Wash: an assessment of flood plain wetland importance to razorback sucker management and recovery. Final Report of U.S. Fish and Wildlife Service, Vernal, Utah, to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Modde, T., K.P. Burnham, and E.J. Wick. 1996. Population status of the razorback sucker in the middle Green River (U.S.A.). Conservation Biology 10(1):110-119.

Modde, T., and D. B. Irving. 1998. Use of multiple spawning sites and seasonal movements by razorback suckers in the middle Green River, Utah. North American Journal of Fisheries Management 18:318–326.

Modde, T., A. T. Scholz, J. H. Williamson, G. B. Haines, B. D. Burdick, and F. K. Pfeifer. 1995. An augmentation plan for razorback sucker in the upper Colorado River basin. American Fisheries Society Symposium 15:102–111.

Modde, T., and E. J. Wick. 1997. Investigations of razorback sucker distribution, movements and habitats used during spring in the Green River, Utah. Final Report of U.S. Fish and Wildlife Service, Vernal, Utah, to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Mueller, G. 1989. Observations of spawning razorback sucker (*Xyrauchen texanus*) utilizing riverine habitat in the lower Colorado River, Arizona-Nevada. Southwestern Naturalist 34: 147–149.

Mueller, G. 1995. A program for maintaining the razorback sucker in Lake Mohave. American Fisheries Society Symposium 15:127–135.

Muth, R.T., G.B. Haines, S.M. Meismer, E.J. Wick, T.E. Chart, D.E. Snyder and J.M. Bundy. 1998. Introduction and early life history of razorback sucker in the Green River, Utah and Colorado, 1992-1996. Colorado State University Larval Fish Laboratory Draft Report to

Recovery Implementation Program for the Endangered Fish Species in the Upper Colorado River Basin.

Muth, R. T., and D. E. Snyder. 1995. Diets of young Colorado squawfish and other small fish in backwaters of the Green River, Colorado and Utah. Great Basin Naturalist 55:95-104.

Muth, R. T., and E. J. Wick. 1997. Field studies on larval razorback sucker in Canyonlands National Park and Glen Canyon National Recreation Area, 1993–1995. Final Report of Colorado State University Larval Fish Laboratory to U.S. National Park Service Rocky Mountain Region, Denver, Colorado.

Nesler, T. P., R. T. Muth, and A. F. Wasowicz. 1988. Evidence for baseline flow spikes as spawning cues for Colorado squawfish in the Yampa River, Colorado. American Fisheries Society Symposium 5:68–79.

O'Brien, J.S. 1984. Hydraulic and sediment transport investigations, Yampa River, Dinosaur National Monument. Fort Collins, Colorado. National Park Service, Water Resources Field Support Laboratory (WRFSL Report 83 (8)).

Osmundson, D. B., and K. P. Burnham. 1996. Status and trends of Colorado squawfish in the upper Colorado River. 1996. Final Report of U. S. Fish and Wildlife Service, Grand Junction, Colorado, to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Osmundson, D. B., and L. R. Kaeding. 1989a. Studies of Colorado squawfish and razorback sucker use of the "15-mile reach" of the upper Colorado River as part of conservation measures for the Green Mountain and Ruedi Reservoir water sales. Final Report of U.S. Fish and Wildlife Service Colorado River Fishery Project, Grand Junction, Colorado.

Osmundson, D. B., and L. R. Kaeding. 1989b. Colorado squawfish and razorback sucker grow-out pond studies as part of conservation measures for the Green Mountain and Ruedi Reservoir water sales. Final Report of U.S. Fish and Wildlife Service Colorado River Fishery Project, Grand Junction, Colorado.

Osmundson, D.B., and L.R. Kaeding. 1991. Flow recommendations for maintenance and enhancement of rare fish habitat in the 15-mile reach during October-June. Final Report. U.S. Fish and Wildlife Service, Grand Junction, Colorado.

Osmundson, D. B., R. J. Ryel, and T. E. Mourning. 1997. Growth and survival of Colorado squawfish in the upper Colorado River. Transaction of the American Fisheries Society 126:687–698.

Osmundson, D. B., R. J. Ryel, M. E. Tucker, B. D. Burdick, W. R. Elmblad, and T. E. Chart. 1998. Dispersal patterns of subadult and adult Colorado squawfish in the upper Colorado River. Transactions of the American Fisheries Society 127:943–956.

Papoulias, D., and W. L. Minckley. 1990. Food limited survival of larval razorback sucker, *Xyrauchen texanus*, in the laboratory. Environmental Biology of Fishes 29:73–78.

Papoulias, D., and W. L. Minckley. 1992. Effects of food availability on survival and growth of larval razorback suckers in ponds. Transactions of the American Fisheries Society 121:340–355.

Platania, S.P. 1990. Biological summary of the 1987 to 1989 New Mexico-Utah ichthyofaunal study of the San Juan River. Unpublished report to the New Mexico Department of Game and Fish, Santa Fe, and the U.S. Bureau of Reclamation, Salt Lake City, Utah, Cooperative Agreement 7-FC-40-05060.

Platania, S. P., K. R. Bestgen, M. A. Moretti, D. L. Propst, and J. E. Brooks. 1991. Status of Colorado squawfish and razorback sucker in the San Juan River, Colorado, New Mexico, and Utah. Southwestern Naturalist 36:147–150.

Platania, S.P., and D.A. Young. 1989. A Survey of the Icthyofauna of the San Juan and Animas Rivers from Achuleta and Cedar Hill (respectively) to their Confluence at Farmington, New Mexico. Department of Biology, University of New Mexico, Albuquerque.

Paulin, K. M., C. M. Williams, and H. M. Tyus. 1989. Responses of young razorback sucker and Colorado squawfish to water flow and light intensity. Final Report of U.S. Fish and Wildlife Service Colorado River Fishery Project, Vernal, Utah.

Quarterone, F. 1993. Historical accounts of upper Colorado River basin endangered fishes. Colorado Division of Wildlife, Denver.

Robinson, A. T., R. W. Clarkson, and R. E. Forrest. 1998. Dispersal of larval fishes in a regulated river tributary. Transactions of the American Fisheries Society 127:772–786.

Rosenfeld, M. J., and J. A. Wilkinson. 1989. Biochemical genetics of the Colorado River *Gila* complex (Pisces: Cyprinidae). Southwestern Naturalist 34: 232–244.

Ruppert, J. B., R. T. Muth, and T. P. Nesler. 1993. Predation on fish larvae by adult red shiner, Yampa and Green rivers, Colorado. Southwestern Naturalist 38:397–399.

Ryden, D. W., and F. K. Pfeifer. 1998. San Juan River seven year study integration flow recommendation report: razorback sucker information. Draft Report of U.S. Fish and Wildlife Service, Grand Junction, Colorado.

Seethaler, K. 1978. Life History and Ecology of the Colorado Squawfish (Ptychocheilus lucius) in the upper Colorado River basin. Thesis, Utah State University, Logan.

Sigler, W. F., and R. R. Miller. 1963. Fishes of Utah. Utah Department of Fish and Game, Salt Lake City.

Simon, J. R. 1946. Wyoming fishes. Wyoming Game and Fish Department Bulletin 4:1–129.

Smith, G. R. 1959. Annotated checklist of fishes of Glen Canyon. Pages 195–199 *in* A. M. Woodberry, editor. Ecological studies of the flora and fauna in Glen Canyon. University of Utah Anthropological Papers.

Snyder, D. E. 1976. Terminologies for intervals of larval fish development. Pages 41–60 *in* J. Boreman, editor. Great Lakes fish egg and larvae identification, proceedings of a workshop. U.S. Fish and Wildlife Service FWS/OBS

Snyder, D. E., and R. T. Muth. 1990. Descriptions and identification of razorback, flannelmouth, white, Utah, bluehead, and mountain sucker larvae and early juveniles. Colorado Division of Wildlife, Technical Publication 38, Fort Collins.

Stanford, J.A. 1994. Instream flows to assist the recovery of endangered fishes of the Upper Colorado River Basin. Biological Report 24. National Biological Survey, Wash., D.C. 47 pp.

Taba, S. S., J. R. Murphy, and H. H. Frost. 1965. Notes on the fishes of the Colorado River near Moab, Utah. Proceedings of the Utah Academy of Science, Arts, and Letters 42(II):280–283.

Thompson, J. M., E. P. Bergersen, C. A. Carlson, and L. R. Kaeding. 1991. Role of size, condition, and lipid content in the overwinter survival of age-0 Colorado squawfish. Transaction of the American Fisheries Society 120:346–353.

Tyus, H. M. 1985. Homing behavior noted for Colorado squawfish. Copeia 1985:213–215.

Tyus, H.M. 1987. Distribution, reproduction, and habitat use of the razorback sucker in the Green River, Utah, 1979-1986. Transactions of the American Fisheries Society 116:111-116.

Tyus, H.M. 1990. Potamodromy and reproduction of Colorado squawfish (*Ptychocheilus lucius*). Trans. Amer. Fish. Soc. 119:1035-1047.

Tyus, H. M. 1991a. Ecology and management of Colorado squawfish. Pages 379–402 *in* W. L. Minckley and J. E. Deacon, editors. Battle against extinction: native fish management in the American Southwest, University of Arizona Press, Tucson.

Tyus, H. M. 1991b. Movements and habitat use of young Colorado squawfish in the Green River, Utah. Journal of Freshwater Ecology 6:43–51.

Tyus, H. M. 1998. Early records of the endangered fish *Gila cypha,* Miller, from the Yampa River of Colorado with notes on its decline. Copeia 1998:190–193.

Tyus, H. M., B. D. Burdick, R. A. Valdez, C. M. Haynes, T. A. Lytle, and C. R. Berry. 1982. Fishes of the upper Colorado River basin: Distribution, abundance and status. Pages 12–70 *in* W. H. Miller, H. M. Tyus, and C. A. Carlson, editors. Fishes of the upper Colorado River system: present and future. Western Division, American Fisheries Society, Bethesda, Maryland.

Tyus, H.M. and G.B. Haines. 1991. Distribution, habitat use, and growth of age-0 Colorado squawfish in the Green River Basin, Colorado and Utah. Trans. Amer. Fish. Soc. 120:79-89.

Tyus, H.M., and C.A. Karp. 1989. Habitat Use and Streamflow Needs of Rare and Endangered Fishes, Yampa River, Colorado. U.S. Fish and Wildlife Service, Biology Report 89(14). 27 pp.

Tyus, H. M., and C. A. Karp. 1990. Spawning and movements of razorback sucker, *Xyrauchen texanus*, in the Green River basin of Colorado and Utah. Southwestern Naturalist 35:427–433.

Tyus, H. M., and C. A. Karp. 1991. Habitat use and streamflow needs of rare and endangered fishes, Green River, Utah. U.S. Fish and Wildlife Service, Vernal, Utah.

Tyus, H. M., and C. W. McAda. 1984. Migration, movements, and habitat preferences of Colorado squawfish, *Ptychocheilus lucius*, in the Green, White, and Yampa, rivers, Colorado and Utah. Southwestern Naturalist 29:289–299.

Tyus, H. M., and W. L. Minckley. 1988. Migrating Mormon crickets, *Anabrus simplex* (Orthoptera: Tettigoniidae), as food for stream fishes. Great Basin Naturalist 48:25–30.

Tyus, H. M., and J. F. Saunders. 1996. Nonnative fishes in the upper Colorado River basin and a strategic plan for their control. Final Report of University of Colorado Center for Limnology to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

U.S. Fish and Wildlife Service. 1987. Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Denver, Colorado. 82 pp.

U.S. Fish and Wildlife Service. 1990a. Humpback chub recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.

U.S. Fish and Wildlife Service. 1990b. Bonytail chub recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.

U.S. Fish and Wildlife Service. 1993. Section 7 Consultation, Sufficient Progress, and Historic Projects Agreement and Recovery Action Plan, Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Denver, Colorado. 50 pp.

U.S. Fish and Wildlife Service. 1994. Determination of critical habitat for four endangered Colorado River fishes. Federal Register 59(54):13374–13400.

U.S. Fish and Wildlife Service. 1998. Razorback sucker *Xyrauchen texanus* recovery plan. Denver, Colorado.

Utah Fish and Game Bulletin, 1953. 'There's Gold in That Thar River', June, pg 2.

Valdez, R. A. 1990. The endangered fish of Cataract Canyon. Final Report to Bureau of Reclamation, Salt Lake City, Utah. Contract No. 6-CS-40-03980, 134-3. 94 pp. + Appendices.

Valdez, R. A., and G. C. Clemmer. 1982. Life history and prospects for recovery of the humpback and bonytail chub. Pages 109–119 *in* W. H. Miller, H.M. Tyus, and C.A. Carlson, editors. Fishes of the upper Colorado River system: present and future. Western Division, American Fisheries Society, Bethesda, Maryland.

Valdez, R. A., P. B. Holden, and T. B. Hardy. 1990. Habitat suitability index curves for humpback chub of the Upper Colorado River Basin. Rivers 1:31–42.

Valdez, R.A., P.G. Mangan, R.P. Smith, and B.C. Nilson. 1982. Upper Colorado River investigation (Rifle, Colorado to Lake Powell, Utah). U.S. Fish and Wildlife Service and Bureau of Reclamation, Final Report, Part 2, Colorado River Fishery Project, Salt Lake City, Utah.

Valdez, R.A., and W.J. Masslich. 1989. Winter habitat study of endangered fish-Green River. Wintertime movement and habitat of adult Colorado squawfish and razorback suckers. Report No. 136.2. BIO/WEST Inc., Logan, Utah. 178 pp.

Valdez, R. A., W. J. Masslich, W. Leibfried, A. Wasowicz, B. Cowdell, R. VanHaverbeke, M. Yard, T. M. Trinca, and L. I. Brown. 1992. Characterization of the life history and ecology of the humpback chub in the Grand Canyon. Annual Report TR 250-05 of BIO/WEST, Inc. (Contract No. 0-CS-40-09110) to U.S. Bureau of Reclamation, Salt Lake City, Utah.

Valdez, R. A., and R. Ryel. 1995. Life history and ecology of the humpback chub (*Gila cypha*) in the Colorado River, Grand Canyon, Arizona. Final Report. BIO/WEST, Inc., Logan, Utah.

Valdez, R. A., and R. Ryel. 1997. Life history and ecology of the humpback chub in the Colorado River in Grand Canyon, Arizona. Pages 3–31 *in* van Riper, C., III, and E.T. Deshler, editors. Proceedings of the Third Biennial Conference of Research on the Colorado Plateau. Transactions and Proceedings Series NPS/NRNAU/NRTP-97/12, National Park Service, Denver, Colorado.

Valdez, R. A., and R. D. Williams. 1993. Ichthyofauna of the Colorado and Green rivers in Canyonlands National Park, Utah. Pages 2–22 *in* P.G. Rowlands, C. van Riper III, and M.K. Sogge, editors. Proceedings of the First Biennial Conference on Research in Colorado Plateau National Parks. Transactions and Proceedings Series NPS/NRNAU/NRTP-93/10, National Park Service, Denver, Colorado.

Vanicek, C. D. 1967. Ecological studies of native Green River fishes below Flaming Gorge Dam, 1964–1966. Doctoral Dissertation. Utah State University, Logan.

Vanicek, C.D., and R.H. Kramer. 1969. Life history of the Colorado squawfish Ptychocheilus lucius and the Colorado chub Gila robusta in the Green River in Dinosaur National Monument, 1964-1966. Transactions of the American Fisheries Society 98(2):193.

Vanicek, C. D., R. H. Kramer, and D. R. Franklin. 1970. Distribution of Green River fishes in Utah and Colorado following closure of Flaming Gorge Dam. Southwestern Naturalist 14:297–315.

Wick, E. J. 1997. Physical processes and habitat critical to the endangered razorback sucker on the Green River, Utah. Doctoral Dissertation. Colorado State University, Fort Collins.

Wick, E.J. and J.A. Hawkins. 1989. Observations on the use of the Little Snake River in Colorado, by endangered Colorado squawfish and humpback chub, 1988. Larval Fish Lab., Colorado State University, Fort Collins, CO. 10 pp.

Wick, E. J., T. A. Lytle, and C. M. Haynes. 1981. Colorado squawfish and humpback chub population and habitat monitoring, 1979–1980. Endangered Wildlife Investigations, SE-3-3, Colorado Division of Wildlife, Denver, Colorado.

Wiltzius, W. J. 1978. Some factors historically affecting the distribution and abundance of fishes in the Gunnison River. Final Report of Colorado Division of Wildlife to U.S. Bureau of Reclamation.

Wolz, E. R., and D. K. Shiozawa. 1995. Soft sediment benthic macroinvertebrate communities of the Green River at the Ouray National Wildlife Refuge, Uintah County, Utah. Great Basin Naturalist 55:213–224.

Wydoski, R. S., and E. D. Wick. 1998. Ecological value of flood plain habitats to razorback suckers in the upper Colorado River basin. Final Report of U.S. Fish and Wildlife Service and U.S. National Park Service to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Table 1.1
Theoretical Virgin Flows
Price River at Woodside

	Average Year 1968		Wet Year 1984		Dry Year 1977	
Month	(cfs)	(ac-ft)	(cfs)	(ac-ft)	(cfs)	(ac-ft)
October	14.4	886	368.0	22,622	28.7	1,765
November	6.8	404	77.5	4,761	20.0	1,227
December	15.0	924	65.4	4,017	23.5	1,443
January	2.0	126	38.2	2,350	9.3	571
February	13.2	735	33.7	2,069	7.4	452
March	40.9	2,514	3.9	238	16.1	987
April	301.5	17,934	570.5	35,070	80.6	4,952
May	514.6	31,632	1,842.6	113,267	85.9	5,282
June	655.0	38,969	1,211.6	74,482	68.0	4,183
July	481.1	29,573	458.3	28,175	184.6	11,346
August	291.1	17,896	463.5	28,492	93.9	5,774
September	263.2	15,657	372.9	22,921	72.5	4,455
Annual Total (ac-ft)		157,249		338,467		42,437

Table 1.2
Environmental Baseline Flows
Price River at Woodside

	Average Year 1968		Wet Year 1984		Dry Year 1977	
Month	(cfs)	(ac-ft)	(cfs)	(ac-ft)	(cfs)	(ac-ft)
October	0.0	0	0.0	0	0.0	0
November	0.0	0	0.0	0	0.0	0
December	0.0	0	0.0	0	0.0	0
January	0.0	0	0.0	0	0.0	0
February	0.0	0	0.0	0	0.0	0
March	0.0	0	0.0	0	0.0	0
April	160.0	9,517	155.8	9,579	56.3	3,295
May	154.8	9,517	155.8	9,579	53.6	3,295
June	266.3	15,844	258.7	15,906	156.5	9,622
July	257.7	15,844	258.7	15,906	156.5	9,622
August	257.7	15,844	258.7	15,906	156.5	9,622
September	266.3	15,844	258.7	15,906	156.5	9,622
Annual Total (ac-ft)		82,412		82,782		45,080

Table 1.3*

Average Monthly Flows with Narrows Project
Price River at Woodside

	Average Year 1968		Wet Year 1984		Dry Year 1977	
Month	(cfs)	(ac-ft)	(cfs)	(ac-ft)	(cfs)	(ac-ft)
October	6.7	410	360.3	22,147	21.0	1,289
November	-1.2	-72	69.7	4,286	12.2	751
December	7.3	448	57.6	3,542	15.7	967
January	-5.7	-350	30.5	1,875	1.5	95
February	4.7	259	25.9	1,594	-0.4	-2.4
March	33.2	2,038	-3.9	-237	8.3	511
April	133.5	7,942	406.9	25,016	19.2	1,181
May	352.0	21,639	1,679.0	103,213	24.6	1,511
June	380.7	22,649	945.1	58,100	-96.2	-5,915
July	215.6	13,253	191.8	11,793	20.3	1,248
August	25.6	1,576	197.0	12,110	-70.3	-4,324
September	-11.1	-663	106.4	6,539	-91.8	-5,643
Annual Total (ac-ft)		69,128		249,976		-8,352

Table 1.4
Average Monthly Flows without Narrows Project
Price River at Woodside

	Average Year 1968		Wet Year 1984		Dry Year 1977	
Month	(cfs)	(ac-ft)	(cfs)	(ac-ft)	(cfs)	(ac-ft)
October	14.4	886	368.0	22,622	28.7	1,765
November	6.8	404	77.5	4,761	20.0	1,227
December	15.0	924	65.4	4,017	23.5	1,443
January	2.0	126	38.2	2,350	9.3	571
February	13.2	735	33.7	2,069	7.4	452
March	40.9	2,514	3.9	238	16.1	987
April	141.5	8,417	414.7	25,492	27.0	1,657
May	359.7	22,115	1,686.7	103,689	32.3	1,987
June	388.7	23,124	952.9	58,576	-88.5	-5,440
July	223.3	13,729	199.6	12,269	28.0	1,723
August	33.4	2,052	204.7	12,586	-62.6	-3,849
September	-3.1	-187	114.1	7,015	-84.1	-5,168
Annual Total (ac-ft)		74,837		255,685		2,643

*It is important to note that the depletion for the Narrows Project used in table 1.3 of the Bureau of Reclamation Price River Hydrology Report is 5,709 AF. This depletion was corrected in November 1999 to be 5,717 AF, therefore numbers in the table does not accurately reflect this new depletion estimate. (K. Schwarz, Bureau of Reclamation; personal communication)

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SANPETE WATER CONSERVANCY DISTRICT

November 11, 1999

Mr. Reed Harris
Field Supervisor, U.S. Fish
and Wildlife Service
Lincoln Plaza
145 East 1300 South, Suite 404
Salt Lake City, Utah 84115

Subject: Draft Amended Biological Opinion – Narrows Project

Dear Mr. Harris:

The Sanpete Water Conservancy District (District) has reviewed the draft, Amended Biological Opinion on the Narrows Project, as transmitted to the Bureau of Reclamation in October 1999.

The District hereby agrees to pay the $14.13 per acre-foot depletion charge (current fiscal year value) which will be used in accomplishment of the Recovery Implementation Program Recovery Action Plan for the endangered fishes of the Colorado River System. Based on the estimated 5,717 acre-foot depletion, the total depletion charge would be $80,781,21.

On July 13, 1995, the District sent a check for $7,063 to the National Fish and Wildlife Foundation to cover what was then 10 percent of the depletion charge. As soon as Reclamation approves the loan for the project, the District will send an additional $1,015.12 to bring the contribution up to 10 percent of the current depletion charge.

Sincerely,

David L. Peterson
President

cc: Mr. Bruce Barrett
Bureau of Reclamation
Attn: PRO-405
302 East 1860 South
Provo, UT 84606

Mr. Richard Noble
Franson-Noble & Associates, Inc.
776 East Utah Valley Drive
American Fork, UT 84003

NARROWS PROJECT
SUPPLEMENTAL DRAFT
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX D

FISH AND WILDLIFE
COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
UTAH FIELD OFFICE
LINCOLN PLAZA
145 EAST 1300 SOUTH, SUITE 404
SALT LAKE CITY, UTAH 84115

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August 21, 1997

MEMORANDUM

TO: Manager, Resource Management Division, Bureau of Reclamation, Upper Colorado Region, Provo Area Office, 302 East 1860 South, Provo, Utah 84606-7317

FROM: Field Supervisor, Ecological Services, Fish and Wildlife Service, Utah Field Office, 145 East 1300 South, Ste. 404, Salt Lake City, Utah 84115

SUBJECT: Formal Section 7 Consultation for the Proposed Narrows Project and Request for Updated Fish and Wildlife Coordination Act Report

On March 10, 1997, the Fish and Wildlife Service reinitiated and entered into formal Section 7 consultation on the proposed Narrows Project, a small reclamation project act loan. The 135-day consultation period expired on July 24, 1997. Due to personnel shortages and the complexities involved with this consultation, we are requesting a 60-day extension of the consultation period in accordance with 50 CFR Part 402.14(e).

The Service is currently in consultation with the Bureau of Reclamation on two projects involving water depletions in the Price River drainage. New information has revealed the presence of the endangered Colorado squawfish in the Price River. The significance of the Price River to the conservation and recovery of the Colorado squawfish has not been addressed as yet. However, it is the Services intention to evaluate the significance of the Price River and to develop a RIPRAP item for Recovery of Colorado squawfish in the Price River. This will be done as expeditiously as possible, however, a new RIPRAP item must be coordinated with the Management Committee of the Colorado River Fishes Recovery Program and will delay the Service's completion of formal Section 7 consultation on the Narrows Project.

In addition, the Service was requested to complete an updated Coordination Act Report by the 1st of June, 1997. At this time we are attempting to update this Report, however, we do not anticipate that an updated Coordination Act Report will be finalized until the issues involved with Section 7 consultation have been resolved.

United States Department of the Interior

BUREAU OF RECLAMATION
Upper Colorado Region
Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

IN REPLY REFER TO:

PRO-751
ENV-6.00

MAY 0 9 1997

Mr. Reed Harris
Ecological Services
U.S. Fish and Wildlife Service
145 East 1300 South, Suite 404
Salt Lake City UT 84115

Subject: Request for Completion of Updated Fish and Wildlife Coordination Act Report for the Narrows Project

Dear Mr. Harris:

The Bureau of Reclamation completed an Environmental Impact Statement for the proposed Narrows Project in January 1995. A Record of Decision (ROD) was signed by Reclamations' Upper Colorado Regional Director. However, the ROD was later rescinded and a notice of intent to prepare a new draft EIS was published in the Federal Register in February 1996.

A Coordination Act Report (dated October 1994) was prepared by your office, with assistance from Utah Division of Wildlife Resources, for the original EIS. The report evaluates the impacts of the proposed Narrows Project on fish and wildlife resources, and recommends appropriate mitigation in accord with the Fish and Wildlife Coordination Act and the U.S. Fish and Wildlife Service's mitigation policy.

Because it has been almost three years since the Coordination Act Report was prepared, Reclamation believes it is necessary for the Service to review and update, if needed, the 1994 report for inclusion with the revised EIS being prepared. We request that the Coordination Act Report review and update, if needed, be completed by June 1, 1997, so that it can be included with the Draft EIS. Kerry Schwartz of my staff discussed this issue with Janet Mizzi of your staff on April 30, 1997.

If you have any further questions regarding this matter, please contact Kerry Schwartz at (801) 379-1167.

Sincerely,

LEE G. BAXTER

ACTING FOR
Larry Fluharty
Manager, Resource Management Division

cc: Mr. Richard Noble
6 South 100 West
American Fork UT 84003

Mr. John Anderson
Pruitt, Gushee, and Bachtell
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Mr. David Peterson
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Mr. Bill Bates
Habitat Manager, Utah Division of Wildlife Resources
Southeastern Regional Office
455 West Railroad Avenue
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bc: Manager, Resources Management Division, Salt Lake City UT, Attention: UC-320
Field Solicitor, Salt Lake City UT, Attention: Scott Loveless

bcc: PRO-750, PRO-751, and PRO-752

GOOSEBERRY NARROWS DAM PROJECT
SANPETE COUNTY, UTAH

A FISH AND WILDLIFE COORDINATION ACT REPORT

PREPARED BY

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
UTAH FIELD OFFICE
SALT LAKE CITY, UTAH

WITH ASSISTANCE FROM

UTAH DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES
SALT LAKE CITY, UTAH
SPRINGVILLE, UTAH
PRICE, UTAH

OCTOBER, 1994

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INTRODUCTION

This Coordination Act Report has been developed in concert with the Environmental Impact Statement being prepared by the Bureau of Reclamation (Reclamation) for the proposed Narrows Dam Project (Narrows). The report evaluates the impacts of the proposed Narrows Project on fish and wildlife resources, and recommends appropriate mitigation in concert with The Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) and the U.S. Fish and Wildlife Service Mitigation Policy (Federal Register, Vol. 46, No. 15, January 23, 1981 (as modified February 4, 1981)). Endangered Species Act (16 U.S.C. 1531 as amended) requirements have been addressed in a separate Biological Opinion from the U.S. Fish and Wildlife Service (Service) to Reclamation, dated March 25, 1992. National Environmental Policy Act (NEPA) documentation is being prepared by the Sanpete Water Conservancy District (District) for Reclamation.

The Narrows project is proposed by the District. It would develop a supplemental irrigation water supply for presently irrigated lands and provide municipal water to project communities in northern Sanpete County, Utah. The project would include a transbasin diversion of 6.7×10^6 cubic meters (m^3) (5,400 acre-feet {af}) per year from the Price River (Colorado River drainage) to the San Pitch River drainage (Great Basin). The District plans to apply to Reclamation for a Small Reclamation Project Act Loan. The District also needs a 404 permit for the project from the U.S. Army Corps of Engineers (Corps).

In January of 1991 two teams of specialists from various State and Federal agencies were formed to review plans for the Narrows and assist in the identification of impacts and the development of mitigation plans. A fisheries team was formed to look at aquatic impacts and fisheries issues. This team consisted of a consultant for the District and members from the Service, Reclamation, Corps, U.S. Forest Service (USFS), and Utah Division of Wildlife Resources (UDWR). A wetlands/wildlife team was formed to evaluate impacts to wetlands and wildlife habitat. The team consisted of a consultant for the District and members from the Service, Reclamation, Corps, USFS, and UDWR. Agency representatives on both teams were not necessarily the same.

Information in this report is based on preliminary documents prepared for the District in coordination with the two teams. These include draft reports on Aquatic Ecology (Woodward - Clyde Consultants, December 1991), Vegetation and Wildlife Impacts (Mt. Nebo Scientific, February 1992), the Preliminary Draft Environmental Impact Statement (Reclamation, August 1993), and other information in Service files.

DESCRIPTION OF THE STUDY AREA

The basin which would be inundated by the proposed reservoir lies in a high elevation, shallow valley in the Wasatch Plateau. The basin, isolated by several ridges, is 2,646 meters (m) (8,680 feet {ft}) above sea level. Vegetation consists of plant communities common to high elevation mountain meadow areas, including Vasey sagebrush, Silver sagebrush, and

various wetland community types. The majority of the reservoir basin is privately owned, although the actual dam site is in the Manti-LaSal National Forest.

Historically the area has been used for livestock grazing. Cattle and sheep were introduced into the area in the late 1800's and subsequently overgrazed the area so that rangeland restoration became necessary. The USFS established a controlled grazing plan for the Manti National Forest in 1908. Sheep still graze in the area.

The Sanpete Valley, which will receive water from the proposed project, lies at an elevation of 1,676-1,890 m (5,500-6,200 ft). It is bordered on the east by the Wasatch Plateau and on the west by the San Pitch Mountains. U.S. Highway 89 extends through the project area, connecting Fairview, Mt. Pleasant, Ephraim, and Manti (the county seat) with Salt Lake City, approximately 209 kilometers (km) (130 miles {mi}) to the north (Figure 1). The estimated population of Sanpete County in 1990 was 16,259. Government, agriculture, services, manufacturing and retail trade are the leading economic sectors. Approximately 44 percent of the land in Sanpete County is in agricultural use, with 36 percent of the total agricultural land developed for crops.

DESCRIPTION OF THE PROJECT

The Narrows project is designed to bring supplemental irrigation water to the Sanpete Valley and to provide supplemental municipal water for irrigation of lawns and gardens. The District also cites the need for honoring long-standing water rights contracts and agreements, for improving water conveyance facilities, and improving recreation and fishery opportunities. The project area consists of the Sanpete Valley and the headwaters area of the Price River (Figure 2). Sanpete Valley contains approximately 68,800 hectares (ha) (170,000 acres {ac}) of land, of which 24,280 ha (60,000 ac) are currently irrigated. About 6,230 ha (15,400 ac) of currently irrigated land would be eligible to receive project water. Currently these lands experience moderate to severe late season irrigation water shortages, averaging 2.3×10^7 m^3 (19,000 af) per year. The project would provide 6.7×10^6 m^3 (5,400 af) of water per year, of which 6.07×10^6 m^3 (4,920 af) would go to irrigation and 5.9×10^5 m^3 (480 af) to municipal supplies.

The proposed action includes construction of a dam on Gooseberry Creek, a tributary of the Price River, approximately 14.5 km (9 mi) east of Fairview, Utah. The proposed dam would be a zoned earthfill embankment, 37 m (120 ft) high, with a crest length of 168 m (550 ft) and a crest width of 9 m (30 ft). The dam would have 3:1 horizontal to vertical slopes upstream and downstream. The dam would impound a reservoir with a capacity of 2.1×10^7 m^3 (17,000 af), with 1.8×10^7 m^3 (14,500 af) of active storage and 3.1×10^6 m^3 (2,500 af) of dead storage. The maximum reservoir surface area is approximately 244 ha (604 ac). At an average water surface during the recreation season (June through September) the reservoir would cover 184 ha (454 ac). The water surface will fluctuate an average of about 3.7 m (12 ft) vertically each year, with a maximum fluctuation of 5.5 m (18 ft) per year.

An alternative, smaller reservoir, would consist of a dam at the same location that would be 30.5 m (100 ft) high, with a crest length of 129.5 m (425 ft) and a crest width of 9 m (30 ft). The impounded smaller reservoir would have a capacity of 9.7×10^6 m^3 (7,900 af), with 6.7×10^6 m^3 (5,400 af) of active storage and 3.1×10^6 m^3 (2,500 af) of dead storage. The maximum reservoir surface area would be 146 ha (362 ac), with an average of 96.3 ha (238 ac) during the recreation season. The water surface would fluctuate an average of 4.9 m (16 ft) vertically per year, with a maximum fluctuation of 6.7 m (22 ft) per year.

An existing tunnel, which currently conveys water from Fairview Lakes into Cottonwood Creek, would be rehabilitated to carry releases from Narrows Reservoir into Cottonwood Creek. The water would be carried in a pipeline for the upper 1.3 km (0.8 mi) of Cottonwood Creek to prevent degradation of the stream channel. At the mouth of Fairview Canyon some of the flow would be diverted into two pipelines, which would convey project water north to Oak Creek and south to Spring City (Figure 2). Project water would also be diverted into Cottonwood-Gooseberry Irrigation Company's existing pressurized irrigation system for use in the Fairview area. The remainder of the project water would flow into the San Pitch River where it could be diverted into existing canals and ditches. A stream-level emergency outlet would also be constructed through the dam to provide downstream releases into Gooseberry Creek for fisheries and emergency evacuation of the reservoir.

The Narrows Reservoir would inundate about 1.3 km (0.8 mi) of the Skyline Coal Mine Road, which provides access between Fairview and Scofield. Under the project, 4.2 km (2.6 mi) of new road would be constructed across the Narrows Dam. Asphalt surfacing would also occur on 0.5 km (0.3 mi) of existing gravel road to Lower Gooseberry Reservoir.

The District studied several other alternatives to meet project needs, but found them to be nonviable. These included using an alternative dam site, providing year-round releases from the new reservoir, additional groundwater development within Sanpete County, using Central Utah Project water, and direct diversion without a reservoir. The District was hampered by the fact that a 1984 water rights settlement agreement dictates the dam location and storage capacity and because the State Engineer has closed the Sanpete Valley to further ground water development due to downstream water rights interests. Other alternatives were eliminated because of economics, including construction of a storage reservoir in the Sanpete Valley and developing a conveyance system to deliver Central Utah Project water to the area.

On-farm conservation measures, including improved irrigation methods such as canal lining, sprinklers, and gated pipe will be required for participants to be eligible for project water. For the most part, due to existing irrigation water shortages, these measures have already been implemented. Without these conservation measures, the supplemental irrigation demand would be 2.8×10^7 m^3 (23,000 af) per year, versus the 1.5×10^7 m^3 (12,300 af) per year that the project is based on.

EVALUATION METHODOLOGY

Terrestrial Resources

Evaluation of terrestrial resources included baseline vegetation mapping and identification of plant and animal species occurring in the potentially affected area. A "Habitat Evaluation Procedures" (HEP) analysis was then used to assess pre-project conditions and impacts to wildlife and their habitats from project development.

Vegetation mapping was achieved by using aerial photography and contour maps on the ground. Plant species lists were compiled from previous reports and verified by District employees on the ground. Wildlife species lists were generated by UDWR, then verified by the District through field observation and animal live-trapping studies.

Use of HEP analysis was chosen by the Wetlands and Wildlife Team biologists as the best tool to quantify project impacts to wetlands, wildlife and their habitats. This is a process developed by the Service and is based on the assumption that habitat quality and quantity can be numerically described on a nonmonetary basis (USFWS, 1980). This species-habitat approach to impact assessment uses selected species as indicators to evaluate habitat for a representative group of species. It is assumed that impacts to indicator species represent impacts to the broader groups as functioning ecosystem units. The HEP process evaluates habitat quality for the selected species and allows for the development of Habitat Suitability Indices (HSI). These indices range from 0.0 to 1.0, with the values being related linearly to the habitat carrying capacity for the species. An HSI value of 1.0 represents optimum habitat for the species, while 0.0 represents unsuitable habitat. Comparison of pre- and post-project HSI values allows for a quantitative determination of impacts to the evaluation species and the groups they represent.

The Wetlands and Wildlife Team determined the species to be evaluated based on the habitat types and wildlife species lists prepared by the District. An attempt was made to identify species which were important or common to the impacted areas. These species were then put into feeding and reproductive guilds, and representative species for which HSI models were available were chosen from these guilds for evaluation. The guilds used are shown in Tables 1 and 2, with chosen indicator species bolded. Indicator species chosen were the montane vole (Microtus montanus)(to represent the closely related Richardson's vole, Microtus richardsoni), yellow warbler (Dendroica petechia), beaver (Castor canadensis), mule deer (Odocoileus hemionus), and Brewer's sparrow (Spizella breweri). It should be noted that, while the mule deer was considered an important species, application of the mule deer model in this situation was not totally appropriate since it is primarily based on winter habitat variables, whereas the reservoir basin is primarily used as summer habitat. Therefore the Brewer's sparrow model was used to evaluate habitat used by mule deer.

District personnel collected data, including quantitative and qualitative habitat variables, and analyzed the HSI models to determine HSI indices. All field parameters were obtained by multiple samplings. Means and standard deviations were calculated for each parameter and an attempt was made to obtain statistically adequate samples for each parameter. Average

Annual Habitat Units were determined for each species by multiplying the determined HSI by the acreage of the cover type(s) used in the evaluation area. The models used and raw data collected are available from the Service.

Aquatic Resources

Analysis of impacts to aquatic resources included evaluating the effects of reservoir inundation, flow alterations on streams, and the effects of the project on reservoir fisheries.

Effects of reservoir inundation were evaluated by assessing the number of stream kilometers (miles) and trout biomass (kilograms {pounds}) and numbers that would be lost to direct inundation by the Narrows project. Standing crop estimates prepared by UDWR provided biomass estimates.

Flow alteration effects will include flow reductions in Middle and Lower Gooseberry and Fish Creeks and a flow increase in Cottonwood Creek. The Instream Flow Incremental Methodology (IFIM) (Bovee, 1982) was chosen by the Fisheries Team to determine the effects flow alterations would have on weighted usable area (WUA) of aquatic habitats. WUA is a measure of usable microhabitat present in a stream reach. It is determined for each life stage of each species evaluated in an analysis and is defined as the microhabitat area per unit length of stream, most often expressed as ft^2 WUA/1,000 ft stream. This procedure uses computer models which combine stream hydraulic characteristics and habitat utilization characteristics for various life stages of a species (Physical Habitat Simulation System (PHABSIM)) (Milhous et al., 1984) to predict changes in WUA with changes in flow. The UDWR used the Habitat Quality Index method to compare project impacts and project-induced mitigation improvements and to provide recommendations for mitigation for stream impacts. The number of Habitat Units present in stream segments which would be impacted by the Narrows project and those which could be used as potential mitigation sites were estimated and compared (Appendix B).

Data on stream channel characteristics was collected in the field by District representatives and Fisheries Team members and the analysis was performed by the District. Five to nine transects were taken across the stream channel at several locations in five different stream reaches (stations) which could be affected. Field measurements were compared with model predictions for calibration. Good calibration was achieved for all stations. The models used and raw data collected are available from the Service.

Reservoir fishery effects were determined by evaluating the number of angler days per year that could be affected by the Narrows project on reservoirs in the Gooseberry and Fish Creek watersheds, including the proposed reservoir.

FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

Terrestrial Resources

Vegetation in the reservoir basin area consists mainly of Vasey sagebrush (Artemisia tridentata v. vaseyana) and silver sagebrush (Artemisia cana) communities. The Vasey sagebrush is the driest plant community in the basin, existing on well-drained soils on upland slopes. Other dominant species include low rabbitbrush (Chrysothamnus viscidiflorus), snowberry (Symphoricarpos oreophilis), Pacific aster (Aster chilensis), slender wheatgrass (Elymus trachycaulus), and Letterman needlegrass (Stipa lettermanii). It encompasses approximately 134 ha (331 ac) of the basin.

The silver sagebrush community type lies downslope of the Vasey sagebrush community and comprises approximately 63.1 ha (156 ac) of the basin. The topography is generally flatter and the soils less well drained than with the Vasey sagebrush type. More mesic species, including shrubby cinquefoil (Potentilla fruticosa), Penstemon spp., orchardgrass (Dactylis glomerata), and Kentucky bluegrass (Poa pratensis) are found in this community.

The majority of the rest of the basin (40.5 ha {100 ac}) is in wetland vegetation types. These include wet meadows, riparian sedge wetlands, and willow thickets. Wet meadows are formed in topographic depressions adjacent to some of the streamside vegetation and seeps. Plant species include rushes (Juncus spp.) and sedges (Carex spp.) and grass species. Riparian sedge wetlands are similar in species and composition, including various rush, sedge, and grass species. They usually form 0.9-1.8 m-wide (3-6 ft-wide) bands of vegetation adjacent to streams. Willow thickets are less common, along stream channels in the basin and along Gooseberry and Cottonwood Creeks. Species include Drummond's (Salix drummondiana), Booth (Salix boothii) and Wolf (Salix wolfii) willows.

Approximately 6.9 ha (17 ac) in the reservoir basin have been previously disturbed by the water diversion tunnel to Cottonwood Creek, and the State road that crosses the north end of the basin.

Plant communities in the Sanpete Valley area which could be temporarily disturbed by pipeline construction include Valley sagebrush, Scrub oak, Grassland and Mountain Brush types.

Approximately 88 bird and 33 mammal species were found to utilize habitats that could be disturbed by the proposed project and adjacent areas. The reservoir basin provides summer habitat for mule deer and elk (Cervus canadensis). Elk use the aspen forests surrounding the reservoir basin for calving. The aspen forest also provides nesting habitat for a variety of passerine and raptorial birds. The linear riparian corridors are important wildlife habitats, providing nesting habitat for a variety of nongame birds, hiding cover for larger animals, and movement corridors for many species. UDWR estimates that up to 70 percent of species in Utah utilize riparian habitats, with some species being dependent on them.

The species picked for HEP analysis were chosen because they were known to use the different vegetation communities in the reservoir basin which will be affected if the project is constructed. Richardson's (meadow) vole uses wet meadow and sedge habitats, which

comprise many of the wetlands in the basin. Beaver also use this type of habitat, damming natural streams and creating additional wetlands. The yellow warbler utilizes the deciduous shrub/scrub wetland habitat. Mule deer range throughout the reservoir basin in summer using a variety of habitat types. The Brewer's sparrow which nests and forages in the sagebrush habitats was chosen as a HEP representative species for the habitat types found in the basin, including summer range for mule deer, that are not wetlands habitat. Table 3 gives acreages of the various vegetation and habitat types in the basin to be disturbed and details the habitat units (HUs) of each of the indicator species which were found to occur in the reservoir basin.

Because the land use of the reservoir basin consists primarily of some sheep grazing activities and light recreation, little change is expected to occur in the existing habitat and wildlife resources in the future without the project.

Aquatic Resources

Stream Fisheries

Stream segments in the area of the project which could be impacted include Gooseberry Creek along with its upper tributaries, Fish Creek and Cottonwood Creek (Figure 3). All three of these provide important recreational fisheries use and contain naturally reproducing game fish populations. Gooseberry and Fish Creeks have characteristics which are unique in the State. Fishery values must be maintained.

Gooseberry Creek and its tributaries are categorized by UDWR as a Class 3B-Unique stream. Class 3 streams are important from the standpoint of supporting fishing pressure, and fisheries should be considered a primary use. The B indicates that the stream provides important spawning and nursery habitat. Unique identifies streams that provide unique physical, chemical and biological values to the fishery. Gooseberry Creek has been divided into three segments (Upper, Middle, and Lower), which are 1.6, 4.8 and 11.4 km (1.0, 3.0, and 7.1 mi) in length, respectively. Three unnamed tributaries combine to form the Upper Gooseberry segment.

Upper Gooseberry Creek supports a naturally reproducing cutthroat trout (Oncorhynchus clarki) population, comprised of adult, juvenile, and young-of-the-year (YOY) fish. Numerous riffle areas provide cutthroat trout spawning habitat. UDWR estimates indicate that the standing crop of cutthroat trout in this segment averages about 42.5 kilograms (kg) per ha (38 pounds {lbs} per ac). This stream segment provides important rearing habitat for cutthroat, with over 720 fish per km (450 fish per mi) (mostly YOY) counted by UDWR. This segment provides only marginal overwinter habitat for cutthroat trout due to low winter flows and limited pool habitat.

The *Middle Gooseberry Creek* segment receives inflow from numerous springs and seeps, as well as several tributary streams. Average flows are consequently higher than in the Upper segment. This segment also supports a reproducing population of cutthroat trout.

The *Lower Gooseberry Creek* segment is downstream from the existing Lower Gooseberry Reservoir. Flow in this segment is double the flow of the Upper and Middle segments. Both cutthroat and rainbow (Oncorhynchus mykiss) trout use this segment. Rainbow trout apparently use this section for spawning a few weeks each year, while cutthroats are year-round residents. Spawning habitat for both species is not abundant in this segment, although YOY have been found to be plentiful, so this does not appear to be a limiting factor. More habitat is available for adult and juvenile trout from April through August than during the rest of the year. UDWR has found that the cutthroat standing crop averages 45- 57.5 kg per ha (40-50 lbs per ac). No estimate of standing crop for rainbows has been made, but both adults and juveniles have been collected in this stream segment.

The three *Gooseberry headwater tributaries* contain 12 stream km (7.5 stream mi). During late summer and early fall major portions of these streams have low flow or are dry. The flowing reaches have high value as cutthroat trout spawning and rearing of YOY habitat. Standing crop in these tributaries averages approximately 97.5 kg per ha (86 lbs per ac), with most being YOY or yearling fish.

Fish Creek is rated by UDWR as Class 2-Unique. Class 2 waters are of great importance to the state fishery, indicating productive streams with high aesthetic value. This segment of Fish Creek extends from the confluence with Gooseberry Creek to Scofield Reservoir. In addition to a self-reproducing cutthroat trout population, this segment also provides spawning and rearing habitat for rainbow trout that migrate upstream from Scofield Reservoir. Thus this stream segment provides habitat for adult, juvenile, spawning, and fry life stages of both species. The UDWR surveys have shown a wide range of standing crop values, with an average of almost 57.5 kg of trout per ha (50 lbs per ac).

The 16 km (10 mi) segment of *Lower Fish Creek* (sometimes considered the upper segment of the Price River) between Scofield Dam and its confluence with the White River forming the Price River, is heavily used as a fishery. It is stocked mainly with brown trout (Salmo trutta), but also contains rainbow and cutthroat trout. UDWR is working to make this stretch a blue ribbon brown trout fishery. At present, the standing crop of all trout species in this segment averages 278 kg per ha (244 lbs per ac).

Cottonwood Creek is rated Class 3B by UDWR, indicating that this segment supports natural reproduction. This segment extends from the Narrows tunnel outlet to the mouth of the canyon. Presently the upper part of the segment doesn't support a self-sustaining trout population due to low or intermittent flows during much of the year. A rainbow trout fishery is maintained by stocking catchable-sized fish during the period in which there is adequate water. Flows in the lower portion of this segment are higher year-round and support a standing crop of approximately 237 kg per ha (210 lbs per ac) of rainbow and brown trout.

Nongame fish in the upper sections of Gooseberry Creek include redside shiner (Richardsonius balteatus) and mountain sucker (Catostomus platyrhynchus). Lower Gooseberry Creek below Gooseberry Reservoir and portions of Fish Creek were poisoned in 1991 to kill nongame fish which were causing problems with the fishery in Scofield Reservoir.

Reservoir Fisheries

Reservoirs in the project vicinity are shown on Figure 3. *Lower Gooseberry Reservoir* has a surface area of approximately 109 ha (270 ac) and is managed as a catchable rainbow trout fishery. It also supports a resident cutthroat trout population. It is estimated that 25,000 trout were harvested in 1982, with 31 percent being cutthroat and the remainder rainbows. A large portion of the reservoir is shallow, which has led to problems with low dissolved oxygen (DO) concentrations and resultant fish kills. Recent steps have been taken by the USFS to improve water quality by releasing water from the bottom of the reservoir.

Fairview Lakes are owned and operated by the Cottonwood-Gooseberry Irrigation Company, with water being delivered via the Narrows Tunnel to Cottonwood Creek. The lakes are managed as a catchable rainbow trout fishery, with approximately 12,000 fish stocked every year, and 8,700 harvested. Stocked trout do not generally survive the winter due to the low level of the lakes during this period.

Scofield Reservoir has a storage capacity of 8.1×10^7 m^3 (65,800 af) and an annual surface area averaging 923 ha (2,282 ac). Approximately 9.9×10^6 m^3 (8,000 af) of the reservoir is available as a conservation pool as the reservoir cannot be further drawn down. It provides water for irrigation, culinary and industrial uses to the Price River Valley. The reservoir supports naturally reproducing cutthroat trout and natural and stocked rainbow trout. UDWR stocks approximately 600,000 3-inch rainbows into the reservoir each year. Approximately 250,000 rainbow and cutthroats were caught in 1986. The reservoir has experienced periodic fish kills resulting from low DO levels. The occurrence of fish kills is increasing due to declining water quality.

No changes in stream segment or reservoir management are predicted in the future without the project.

FISH AND WILDLIFE RESOURCES WITH THE PROJECT

Terrestrial Resources

Approximately 244 ha (604 ac) of wildlife habitat, including 40.5 wetland ha (100 ac), in the reservoir basin will be inundated by dam construction under the proposed project. Under the smaller alternative, 147 ha (363 ac) would be inundated. Also inundated will be 6.9 km (4.3 mi) (6.1 km {3.8 mi} under the smaller reservoir alternative) of linear stream channel riparian corridors. This habitat will be lost over a 2-5 year period after dam closure while

the reservoir fills. All HUs for indicator species in the reservoir basin will eventually be lost. In addition to habitat inundated by the reservoir, an additional 13 ha (32 ac) would be lost to highway relocation and recreational construction, including campground, boat ramp, picnic site, and restroom facilities.

Riparian vegetation in affected downstream segments will be impacted by the change in water regime. It could be killed by the lowering of the water table and narrowing of stream channels, or flooded by large increases in flow. Hydraulic analyses were performed on Gooseberry and Cottonwood Creeks by the District (Barnes, September 12 and 27, 1991). The maximum reduction in depth of flow for Gooseberry Creek was projected to be 0.15-0.27 m (0.5-0.9 ft), which would occur in May, during normal spring runoff. Since Gooseberry Creek is a gaining stream, the depth of the ground water table adjacent to the stream is directly linked with the water surface of the stream. In Cottonwood Creek 0.6 ha (1.5 ac) of riparian habitat, mostly willows, throughout the affected stream segments will be lost to channel widening due to higher flows. The linear riparian corridors lost to reservoir development may be replaced by wetland vegetation surrounding the reservoir which will not provide the same critical wildlife values. Due to fluctuating reservoir levels it will be hard to reestablish trees around the reservoir.

Wildlife in the area will be directly impacted by loss of habitat to the reservoir and associated activities such as roadbuilding, or indirectly impacted through increased human activities, including recreational uses such as fishing, boating and off-road vehicle use, constructing cabins and increasing traffic throughout the area. A small area of aspen (Populus tremuloides) forest will be disturbed when the road is rerouted over the new dam. Bisection of the aspen grove by the rerouted road and increased traffic through the area may cause elk to desert their calving areas. Although less than 0.4 ha (one ac) of actual disturbance to the aspen habitat is proposed, the road will divide and fragment the existing unbroken block of forest, which could create passage problems for big game and will give interior forest-nesting birds smaller areas of suitable nesting habitat. Nesting raptors may be subject to harassment in addition to loss of prey base from the flooded meadows. Loss of hiding cover may cause many medium- and large-sized animals to discontinue traveling through the basin.

Construction of a water distribution system in the Sanpete Valley will temporarily disturb plant communities including Valley sagebrush/grass, scrub oak, grassland and mountain brush. These disturbances will be temporary as the pipelines will be buried underground and the linear nature of the disturbance will cause relatively small areas to be disturbed per unit area. A total of 12.1 ha (30 ac) along the 27.4 km (17 mi) pipeline alignment would be disturbed. These disturbed areas will be reseeded following completion of construction and wildlife impacts should be minimal.

UDWR has identified a potential impact of the project on an existing crop depredation program in northern Sanpete County. They have determined that increasing alfalfa production through use of project water will encourage mule deer to remain at low elevations

during summer to feed on agricultural fields, exacerbating an existing problem. Crop depredations could increase, requiring UDWR to spend additional time removing problem deer and to pay additional damages for crop depredations. UDWR will also have to pay for fencing for any new haystacks developed due to greater alfalfa production. It estimates that additional depredation expenses could increase by as much as $2,000 over the existing program costs of approximately $20,000. No mitigation for this project impact has been identified by UDWR at this time.

Aquatic Resources

Stream Fisheries

Operation of the dam will affect flows in Gooseberry, Fish and Cottonwood Creeks. The Upper Gooseberry Creek segment (1.6 km {one mi}) and 6.9 km (4.3 mi) of the tributary streams will be inundated. Under the smaller reservoir alternative 6.1 km (3.8 mi) of the Gooseberry Creek tributaries would be inundated. All other aquatic impacts should be the same under both alternatives.

Flows in the Middle Gooseberry Creek segment will be reduced by an average of 91 percent. The State Engineer has stipulated that a minimum of 0.03 cubic meters per second (cms) (one cubic foot per second {cfs}) be released from the Narrows Dam so that the segment will not be totally dewatered. If the flow at the Gooseberry Campground (approximately one mile below the dam site) is not 0.04 cms (1.5 cfs), then 0.035 cms (1.25 cfs) must be released from the dam. Flows in Lower Gooseberry Creek are expected to be reduced by as much as 62 percent, with an average flow reduction of 51 percent. Fish Creek flows will be reduced by an average of 18 percent, and up to 24 percent. Flows in the upper part of Cottonwood Creek would be increased by up to 1000 percent through the diversion of project water. Flows in the lower section would increase by up to 550 percent.

Table 4 shows the pre- and post-project flows for Gooseberry Creek, Fish Creek, the Price River, and Cottonwood Creek. Tables 5-9 show changes in WUA for cutthroat and rainbow trout in Gooseberry and Fish Creeks with the implementation of the project. Changes range from a monthly decrease of less than one percent to 100 percent.

In general, the decrease in flow in the *Middle Gooseberry segment* will have the greatest impacts during the spring and summer when flow is normally the highest. This is the time when cutthroat spawning occurs. Flow will be reduced to 0.03 cms (one cfs) from average flows of 1.27 and 1.76 cms (45 and 62 cfs) in May and June, respectively. Spawning and fry habitat will be seriously reduced (by 94 and 45 percent, respectively). Fry will also be prevented from being carried downstream by the dam. Adult (-72 percent) and juvenile (-81.6 percent) habitat will also be reduced during this period. Without flushing flows the width of the stream will reduce and more fine materials will accumulate in the substrate, which could eliminate any remaining spawning habitat. Fifty to 75 percent of trout biomass could be lost from this segment.

Lower Gooseberry Creek will also suffer the largest flow reduction from April to August. However, due to tributary inflow, reductions will not be as severe. Flows will be reduced from approximately 2.29 to 1.05 cms (81 to 37 cfs) in May and from 2.78 to 1.05 cms (98 to 37 cfs) in June. The low flow period, from October through March, is considered to be the most restrictive for providing trout habitat. Flows would be reduced from 8-32 percent at this time. During this period adult and juvenile cutthroat trout habitat would be reduced by 10.5 and 29.5 percent respectively. Reductions of adult and juvenile habitat of less than 10 percent will occur during other times of the year. Rainbow trout adult and juvenile habitat is projected to be reduced by 6.5 and 5.4 percent, respectively, during the low flow period. Implementation of the proposed project is expected to slightly increase rainbow spawning and fry habitat.

During the low flow period average flow will be reduced between 5 and 8 percent in *Fish Creek*. Habitat is expected to be reduced by up to 7.3 and 3.3 percent,respectively, for adult and juvenile cutthroat trout. For rainbow trout habitat may be reduced by up to 2.7 and 1.3 percent, for adults and juveniles, respectively. Spawning habitat could decrease by 16 percent for rainbows and increase by approximately the same amount for cutthroats. Fry habitat would change by less than 3 percent for both species.

Flows in *Lower Fish Creek* will not be directly affected by construction of the Narrows, but will be indirectly affected by changes in operation of Scofield Reservoir. Because the Narrows will capture runoff during spring high flows that would otherwise have gone to Scofield Reservoir, Scofield will spill less frequently and for shorter durations, lowering the volume of peak flows in Lower Fish Creek, and consequently in the Price and Green Rivers downstream. Controlled releases from Scofield Reservoir would remain unaltered during most years. However, under prolonged drought conditions, irrigation releases would be reduced due to lack of water in the reservoir. In simulations using data for the years 1960-1992, reductions would have occurred in 5 of the 33 years if the Narrows Project had been in place.

Flows in *Cottonwood Creek* will increase dramatically during water delivery, from July to October (Table 4). Because flows will not be increased during the low flow period the upper portion will still support a catch and release fishery. However, fishing will be more difficult due to higher flows. The self-sustaining fishery in the lower portion of the creek could be affected by impacts to riparian vegetation or streambank sloughing due to high flows. An engineering stability report (Barnes, September 12, 1991) was prepared for the District, which showed that the increased flows will degrade the channel by up to 0.1 m (0.36 ft) in certain segments. The District has committed to place a pipe in the upper 1.3 km (0.8 mi) of the stream to convey irrigation releases during the summer season. Thus, project impacts in this segment will be avoided. Change in flows could affect the lower 7.9 km (4.9 mi) of Cottonwood Creek. An IFIM analysis has not been done on Cottonwood Creek, so exact reductions in habitat for fish life stages, due to the project are unknown.

Reservoir Fisheries

Flow of Gooseberry Creek into *Lower Gooseberry Reservoir* will be substantially reduced, particularly during spring and summer months. Flow reduction during this period may reduce the exchange rate in the reservoir, affecting water quality and leading to more severe fish kill problems. The project could also affect the cutthroat trout population in the reservoir by decreasing recruitment from upstream.

Fairview Lakes will not be directly affected by the project, but changes in management and fishing pressure may occur due to coordination of operation with the Narrows. Effects on the fishery could be beneficial due to reduced fishing pressure and greater availability of water due to operational changes.

A study prepared for the District (Cloward, Madden & Associates, November 1991) has shown that probability of eutrophication of *Scofield Reservoir* is slightly lower with the project conditions (from 79.3 to 78.0 percent). This is due to reduced sediment entering Scofield. However, sediments currently existing in the reservoir will continue to act as a nutrient sink, and reduction of incoming sediments due to the project will not improve the situation. After project construction, sediments would be intercepted in the Narrows Reservoir or build up in the contributing stream channels as discussed above.

Another concern is that decreased inflow may degrade water quality and increase the number of periodic fish kills. A comparison of Scofield Reservoir flushing rates under future without-project and project conditions showed an increase in projected fish kills from four in 30 years to five in 30 years. This is based on the assumption that fish kills occur 80 percent of the time when the annual flushing rate is less than 0.85 (Stephens, 1985). Decreased inflow will also result in a lower average surface area for the reservoir which will reduce the standing crop of fish in the reservoir. This loss of fish biomass would result in the loss of approximately 4,500 angler days per year.

The loss of spawning habitat for rainbow trout in Fish Creek could affect the fishery in Scofield Reservoir by reducing the number of rainbows entering the Scofield population from natural reproduction. It is not known what proportion of the rainbow trout existing in Scofield Reservoir come from natural production.

The *Narrows Reservoir* will be operated so that it will be at its highest level following spring runoff and water would be released so that most of the 6.7×10^6 m^3 (5,400 af) would be delivered by the end of September. It is expected that UDWR will manage the reservoir for a cutthroat trout fishery, though sterile rainbows may also be stocked. Natural cutthroat reproduction is expected under the proposed project alternative in the remaining segments of the three tributary streams, but this may need to be supplemented by stocking of fingerling cutthroats and rainbows. UDWR has expressed concern that, due to existing demand, there may not be enough hatchery stock available to meet demand in the new reservoir. The reservoir may support approximately 13,700 angler days of fishing annually (7,200 days

under the smaller reservoir alternative), if managed similarly to other reservoirs in the area.

Endangered Species

The Service determined that the endangered bald eagle (Haliaeetus leucocephalus) and the endangered Colorado squawfish (Ptychocheilus lucius), razorback sucker (Xyrauchen texanus), humpback chub (Gila cypha) and bonytail chub (Gila elegans) could occur in the area of the project. Reclamation prepared a Biological Assessment (BA) with a determination that the project "may affect" the four endangered Colorado River fish through the 6.7×10^6 m^3 (5,400 af) depletion. The Service prepared a Biological Opinion (March 25, 1992) based on the BA which concluded that the Narrows project would not jeopardize the continued existence of the fish species with the implementation of a designated Conservation Measure. The Conservation Measure requires the payment of a depletion charge into the Recovery Implementation Program (RIP) established by the Service to recover the endangered Colorado River fish. If sufficient progress is not made in the RIP through the ongoing reoperation of Flaming Gorge Dam, additional steps may need to be taken by the District to offset the Narrows depletion. Since the Biological Opinion was prepared the District has changed its estimate of average annual water depletion to 6.85×10^6 m^3 (5,557 af). The Service is preparing a revised Biological Opinion at this time. Additional mitigation measures may be required under the RIP in the amended Biological Opinion. These measures are not included in this document, but would need to be added to the District's final mitigation plan.

A category 2 candidate species, the spotted frog (Rana pretiosa) could also occur in the project vicinity. The District conducted a survey for this species in historic habit in the Sanpete Valley. Two frogs were found near Oak Creek at the northern terminus of the proposed water delivery pipeline. It is not expected that the project will have an adverse effect on this species (Hovingh, 1992).

Since the Biological Assessment was prepared the roundtail chub (Gila robusta), a fish which occurs in the lower Price River, has been added to the list of species which are candidates for threatened or endangered species listing. It is not known how this species could be impacted by lowered flows in the Price River.

DISCUSSION/PROPOSED MITIGATION

The main impacts of the Narrows project will occur on fish and wildlife resources in the reservoir basin and adjacent downstream segments of Gooseberry Creek and Cottonwood Creek. Proposed fish and wildlife mitigation measures as detailed in the Draft Environmental Impact Statement are described below. These measures were developed through coordination of the two technical teams and adopted by the District. They are referenced in the following text as the District's proposed mitigation, but it should be understood that these measures were developed with input from all interested agencies. Where there are differences between the project proposal and the small reservoir alternative,

information pertaining to the small reservoir alternative is shown in parentheses. The District's intention is to totally mitigate all impacts, where possible. To the extent possible, the District attempted to find mitigation measures which could be implemented "in place" and "in kind".

Flooding of the reservoir basin will destroy all HUs of indicator species present, as shown in Table 3. Wetland areas to be destroyed, including 6.9 km (4.3 mi) of the Gooseberry Creek tributaries (6.1 km {3.8 mi}) and the 1.6 km (one mi) Upper Gooseberry Creek segment, provide habitat units for the Richardson's vole, yellow warbler, mule deer and beaver. The District has proposed two alternatives to mitigate for wetlands losses. One alternative would involve enlarging existing wetlands and creating new wetlands adjacent to the Narrows Reservoir. Under this proposal approximately 44.5 ha (110 ac) of new wetlands will replace the hectares (acres) lost, including riparian habitat lost to flooding along Cottonwood Creek. Habitat units lost for all wetland habitat types will be replaced onsite adjacent to the reservoir according to the District's plan. However, the Corps has not accepted this plan as mitigation for wetland losses at this time. The District has proposed another alternative for full or partial mitigation that consists of purchase and restoration of wetlands adjacent to Mud Creek, a tributary to Scofield Reservoir. Approximately 89 ha (220 ac) of private lands containing degraded wetlands would be purchased. Most of the degradation has been caused by cattle which would be removed to facilitate enhancement of the wetlands. Figure 4 shows the location of the alternative wetland mitigation sites.

Conversion of upland habitat adjacent to the reservoir for wetland replacement would remove additional HUs for mule deer and Brewer's sparrow. This is reflected in the acreage of impacted HUs shown in Table 3 and will need to be mitigated if this alternative is chosen for wetlands mitigation. If the Mud Creek alternative wetland mitigation is chosen, these additional HUs would not be required.

The District has proposed mitigation measures to replace lost upland shrub HUs for mule deer and Brewer's sparrow. Proposed measures include acquiring 60.7 ha (150 ac) of conservation easements with land use restrictions adjacent to the reservoir basin, which would avoid future adverse impacts, but would not mitigate for project impacts. Offsite mitigation through participating in other projects in the Manti-LaSal National Forest such as reclaiming areas infested with tarweed (Media glomerata) to native shrub/grass habitats is also proposed. It is not known if these rehabilitated areas would meet the specific habitat needs of mule deer and Brewer's sparrow lost due to the project. Specific projects have not been committed to as yet. The District has also committed to acquire 259 ha (640 ac) of private land adjacent to Lower Fish Creek (Price River) below Scofield Reservoir. The sections also contain some upland sagebrush habitats whose protection could compensate somewhat for upland habitats including elk calving and mule deer fawning areas lost to the project. Wildlife values would be enhanced by fencing.

Other project impacts include impacts to stream fisheries, stream channels and riparian habitat corridors in downstream segments of Gooseberry and Cottonwood Creeks.

The 4.8 km (3 mi) Middle Gooseberry segment will be largely dewatered. The channel will become narrower and shallower. Sediments will also accumulate due to low flow conditions. The District proposes to mitigate riparian habitat losses onsite by placing constrictions in the channel to prevent the water surface from dropping and modifying stream banks so that overbank flooding will still be possible. Riparian plantings will be used in areas where vegetation has been damaged or destroyed. Buildup of fine sediments in the stream channel will be minimized by providing flushing flow releases from the Narrows Dam when necessary. The District has proposed to acquire a 16.2 ha (40 ac) parcel of private land that this segment of the creek runs through.

Impacts to stream fisheries in the inundated segments in Upper Gooseberry will be total, and they will be severe in the Middle Gooseberry segment. Other impacted stream segments will not be as directly affected. To mitigate onsite for lost fisheries the District will restore year-round flows in two of the Gooseberry Creek tributaries through releases from Fairview Lakes. This will result in the creation of approximately 3.7 km (2.3 mi) of spawning and rearing habitat for cutthroat trout, which will partially mitigate for the 8.5 km (5.3 mi) lost in the Upper Gooseberry segments. Under the smaller reservoir alternative, this mitigation measure will not be available and the District will need to provide an additional stream segments for cutthroat spawning habitat elsewhere.

The District has proposed to release water from the Narrows Dam for flushing sediments and for fish habitat during critical periods to avoid some fishery losses in the Middle Gooseberry segment. An average of 3.7×10^5 m^3 (300 af) would be available for release each year. UDWR has also suggested that the water might be used as an instream flow supplement during the winter period to help prevent fish kills in Lower Gooseberry Reservoir. The District and UDWR would determine the timing and amount of water to be released.

Through these measures, spawning and rearing habitat for cutthroat trout will be able to be maintained in the Middle Gooseberry segment. However, habitat for adult and juvenile trout will be lost throughout 6.4 km (4 mi) of stream in the Upper and Middle segments. The District has proposed to acquire stream segments in a 1:1 ratio with the mileage of impacted streams. The District proposed to acquire approximately 20.2 ha (50 ac) of private land containing live fishery streams. A corridor, approximately 61 m (200 ft) wide, would be acquired along a total of 6.4 km (4 mi) of stream. The project might include parcels from several different streams. In the DEIS, the District identified five stream segments that may be available for purchase. The acquired stream corridors would be fenced with a pole top fence to exclude grazing. These stream segments would provide habitat for all life stages of cutthroat trout.

The purchase of the State section in the Lower Fish Creek area could also contribute to mitigation of fishery impacts associated with the project, particularly to stream segments suitable for adult and juvenile occupancy. This section of Fish Creek currently provides habitat for adult and juvenile cutthroat, rainbow and brown trout.

The District has proposed to prevent stream degradation from increased flows in Upper Cottonwood Creek by construction of a 1.3 km (0.8 mi) pipeline to convey reservoir releases. A winter release of 0.056 cms (2 cfs) would also be made from the Narrows Reservoir to Cottonwood Creek during the winter months (October through March) to increase fish habitat during that period and to provide mitigation for stream channel widening that would occur due to high summer flows. No mitigation was proposed for loss of fishery habitat in Lower Cottonwood Creek.

Lower stream flows and their impacts on fisheries in Gooseberry and Fish Creeks may affect reproduction and recruitment into the Lower Gooseberry and Scofield Reservoir populations. This could impact recreational use of the two reservoirs. The District calculates that 4,500 angler days per year will be lost at Scofield Reservoir but does not calculate potential losses at Lower Gooseberry Reservoir. Creation of a new fishery on the Narrows Reservoir would provide approximately 13,700 angler days of use, according to the District, offsetting losses at other reservoirs. The smaller reservoir alternative would provide approximately 7,200 days of angler user.

The District has committed to a monitoring program to evaluate the progress of wildlife and wetlands mitigation plans, both qualitatively and quantitatively to ensure that lost HUs and wetland acreages are replaced. Statistical comparisons will be made and additional mitigation measures would be required if full mitigation standards are not achieved. A similar monitoring program for aquatic mitigation measures was not included in the Draft EIS.

The Service and UDWR believe that the types of mitigation proposed in the DEIS are appropriate. However, the two agencies were concerned about inadequacies in the amount of mitigation proposed, as not all impacts were proposed to be totally mitigated. The Corps will determine whether the amount of mitigation proposed for wetland resource losses is appropriate. Mitigation for upland wildlife species will be total replacement of lost HUs. The main concern of the Service and UDWR was the adequacy of proposed aquatic mitigation measures, particularly for losses of stream segments that support fisheries. In a letter dated September 21, 1994 (see Appendix B), the UDWR has recommended measures, including some already committed to by the District, to be taken to totally mitigate for these losses in both the Price River Basin and the Sanpitch River Basin. The Service concurs with the recommendations of UDWR. The District voted on September 7, 1994 to incorporate those additional measures not contained in the DEIS into their mitigation plan in the Final EIS. Therefore the cost estimate (Appendix A) and the Aquatic Impacts and Mitigation Measures (Table 10) include these additional measures, as described below.

Affected streams in the **Price River Basin** (Gooseberry Creek, and Fish Creek) will suffer losses to fishery values; in some segments the losses will be complete. The UDWR recommended the following measures to offset project impacts. Acquisition and fencing of 4.0 miles of Mud Creek would complement the proposed wetland mitigation project in this area. These projects together would mitigate for both wetlands and stream impacts, as well as potentially benefitting water quality in Scofield Reservoir by reducing nutrients entering

the reservoir from the Mud Creek drainage. UDWR recommended that two miles of Lower Fish Creek be acquired, fenced and enhanced. This would be done in conjunction with the acquisition of a section of State School trust lands which is proposed as mitigation for upland impacts. It is also recommended that 2.5 miles of Winterquarters Creek, and one mile of Pondtown Creek within the USFS boundary, be acquired, fenced, and/or enhanced for improvement of stream and riparian habitat conditions.

Recommendations for the **Sanpitch River Basin** include piping the irrigation flows in the upper 0.8 miles of Cottonwood Creek and providing a minimum 2 cfs instream flow for this stretch during the winter season. For enhancement of the segment of Cottonwood Creek from the canyon mouth to the confluence with the Sanpitch River, UDWR recommended a 2 cfs minimum instream flow during the irrigation season. This will provide year-round flows for fish habitat and enhance the riparian corridor. Currently, this stream segment is dewatered during the irrigation season. UDWR also recommended enhancement of 4 miles of Starvation Creek, from the confluence of Bennion Creek to the confluence with Soldier Creek in Spanish Fork Canyon to improve water quality and riparian habitat. Enhancement may include bank stabilization, revegetation, or other measures.

RECOMMENDATIONS

Properties acquired for mitigation, whether for upland wildlife, wetlands, or aquatic wildlife, could be managed under the following strategies: acquisition for protection, acquisition for enhancement, conservation easements for protection, conservation easements for enhancement, enhancement of USFS property and enhancement of UDWR property. Mitigation for this project will probably includes a combination of several or all of these strategies.

The following recommendations also need to be addressed in the Final EIS to complete the mitigation plan:

1. The above recommendations apply to the preferred (large reservoir) alternative. If the small reservoir alternative is chosen, additional mitigation will be required for the loss of cutthroat trout spawning habitat which could not be replaced by restoration of headwater streams from Fairview Lakes. At the time this alternative is chosen, additional mitigation measures will be developed in coordination with the Service and UDWR.

2. Acquisition of private lands should preferably be made by fee title. In areas adjacent to the reservoir basin easements would be appropriate. In the Final EIS the District should identify the appropriate management entities for specific properties being considered for acquisition. Conditions of easements should also be specified in the Final EIS.

3. As part of the mitigation plan the District must develop a comprehensive monitoring and maintenance program to ensure that aquatic and wildlife habitat replacement values are being met. This program will address monitoring procedures, responsible parties, and steps to be taken if mitigation efforts do not prove successful. It should also include an Operation and Maintenance account with adequate funding to ensure that mitigation requirements are met. This plan should be included as part of the Final EIS.

4. Reclamation will ensure that language in the Small Reclamation Project Loan repayment contract stipulates that mitigation will be concurrent with project construction.

5. Any additional measures for wetland mitigation required by the Corps should be included in the Final mitigation plan.

6. Any additional measures for impacts to listed fish species required by the Amended Biological Opinion should be included in the Final mitigation plan.

7. The Final EIS should list detailed mitigation commitments for all project impacts. Specifics such as management entities for the various stream segments, and specific enhancement measures to be taken in each area should be listed. If there are any areas where a specific final mitigation strategy has yet to be determined a timetable for development should be included, along with a list of agencies to be consulted for concurrence.

Appendix A includes a preliminary cost analysis of the mitigation plan including costs for mitigation as proposed by the District in the DEIS as well as costs for additional mitigation measures approved by the District as discussed above. Costs are estimated since property acquisition costs may vary.

LITERATURE CITED

Barnes, F.R. September 12, 1991. Cottonwood Creek Channel Degradation. Memorandum prepared for Cottonwood Canyon Slope Stability Team Members - Narrows Project. 2 pp. + tables.

Barnes, F.R. September 27, 1991. Comparison of Gooseberry Creek Preproject and Project Flow Depths - Narrows Project Environmental Analysis. Memorandum to Narrows Project Files. 2 pp. + tables.

Bovee, K.D. 1982. A guide to stream habitat analysis using the Instream Flow Incremental Methodology. Instream Flow Inf. Paper No. 12, FWS/OBS - 82/26. U.S. Fish and Wildlife Service, Office of Biological Services. Ft. Collins, CO. 248 pp.

Cloward, Madden & Associates. November 1991. Schofield (sic) Eutrophication Study. 28 pp.

Franson - Noble & Associates. February 1992. Preliminary Narrows Project Proposed Fish and Wildlife Mitigation Measures. 3 pp. + figure.

Hovingh, P. November 1991. Spotted Frog Survey of San Pitch River System. Summary of Findings. 14 pp. + tables.

Milhous, R.T., D.L. Wegner, and T. Waddle. 1984. User's guide to the Physical Habitat Simulation System. Instream Flow Inf. Paper No. 11, FWS/OBS - 81/43. U.S. Fish and Wildlife Service, Office of Biological Services. Ft. Collins, CO. 465 pp.

Mt. Nebo Scientific. February 1992. Vegetation and Wildlife Impacts from the Narrows Project. Draft Report. 28 pp. + tables.

Stephens, D.W. 1985. Why Scofield Reservoir is eutrophic - Effects of nonpoint source pollutants on a water supply reservoir in Utah. Pages 142-146 in Perspectives on nonpoint source pollution. U.S. Environmental Protection Agency report 440/5-85-001.

U.S. Fish and Wildlife Service. 1980. Habitat Evaluation Procedures (HEP). Ecological Services Manual, Part 102.

Woodward - Clyde Consultants. December 1991. Aquatic Ecology Section. 22 pp. + tables.

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APPENDIX A

MITIGATION COST ESTIMATE (PREFERRED ALTERNATIVE)

Mitigation Item	Quantity	Unit	Unit Price	Cost
Wetland Mitigation Area (adjacent to reservoir)	110	acre	500	55,000
Plantings for Wetland Mitigation Area	lump sum	lump sum	10,000	10,000
or				
Wetland Mitigation Area *(Mud Creek)	220	acre	500	110,000
Fencing on Mud Creek	2	mile	13,000	26,000
Wildlife Conservation Easement Adjacent to Reservoir	150	acre	400	60,000
Acquire State Section on Price River below Scofield Reservoir	640	acre	350	224,000
Fencing for State Section	4	mile	13,000	52,000
Acquire Middle Gooseberry land	40	acre	350	14,000
Fencing on Middle Gooseberry	0.25	mile	13,000	3,250
Middle Gooseberry Channel rehab	3	mile	10,000	30,000
Upper Gooseberry Tributaries Planting & Channel Improvements	lump sum	lump sum	10,000	10,000
Reseeding on Forest Service lands	900	acre	30	27,000
Monitoring Aquatic and Wildlife Mitigation	lump sum	lump sum	50,000	50,000
Endangered Fish Depletion Fee (1995 Cost)	5,557	acre-feet	12.71	70,629.47

Acquire Stream Segments (2 mi *Mud Creek, 1 mi Lower Fish Creek, 1 mi Upper Fish Creek, 2.5 mi Winterquarters Creek, 2 mi Pondtown Creek, 4 mi Starvation Creek)	303	acre	500	151,500
Fence Fishery Segments	25	mile	13,000	325,000
Enhance Stream Segments	13.5	mile	15,000	202,500

TOTAL (Wetlands Alternative Adjacent to Reservoir)	1,284,879.47
TOTAL (Mud Creek Wetland Alternative)	1,355,879.47

*2 miles of Mud Creek will be purchased for mitigation of aquatic impacts. If the Mud Creek wetlands mitigation alternative is chosen, an additional 2 miles of stream will be purchased and fenced.

APPENDIX B

UTAH NATURAL RESOURCES
Wildlife Resources
1596 West North Temple • Salt Lake City, UT 84116-3195 • 801-533-9333

memorandum

SEP 28 1994

September 21, 1994

Mr. Reed Harris
U.S. Fish and Wildlife Service
Lincoln Plaza
145 East 1300 South, Suite 404
Salt Lake City, Utah 84115

Subject: Final Comments, Fish and Wildlife Coordination Act Report, Narrows Project

Dear Reed:

We have reviewed the subject draft Fish and Wildlife Coordination Act Report dated June 1994 for the proposed Narrows Project in Utah. Contained herein are the Division of Wildlife Resources' (Division) final comments regarding the document. We have provided additional information and mitigation recommendations which have been derived since the draft report was issued.

Through previous consultation among our agencies, the Division had recommended that mitigation for stream impacts occur on a 3:1 or 2:1 linear basis whenever the project sponsor proposed improvement of existing stream segments as a mitigation method, by either fencing to protect riparian and stream bank areas, or through other unidentified methods. Since that time, Division staff have refined the recommendation to account for project impacts and project-induced mitigation improvements using the Habitat Quality Index method. For this analysis, Division staff used existing file data, published reports, and professional judgement to estimate the number of Habitat Units present in stream segments which would or could be affected by the Narrows project, either as impacted streams or as potential mitigation sites. Both pre- and post-project Habitat Units were estimated using those methods.

Table 1 presents the Division's recommended mitigation for impacts to stream fishery resources of the Proposed Large Dam Alternative of the Narrows Project which had previously been recommended in concept at 3:1 or 2:1 linear ratios. All other proposed mitigation recommendations in the draft report would

remain unchanged, unless specifically modified herein. Also shown is the analysis of Habitat Units for each stream segment under existing and Post-Project conditions. Specific recommendations regarding the types of improvements which should be implemented follow.

Price River Basin

The recommendation to acquire and fence 4.0 miles of Mud Creek is intended to complement the proposed wetland mitigation project also along Mud Creek. Together these two projects would not only mitigate wetland and stream impacts, but could potentially benefit water quality in Scofield Reservoir by trapping and reducing nutrients entering Scofield Reservoir from the Mud Creek drainage. The recommendation regarding Lower Fish Creek is to acquire, fence and enhance two miles. Much of this would be accomplished in concert with the proposed mitigation for upland impacts of acquiring a section of State School Trust lands. Acquiring and fencing 2.5 miles of Winterquarters Creek would allow for improvement of stream and riparian conditions. One mile of Pondtown Creek within the U.S. Forest Service boundary is also recommended for acquisition and fencing or enhancement.

Sanpitch River Basin

Piping most of the irrigation flows from the tunnel outlet downstream 0.8 miles to discharge into Cottonwood Creek will avoid an impact from high project releases, and will allow for enhancement of summer flows in the upper 0.8 mile reach of Cottonwood Creek. Providing a 2 cfs minimum instream flow in the winter season to this same reach of stream will provide for establishment of year-round flows and a naturally reproducing complement of fish species. The enhancement measure proposed for the lower Cottonwood Creek, from the canyon mouth to the confluence of the San Pitch River, is to provide a 2 cfs minimum instream flow during the irrigation season. This will provide year-round flows in the stream, which will provide some fish habitat, will create a fishery for local residents, and enhance the riparian corridor. Presently this reach of stream is de-watered during the irrigation season.

Enhancement along the 4 miles of Starvation Creek, from the confluence of Bennion Creek down to the confluence with Soldier Creek (Utah County, Spanish Fork Canyon) will improve water quality and riparian habitat of the stream. Enhancement can

include, but is not limited to, bank stabilization, especially where the road confines the stream channel and causes bank erosion, and revegetation in appropriate locations.

Mitigation recommendations for the Small Dam Alternative would be similar to the recommendations provided for the Large Dam Alternative, with the exception that additional mitigation for loss of cutthroat trout spawning habitat would need to be provided in lieu of the restoration of headwater streams from Fairview Lakes. The Division proposes that a final mitigation plan for that impact would be developed in consultation with the project sponsor at that time, if the Smaller Dam Alternative is selected.

The only other comment we have on the report is that the 2 cfs minimum streamflow release from the Narrows Tunnel to the headwaters of Cottonwood Creek during the "winter" should actually be a commitment to maintain the 2 cfs minimum flow in the stream from the end of one irrigation season to the beginning of the next. This should be noted in the report, rather than beginning and ending on a fixed date regardless of when irrigation deliveries equal to or greater than the 2cfs minimum begin and end.

We appreciate the efforts of your staff in working closely with Division staff during the past several years on this project. Please contact Mark Holden or Catherine Quinn at 538-4700 if you have any questions regarding these comments.

Sincerely,

Robert G. Valentine
Director

RGV/MH/kj

cc: Richard Noble, Franson-Noble Associates
Manti-LaSal National Forest Supervisor

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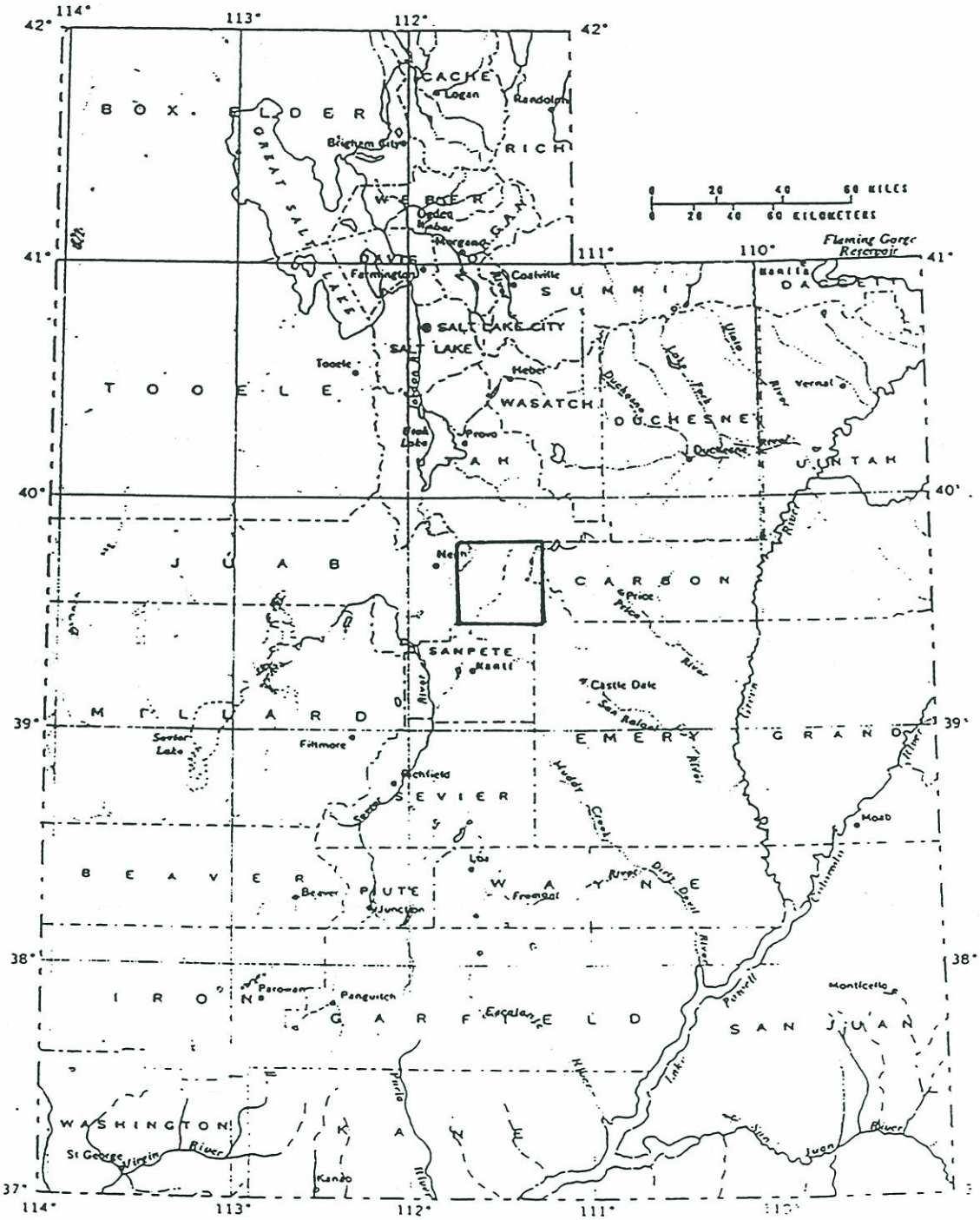
TABLE 1
ESTIMATION OF HABITAT QUALITY INDEX UNITS ON AFFECTED AND POTENTIAL MITIGATION REACHES, PREFERRED ALTERNATIVE

Stream	Miles Affected	Existing HUs/mi	HUs Post Project	Change in HUs/mi	HUs to Replace	Replacement HUs Gained
Price River Basin						
Middle Gooseberry C.	4	139	0	-139	556	-----
Lower Gooseberry Cr.	2	203	132	-71	142	-----
Total HUs Lost					**698**	
Mud Creek	4	79	160	81	----	324
Lower Fish Creek	2	312	350	38	----	76
Upper Fish Creek	1	432	517	85	----	85
Winterquarters Creek	2.5	35	77	42	----	105
Pondtown Creek	2	50	103	53	----	106
Total HUs Replaced						**696**
Sanpitch River Basin						
Cottonwood Creek	4.9	79	13	-66	322	----
Total HUs Lost					**322**	
Upper Cottonwood Cr.	0.8	4	202	198	----	158
Lower Cottonwood Cr.	1.2	0	40	40	----	48
Starvation Creek	4	82	111	29	----	116
Total HUs Replaced						**322**

Figure 1 - General Project Location Map



PROJECT AREA

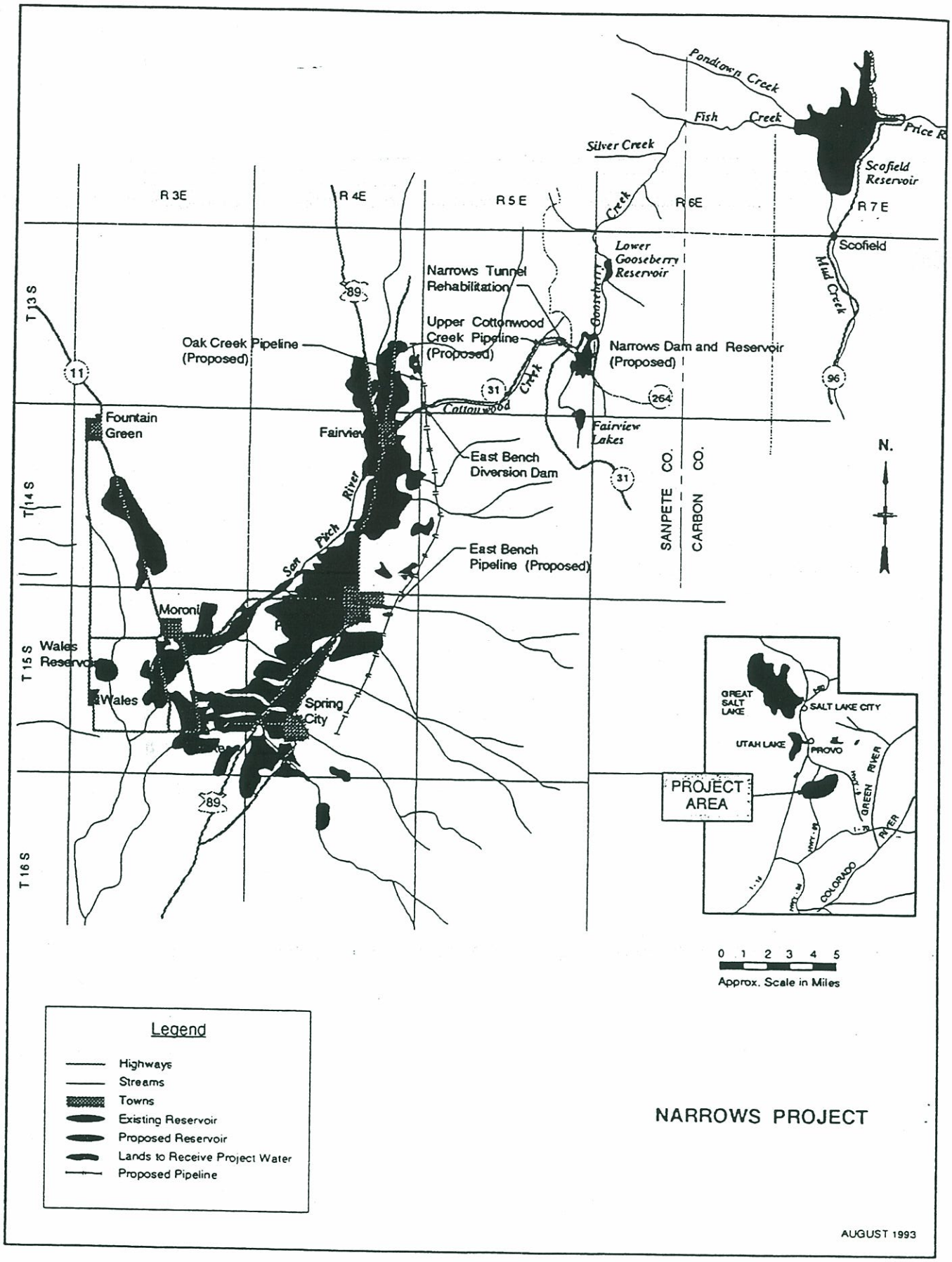


Figure 2. Narrows Project Area and Water Distribution System

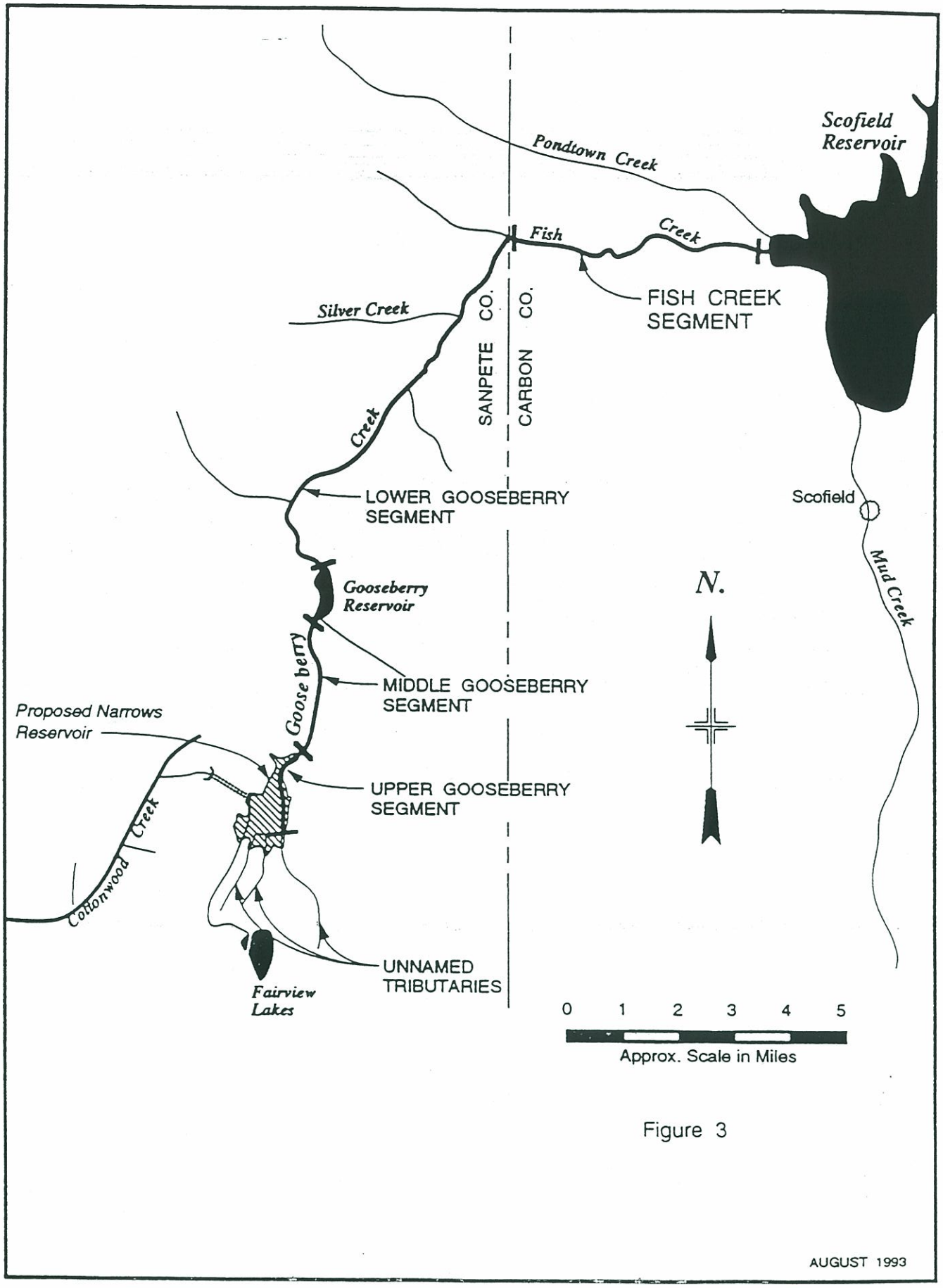
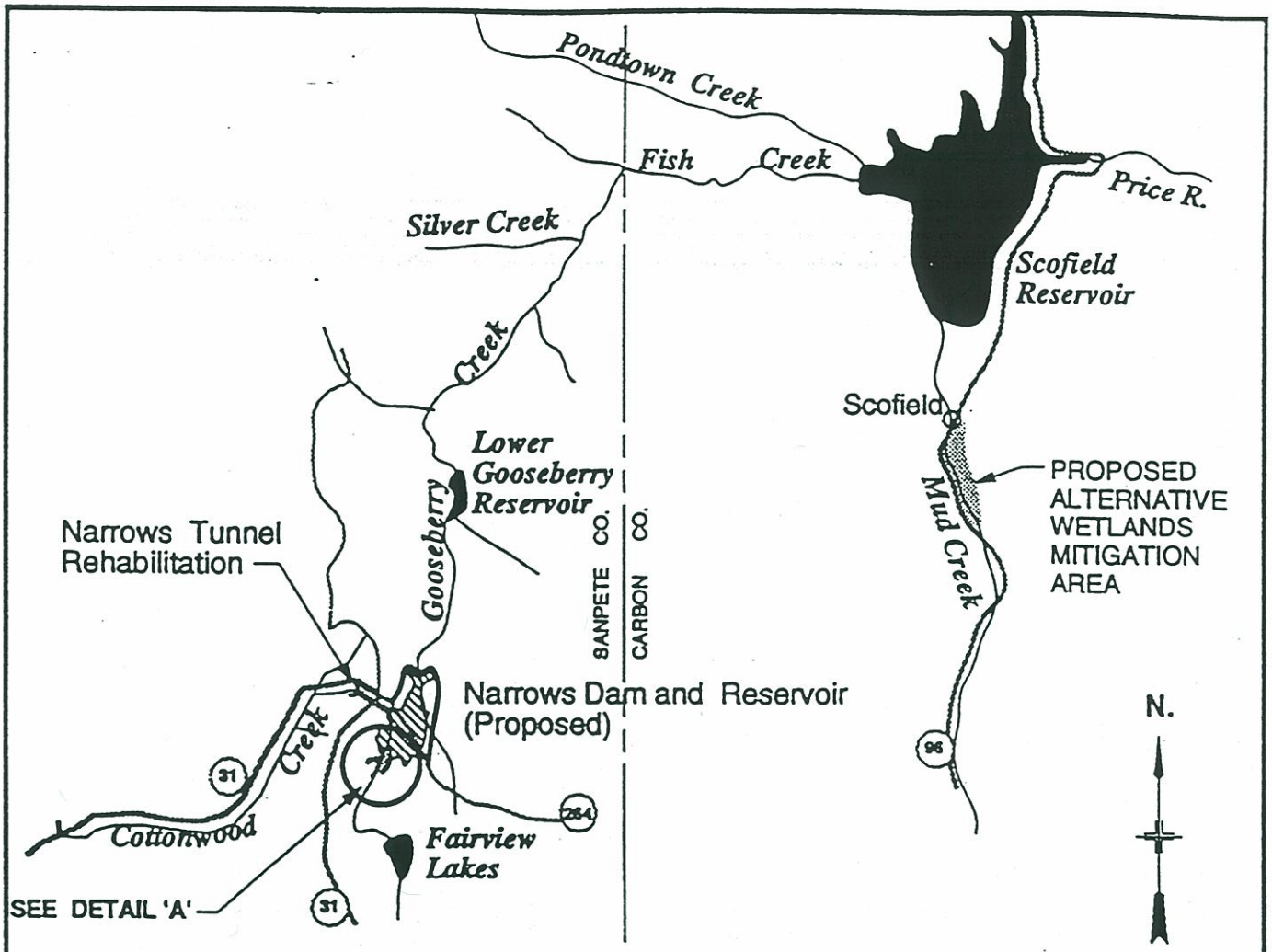
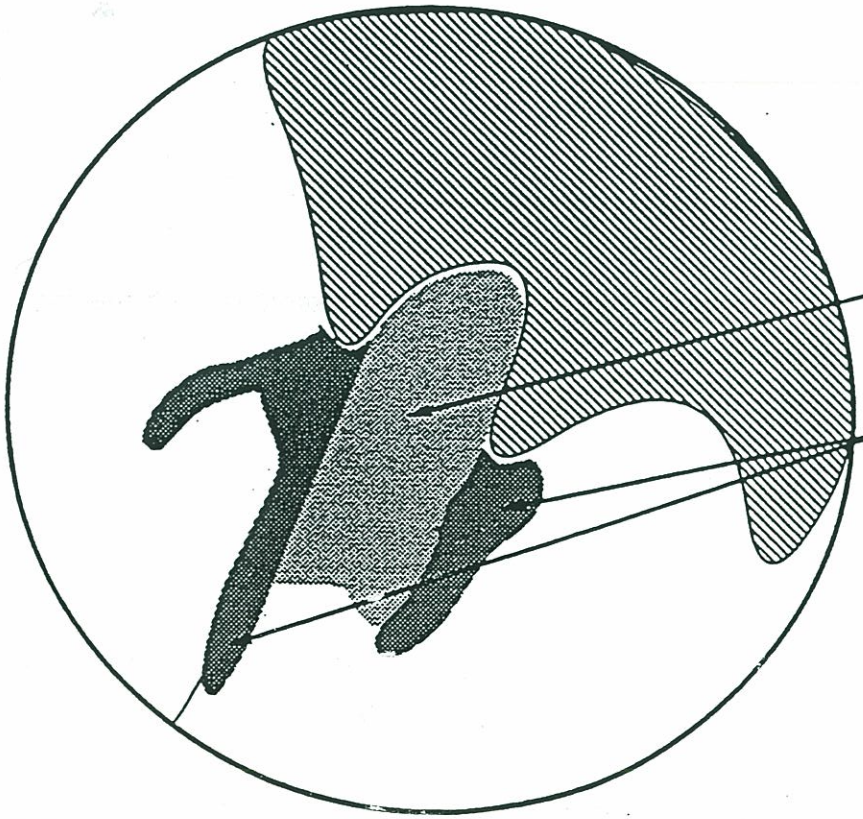


Figure 3

Figure 3. Streams and Reservoirs in the Narrows Project Area





0 1 2 3 4 5

Approx. Scale in Miles

DETAIL 'A'

PROPOSED ALTERNATIVE WETLANDS MITIGATION AREA

EXISTING WETLAND AREA

Figure 4

ALTERNATIVE WETLANDS MITIGATION SITES

NARROWS PROJECT

JUNE 1993

TABLE 1: Wildlife Feeding Guilds for the Narrows Basin Study.

COVER	FEEDING TYPES: CARNIVORE	INSECTIVORE	HERBIVORE	OMNIVORE
AERIAL		Common Nighthawk Poor-will Townsend's Solitaire Tree Swallow Small Footed Myotis Western Pipistrelle		
SHRUB LAYER		Willow Flycatcher		Mtn. Bluebird Greentailed Towhee Brewer's Sparrow Sage Sparrow
TERRESTRIAL SURFACE	Cooper's Hawk Gt. Horned Owl Northern Harrier	Killdeer Vagrant Shrew Northern Flicker Sagebrush Lizard Short-horned Lizard Western Garter Snake	Broadtail Hummingbird Montane Vole Jumping Mouse Deer Mouse Uinta Ground Squirrel Cottontail Rabbit Least Chipmunk Moose Elk Mule Deer	Magpie Raven Rock Wren Coyote
TERRESTRIAL SUBSURFACE	Badger		Pocket Gopher	
RIPARIAN/ WETLAND	Belted Kingfisher	Tiger Salamander Northern Leopard Frog Water Shrew Common Snipe Yellow Warbler	Green-winged Teal Cinnamon Teal Mallard Canada Goose Sandhill Crane American Dipper Beaver Montane Vole	

Bolded names were evaluation species.

TABLE 2: Wildlife Reproductive Guilds for the Narrows Basin Study

COVER TYPES	REPRODUCTIVE GUILD SPECIES
SHRUB	
Vegetation	Green-tailed Towhee, **Brewer's Sparrow**, Willow Flycatcher, **Yellow Warbler**
Bareground	Cottontail, Deer Mouse, Common Nighthawk, Poor-will, Sagebrush Lizard, Short-horned Lizard
RIPARIAN/WETLAND	
Vegetation	**Montane Vole**, Harvest Mouse, Common Snipe, Vagrant Shrew, Water Shrew, Tiger Salamander, Northern Leopard Frog, Western Garder Snake, Green-winged Teal, Cinnamon Teal, Mallard
Organic Litter	Northern Harrier, Poor-will, Jumping Mouse, **Beaver**
Bareground	Killdeer
Bank	Belted Kingfisher, Muskrat, Dipper
SUBSURFACE	
Borrow	Badger, Uinta Ground Squirrel, Least Chipmunk, Pocket Gopher

Bolded names were evaluation species.

TABLE 3: Baseline Habitat Conditions Within the Narrows Reservoir Basin for (A) Affected Areas; and (B) Evaluation Species.

(A) AFFECTED AREAS

Vegetation type (HEP cover type)

Reservoir inundation	Acres
Vasey sagebrush (USHE)	331
Silver sagebrush (USHE)	156
Wetlands (PEM, PSS)	100
Aspen	0.19
Previously disturbed	17
Subtotal	604.19

Potential Disturbance in wetland mitigation area

Vasey sagebrush	110.00
TOTAL	714.19

(B) EVALUATION SPECIES

(Smaller Reservoir Alternative in Parentheses)

Species	Cover Type(s) Used	Acres	HSI	HUs
Richardson's vole	PEM	63 (18)	1.00	63 (18)
Yellow warbler	PSS	37 (10)	0.70	26 (7)
Beaver	PEM,PSS	100 (28)	0.13	13 (4)
Mule deer	PEM,PSS, USHE	587 (246)	0.23	135 (57)
Brewer's sparrow	USHE	487[a](218)	0.98	624 (214)

HEP = Habitat Evaluation Procedures
PEM = Palustrine emergent wetland cover (herbaceous wetlands)
PSS = Palustrine scrub/shrub cover (shrubby wetlands)
USHE = Shrub cover (Vasey sagebrush; silver sagebrush)
HSI = Habitat Suitability Index
HUs = Habitat Units
a = all USHE habitat type areas, including area disturbed for mitigation

TABLE 4

Average Existing and Projected Flows
(unit—cfs)

Month	Recommended Plan			Smaller Reservoir Plan			No Action Plan		
	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)
Gooseberry Creek at Proposed Narrows Damsite									
October	1.0	1.0	1.0	1.0	1.0	1.0	2.0	4.7	1.6
November	1.0	1.0	1.0	1.0	1.0	1.0	1.5	3.3	1.4
December	1.0	1.0	1.0	1.0	1.0	1.0	1.4	4.2	0.7
January	1.0	1.0	1.0	1.0	1.0	1.0	1.3	2.4	1.0
February	1.0	1.0	1.0	1.0	1.0	1.0	1.3	2.4	1.2
March	1.0	1.0	1.0	1.0	1.0	1.0	1.4	2.4	1.2
April	1.0	1.0	1.0	1.0	1.0	1.0	3.5	5.3	5.5
May	5.9	79.3	5.9	1.0	87.2	1.0	45.3	102.9	15.1
June	10.5	100.0	1.0	37.7	102.0	1.0	61.8	92.8	6.5
July	1.0	1.0	1.0	1.0	1.0	1.0	7.2	12.8	3.0
August	1.0	1.0	1.0	1.0	1.0	1.0	4.9	6.0	1.5
September	1.0	1.0	1.0	1.0	1.0	1.0	3.2	4.3	0.9
Gooseberry Creek Below Lower Gooseberry Reservoir									
October	2.9	5.8	2.4	2.9	5.8	2.4	4.1	10.2	3.0
November	3.1	5.9	2.2	3.1	5.9	2.2	3.8	8.8	2.7
December	3.2	5.4	2.1	3.2	5.4	2.1	3.8	9.0	1.9
January	3.6	6.2	2.1	3.6	6.2	2.1	4.0	7.8	2.1
February	3.7	6.1	2.2	3.7	6.1	2.2	4.1	7.6	2.4
March	3.7	5.2	2.3	3.7	5.2	2.3	4.2	7.0	2.6
April	4.6	6.4	6.5	4.6	6.4	6.5	7.5	11.2	10.9
May	38.2	172.5	0.9	33.3	180.5	0.9	82.1	199.3	12.9
June	34.8	156.9	3.9	62.0	159.0	3.9	92.1	162.0	9.8
July	5.9	9.9	1.5	5.9	9.9	1.5	12.8	24.1	3.8
August	5.6	4.9	1.3	5.6	4.9	1.3	10.0	10.7	2.0
September	3.9	3.6	1.9	3.9	3.6	1.9	6.4	7.4	1.9
Fish Creek Above Scofield Reservoir									
October	9.4	18.9	7.6	9.4	18.9	7.6	10.6	23.3	8.2
November	9.5	17.3	7.9	9.5	17.3	7.9	10.2	20.2	8.4
December	8.4	15.6	7.5	8.4	15.6	7.5	9.1	19.2	7.3
January	9.1	16.3	5.5	9.1	16.3	5.5	9.5	17.9	5.6
February	10.6	19.0	5.3	10.6	19.0	5.3	11.1	20.6	5.5
March	14.1	17.3	5.4	14.1	17.3	5.4	14.6	19.1	5.7
April	17.8	43.7	24.5	17.8	43.7	24.5	20.7	48.5	29.0
May	211.7	614.5	11.4	206.8	622.5	6.5	255.6	641.3	23.5
June	173.5	360.8	8.5	200.7	362.8	8.5	230.8	365.8	14.4
July	29.6	51.4	4.6	29.6	51.4	4.6	36.5	65.7	6.8
August	17.6	21.6	3.5	17.6	21.6	3.5	22.0	27.4	4.1
September	12.2	17.3	3.5	12.2	17.3	3.5	14.7	21.0	3.5

TABLE 4 (continued)

(unit—cfs)

Month	Recommended Plan			Smaller Reservoir Plan			No Action Plan		
	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)	Average year (1968)	Wet year (1984)	Dry year (1977)
Price River Below Scofield Dam									
October	40.0	176.5	22.8	40.0	176.5	22.8	40.0	204.0	22.8
November	2.8	5.1	10.1	2.8	5.1	10.1	2.8	5.1	10.1
December	3.4	0.0	11.4	3.4	0.0	11.4	3.4	0.0	11.4
January	3.7	0.0	13.0	3.7	0.0	13.0	3.7	0.0	13.0
February	0.3	0.0	7.2	0.3	0.0	7.2	0.3	0.0	7.2
March	0.0	0.0	6.5	0.0	0.0	6.5	0.0	199.0	6.5
April	0.0	274.6	32.0	0.0	274.6	32.0	0.0	309.8	32.0
May	0.0	661.9	41.1	0.0	669.9	41.1	27.7	463.7	41.1
June	4.4	529.2	43.8	4.4	531.2	43.8	4.4	534.2	43.8
July	152.8	149.3	61.9	152.8	149.3	61.9	152.8	155.3	61.9
August	87.2	108.5	39.1	87.2	108.5	39.1	87.2	124.2	39.1
September	163.8	114.1	21.9	163.8	114.1	21.9	163.8	135.6	21.9
Fairview Tunnel at Outlet									
October	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0
November	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0
December	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0
January	2.0	2.0	2.0	2.0	2.0	1.3	0.0	0.0	0.0
February	2.0	2.0	2.0	2.0	2.0	0.2	0.0	0.0	0.0
March	2.0	2.0	2.0	2.0	2.0	0.2	0.0	0.0	0.0
April	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
May	0.6	1.2	0.0	0.6	1.2	0.0	0.6	1.2	0.0
June	4.3	12.3	8.8	4.3	12.3	8.8	4.1	12.1	8.6
July	45.3	45.0	43.3	45.3	45.0	25.3	14.7	12.4	0.3
August	43.5	45.5	33.1	43.5	45.5	0.2	13.4	16.3	0.2
September	17.4	24.9	0.1	17.4	24.9	0.1	1.6	10.3	0.1
Cottonwood Creek at Mouth of Canyon									
October	3.3	5.1	3.1	3.3	5.1	3.1	1.3	3.1	1.1
November	3.6	5.0	3.3	3.6	5.0	3.3	1.6	3.0	1.3
December	3.4	4.8	3.2	3.4	4.8	3.2	1.4	2.8	1.2
January	3.4	4.7	3.0	3.4	4.7	2.3	1.4	2.7	1.0
February	3.6	4.6	3.2	3.6	4.6	1.4	1.6	2.6	1.2
March	4.0	4.7	3.3	4.0	4.7	1.5	2.0	2.7	1.3
April	3.7	8.1	3.2	3.7	8.1	3.2	3.7	8.1	3.2
May	45.0	117.1	4.9	45.0	117.1	4.9	45.0	117.1	4.9
June	46.6	63.4	12.8	46.6	63.4	12.8	46.4	63.2	12.6
July	49.4	53.5	44.6	49.4	53.5	26.6	18.8	20.9	1.6
August	46.0	49.2	34.0	46.0	49.2	1.1	15.9	20.0	1.1
September	19.1	27.9	1.0	19.1	27.9	1.0	3.3	13.3	1.0

Table 5
Weighted Usable Area for
Cutthroat Life Stages in
Upper Gooseberry Creek with Existing Flows

Month	Life Stage	Average Weighted Usable Area (1,000 units)
January	Adult	8.4
	Juvenile	1.9
February	Adult	8.4
	Juvenile	1.9
March	Adult	8.7
	Juvenile	1.9
April	Adult	11.3
	Juvenile	3.3
May	Adult	11.7
	Juvenile	2.7
	Spawning	0.0
June	Adult	10.7
	Juvenile	2.5
	Spawning	0.0
July	Adult	13.2
	Juvenile	3.5
	Spawning	1.5
August	Adult	12.2
	Juvenile	3.7
	Spawning	1.3
	Fry	4.7
September	Adult	11.1
	Juvenile	3.0
	Fry	4.8
October	Adult	10.2
	Juvenile	2.0
November	Adult	8.9
	Juvenile	2.0
December	Adult	8.7
	Juvenile	1.9

Table 6
Monthly Pre- and Post-Project Cutthroat Trout Habitat In Middle and Lower Gooseberry Creek During Average Water Year[1/]

Month	Life Stage	Middle Gooseberry Creek			Lower Gooseberry Creek		
		Pre-project	Post-project	Change (%)	Pre-project	Post-project	Change (%)
January	Adult	62.9	57.6	8.4	355.4	344.7	-3.0
	Juvenile	18.0	16.7	7.2	61.6	60.9	-1.1
February	Adult	62.9	57.6	-8.4	359.0	348.5	-2.9
	Juvenile	18.0	16.7	-7.2	63.0	61.1	-3.0
March	Adult	64.7	57.6	-11.0	359.0	344.7	-4.0
	Juvenile	18.3	16.7	-8.7	62.6	60.9	-2.7
April	Adult	106.2	57.6	-45.8	404.9	393.1	-2.9
	Juvenile	30.1	16.7	-44.5	73.2	68.7	-6.1
May	Adult	205.8	57.6	-72.0	562.1	548.3	-2.5
	Juvenile	91.0	16.7	-81.6	75.0	56.0	-25.3
	Spawning	1.5	0.1	-93.3	0.0	0.0	-
June	Adult	202.6	57.6	-71.6	553.2	548.1	-0.9
	Juvenile	88.7	16.7	-81.2	79.6	56.1	-29.5
	Spawning	0.4	0.1	-75.0	0.0	0.0	-
July	Adult	144.4	57.6	-60.1	430.6	405.3	-5.9
	Juvenile	42.7	16.7	-60.9	71.3	73.4	+2.9
	Spawning	0.9	0.1	-88.9	0.0	0.0	-
August	Adult	127.4	57.6	-54.8	413.9	398.7	-3.7
	Juvenile	36.6	16.7	-54.4	73.0	70.4	-3.6
	Spawning	2.8	0.1	-96.4	0.0	0.0	-
	Fry	57.3	28.1	-51.0	65.3	73.1	+11.9
September	Adult	100.2	57.6	-42.5	397.3	355.4	-10.5
	Juvenile	28.4	16.7	-41.2	69.8	61.6	-11.7
	Fry	44.5	28.1	-36.9	73.6	67.1	-8.8
October	Adult	75.4	57.6	-23.6	362.2	327.4	-9.6
	Juvenile	20.9	16.7	-20.1	63.2	58.0	-8.2
November	Adult	66.4	57.6	-13.3	341.5	323.9	-5.2
	Juvenile	18.8	16.7	-11.2	60.0	57.5	-4.2
December	Adult	64.7	57.6	-11.0	348.5	330.9	-5.1
	Juvenile	18.3	16.7	-8.7	61.1	58.5	-4.3

1/ The amount of Weighted Usable Area is expressed in 1,000 units. Average water year is defined as 1968 flows.

Table 7
Monthly Pre- and Post-Project Rainbow Trout Habitat
In Lower Gooseberry Creek During Average Water Year[1/]

Month	Life Stage	Pre-project	Post-project	Change (%)
January	Adult	44.1	43.2	-2.0
	Juvenile	21.0	21.0	0.0
February	Adult	44.5	43.5	-2.2
	Juvenile	21.1	21.0	-0.5
March	Adult	44.5	43.2	-2.9
	Juvenile	21.1	21.0	-0.5
April	Adult	65.6	50.0	-23.8
	Juvenile	29.4	22.3	-24.1
May	Adult	142.1	133.0	-6.4
	Juvenile	49.7	51.9	+4.4
	Spawning	0.0	0.0	-
June	Adult	141.9	132.9	-6.3
	Juvenile	47.8	51.9	+8.6
	Spawning	0.3	0.0	-100.0
July	Adult	87.0	66.3	-23.8
	Juvenile	35.1	29.7	-15.4
	Spawning	0.0	0.0	-
August	Adult	79.4	56.3	-29.1
	Juvenile	35.3	25.2	-28.6
	Spawning	0.1	0.0	-100.0
	Fry	62.6	51.8	-17.3
September	Adult	54.4	44.2	-18.8
	Juvenile	24.3	21.0	-13.6
	Fry	49.7	48.8	-1.8
October	Adult	44.8	41.7	-6.9
	Juvenile	21.1	20.9	-0.9
November	Adult	42.9	41.4	-3.5
	Juvenile	21.0	20.9	-0.5
December	Adult	43.5	42.0	-3.4
	Juvenile	21.0	20.9	-0.5

1/ The amount of Weighted Usable Area is expressed in 1,000 units. Average water year is defined as 1968 flows.

Table 8
Monthly Pre- and Post-Project Cutthroat Trout Habitat In Fish Creek During Average Water Year1/

Month	Life Stage	Pre-project	Post-project	Change (%)
January	Adult	362.7	363.0	+0.1
	Juvenile	85.3	85.5	+0.2
February	Adult	370.4	365.7	-1.3
	Juvenile	85.8	85.3	-0.6
March	Adult	414.2	406.6	-1.8
	Juvenile	88.3	88.3	0.0
April	Adult	476.9	456.1	-4.4
	Juvenile	87.5	87.8	+0.3
May	Adult	666.4	694.6	+4.2
	Juvenile	226.7	235.4	+3.8
	Spawning	0.8	6.0	+650.0
June	Adult	680.8	714.1	+5.0
	Juvenile	231.2	229.4	-0.7
	Spawning	1.7	21.8	+1,182.4
July	Adult	603.4	575.2	-4.7
	Juvenile	91.3	88.3	-3.3
	Spawning	39.8	27.3	-31.4
August	Adult	489.6	454.1	-7.3
	Juvenile	87.4	87.8	+0.5
	Spawning	17.8	14.2	-20.2
	Fry	88.6	84.2	-5.0
September	Adult	415.2	387.8	-6.6
	Juvenile	88.2	87.6	-0.7
	Fry	82.2	81.3	-1.1
October	Adult	369.2	362.5	-1.8
	Juvenile	86.0	85.2	-0.9
November	Adult	364.5	362.8	-0.5
	Juvenile	82.1	85.3	+3.9
December	Adult	363.1	363.9	+0.2
	Juvenile	85.5	85.9	+0.5

1/ The amount of Weighted Usable Area is expressed in 1,000 units. Average water year is defined as 1968 flows.

Table 9
Monthly Pre- and Post-Project Rainbow Trout Habitat In Fish Creek During Average Water Year1/

Month	Life Stage	Pre-project	Post-project	Change (%)
January	Juvenile	170.7	171.0	+0.2
February	Juvenile	173.1	171.5	-0.9
March	Juvenile	187.2	185.0	-1.1
April	Juvenile	203.1	198.4	-2.3
May	Juvenile	239.5	239.6	<0.1
	Spawning	45.9	44.9	-2.2
June	Juvenile	240.2	238.8	-0.6
	Spawning	48.4	36.9	-23.8
July	Juvenile	224.0	219.5	-2.0
	Spawning	23.6	18.2	-22.9
August	Juvenile	202.6	197.9	-2.3
	Spawning	11.0	8.2	-25.5
	Fry	226.4	223.1	-1.5
September	Juvenile	183.7	179.0	-2.6
	Fry	219.0	214.9	-1.9
October	Juvenile	172.7	170.5	-1.3
November	Juvenile	171.1	170.8	-0.2
December	Juvenile	171.0	171.6	+0.4

1/ The amount of Weighted Usable Area is expressed in 1,000 units. Average water year is defined as 1968 flows.

Table 10

Narrows Project
Aquatic Impacts and Recommended Mitigation Measures

Impacts	Mitigation Commitment
Stream Fisheries	
Gooseberry Creek tributaries - Loss of 4.3 miles (spawning cutthroat).	Restore year-round flows in 2.3 miles of tributaries and stabilize 3.0 miles of middle Gooseberry Creek.
Upper Gooseberry Creek - Loss of 1.0 mile (all life stages cutthroat); Middle Gooseberry Creek - 72% reduction in average annual flow for 3.0 miles (all life stages cutthroat); Lower Gooseberry Creek - 47% flow reduction for 7.1 miles. (Decrease of 5% adult and 4% juvenile low-flow habitat for cutthroat); Fish Creek - Average 17% flow reduction of 6.0 miles. (Decrease of less than 1% adult and juvenile low-flow habitat for cutthroat. Overall increase of 15% spawning and 3% fry habitat for cutthroat. Decrease of 1.3% adult and 0.5% juvenile low-flow habitat for rainbow. Overall decrease of 16% spawning and 2% fry habitat for rainbow.)	Acquire, fence, and improve fishery habitat on the following stream segments: Mud Creek 4.0 miles Winterquarters Creek 2.5 miles Upper Fish Creek 1.0 mile Pondtown Creek 2.0 miles Price River below Scofield Reservoir 2.0 miles
Upper Cottonwood Creek - No summer flow increase, 2 cfs winter flow provided.	Construct Upper Cottonwood Creek Pipeline and provide 2 cfs winter release.
Lower Cottonwood Creek - Average 162% annual flow increase. Average 300% summer flow increase. Loss of 4.9 miles of habitat for all life stages for Rainbow, Cutthroat, and Brown Trout.	Provide 2 cfs minimum flow during irrigation season in lower Cottonwood Creek, Acquire (as necessary), fence, and improve fishery habitat on 4.0 miles of Starvation Creek.
Reservoir Fisheries	
Scofield Reservoir - Increased potential for poor water quality resulting in fish kills, loss of some natural reproduction in rainbows. Reduced surface area resulting in reduced standing crop of fish and loss of 4,500 angler days per year.	Reduce external phosphorus loading by improving riparian areas along Mud Creek, Winterquarters Creek, Upper Fish Creek, and Pondtown Creek. These measures will also improve habitat for all life stages of cutthroat and rainbow trout including spawning. Lost angler days would be replaced by fishery in Narrows Reservoir.
Lower Gooseberry Reservoir - Increased potential for poor water quality resulting in fish kills.	Provide 300 acre-feet of water from Narrows Reservoir to be used for instream flow augmentation in consultation with UDWR.
Fairview Lakes - Lower fishing pressure, less severe drawdown during fishing season.	Beneficial impact. No mitigation required.
Narrows Reservoir - New reservoir fishery.	Would provide approximately 13,700 angler days use.

NARROWS PROJECT
SUPPLEMENTAL DRAFT
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX E

CULTURAL RESOURCE COORDINATION

SEP 10 1997

UC-325
ENV-3.00

CERTIFIED - RETURN RECEIPT REQUESTED

Mr. Max J. Evans
Utah State Historic Preservation Officer
300 South Rio Grande
Salt Lake City UT 84101

Subject: Gooseberry Narrows Environmental Commitments - Cultural Resources

Dear Mr. Evans:

In order to comply with Section 106 of the National Historic Preservation Act (NHPA) of 1966, the Provo Area Office of the Bureau of Reclamation wishes to consult with you concerning proposed environmental commitments regarding cultural resources compliance with NHPA on the Gooseberry Narrows Project.

The Gooseberry Narrows Project consists of construction of a dam and a small reservoir on Gooseberry Creek for the purpose of diverting water from the Price River drainage for the use of farmers in Sanpete County. The area of potential effect includes the zone of construction of the dam and reservoir, a 1/4 mile zone around the reservoir that will be used by fishermen and other recreational visitors, the zone of construction and use of recreational facilities associated with the project, improvements to an existing tunnel (which may itself be National Register eligible), the zone of construction of a delivery system (pipeline) for the water, and the zone of construction associated with enhancing wetlands as part of wildlife mitigation associated with the project.

Current Status of Project

The current status of this project is as follows: An environmental impact statement (EIS) is being prepared by the Provo Area Office, working with the Sanpete Water Conservancy District and with a private contractor. Because the project has been controversial, all parties wish to see a record of decision on the EIS prior to commencing with the environmental compliance work required, including cultural resources compliance. Therefore, the cultural resources work necessary to comply

with Section 106 takes the form of environmental commitments in the EIS. These commitments must be met prior to any construction on the project.

The current status of cultural resources compliance on the Gooseberry Narrows project is as follows: An inventory of the reservoir pool area was done by the University of Utah in 1976, and three sites (two prehistoric lithic scatters and one historic foundation) were recorded. The sites were not evaluated as to their National Register eligibility, and a testing program was recommended (but never completed). The current pool area is slightly different than the area inventoried in 1976, but there is a great deal of overlap with the 1976 inventory. A1992 letter from your office outlines steps that need to be taken in order to complete NHPA Section 106 requirements. The project has changed somewhat in scope since 1992, and the environmental commitments for cultural resources compliance for the present configuration of the project are outlined below.

Native American consultation regarding the project has been initiated. On August 5, 1997, Betsy Chapoose and Clifford Duncan of the Uintah-Ouray Ute Tribe toured the project area with Signa Larralde and Kerry Schwartz of the Provo Area Office and were briefed on the scope of the proposed project. The Uintah-Ouray Ute Tribe is the only tribe believed to have aboriginal ties to the project area. We are currently awaiting feedback from Ms. Chapoose and Mr. Duncan regarding any areas of traditional cultural importance within the project area. The only concerns expressed on the tour were that the Utes be provided with a list of plants in the project area, with the possible intent of plant collecting for medicinal use in the future.

Environmental Commitments for Cultural Resources Compliance

The following environmental commitments to be included in the EIS provide compliance with Section 106 of the National Historic Preservation Act:

- Evaluate three previously recorded sites in pool area as to National Register eligibility. Limited testing necessary in order to evaluate the sites will be accomplished through placing auger holes in a pattern on each site, or excavating test units.

- Inventory any of the pool area, dam construction zone, and road realignments not inventoried in 1976, including a 1/4 mile zone around pool area that would be impacted by recreational use of the reservoir. Inventory the location of all recreational facilities proposed in the project plan, plus all areas slated for wetlands enhancement.

- Inventory the rights of way for the proposed East Bench and Oak Creek pipelines, consisting of 16.1 linear miles of proposed water pipeline near Fairfield in Sanpete County.

- Inventory and evaluate the existing historic tunnel delivery system on Gooseberry Creek as to its National Register eligibility.

- Conduct a cultural resources overview of U.S. Forest Service information on historic features in and near project area; evaluate any features within the project area as to their National Register eligibility.

- Conduct a paleontological literature search and survey of the project area and its immediate vicinity, with the particular view of assessing the likelihood of recovering Pleistocene fauna during the project (the project area is near the site of the Huntington mammoth discovery).

- Consult with your office regarding the National Register eligibility of any historic or archaeological sites found during work associated with any of the above commitments. If we jointly reach the conclusion that significant sites will be impacted by the project, Reclamation will then consult with your office and with the Advisory Council on Historic Preservation to negotiate a Memorandum of Agreement that outlines mitigation measures to be taken prior to project construction to avoid adverse effects of the project on historic properties.

We would appreciate it if you would review the above environmental commitments and respond as to whether or not your office believes they will provide compliance with Section 106 of the National Historic Preservation Act. We would also appreciate any suggestions you may have as to how best to complete the cultural resources work and the consultation necessary for compliance. We would very much appreciate a response within 30 days of receipt of this letter, or by October 15, 1997.

Should you have any questions about the Gooseberry Narrows Project, please contact Signa Larralde at 524-3684.

Sincerely,

Larry Walkoviak

Larry Walkoviak
Manager, Resources Management Division

cc: Area Manager, Provo UT
Attention: PRO-406

David Peterson, President, Sanpete Water Conservancy District,
1484 South 70 West, Box 265, Mount Pleasant UT 84647

WBR:SLarralde:lw:09/03/97:801-524-3684:NARRWSHP.997

ORIGINAL

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September 16, 1997

Larry Walkoviak
Manager, Resources Management Division
Bureau of Reclamation
Upper Colorado Regional Office
125 South State Street, Room 6107
Salt Lake City UT 84138-1102

RE: Gooseberry Narrows Environmental Commitments

In Reply Please Refer to Case No. 94-0609

Dear Mr. Walkoviak:

The Utah State Historic Preservation Office received information on the project referenced above on September 11, 1997. After consideration of the letter and the seven environmental commitments, the Utah Preservation Office concur with the Bureau of Reclamation that they do meet the standards for Section 106 of the National Historic Preservation Act.

This information is being provided on request to assist the Bureau of Reclamation in identifying historic properties, as specified in §36CFR800, for Section 106 consultation procedures. If you have questions, please contact me at (801) 533-3555, or Barbara L. Murphy at (801) 533-3563. My email address is: jdykman@history.state.ut.us

As ever,

James L. Dykmann
Compliance Archaeologist

JLD:94-0609 BOR/NAE

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NARROWS PROJECT
SUPPLEMENTAL DRAFT
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX F

ENVIRONMENTAL COMMITMENTS

Appendix F

Narrows Project Supplemental Draft Environmental Impact Statement Environmental Commitments

The following list summarizes major environmental commitments for the Narrows Project, Utah. These commitments would be included in construction contracts and other agreements to ensure their implementation. Mitigation measures would be concurrent with project construction. If environmental commitments are not kept, project funding would be withheld by the Bureau of Reclamation. Additionally, the 404 Permit issued by the U.S. Army Corps of Engineers (USACE) could restrict filling of the reservoir if environmental commitments are not met.

1. Prior to initiation of final design and construction, detailed cultural resource surveys would be performed along the proposed alignments of the Upper Cottonwood Creek, Oak Creek, and East Bench Pipelines. If cultural resource sites are found, the pipelines would be re-routed where possible to avoid the impact. If the pipeline cannot be re-routed, appropriate mitigation would be developed through coordination with the State Historic Preservation Office.

2. Contractors would be required to cease work immediately if they should discover prehistoric, historical, or archeological evidence during construction. Work would not be resumed until such evidence is properly evaluated by qualified cultural resources specialists.

3. Evaluate three previously recorded sites in pool area as to the *National Register of Historic Places* (NRHP) eligibility. Limited testing necessary to evaluate the sites will be accomplished through placing auger holes in a pattern on each site or excavating test units.

4. Inventory any of the pool area, dam construction zone, and road realignments not inventoried in 1976, including ¼-mile zone around pool area that would be impacted by recreational use of the reservoir. Inventory the location of all recreational facilities proposed in the project plan, in addition to all areas slated for wetlands enhancement.

5. Inventory and evaluate the existing tunnel delivery system on Gooseberry Creek as to its NRHP eligibility.

6. Conduct a paleontological literature search and survey of the project area and its immediate vicinity with the particular view of assessing the likelihood of recovering Pleistocene fauna during the project.

7. All construction activities would comply with applicable Federal and State laws, orders, and regulations relating to air and water quality. This would include obtaining proper permits, such as a 402 Storm Water Permit, from the State of Utah, and complying with any limitations imposed by those permits. Best management practices specified in the *Nonpoint Source Water Pollution Control Plan for Hydrologic Modification in Utah* would be implemented as a requirement of all construction contracts.

8. All construction contractors would be required to comply with Federal and State laws concerning the use of pesticides and hazardous wastes.

9. The asphalt road surface and road base would be removed from the reservoir basin.

10. All disturbed landscape would be recontoured and revegetated with native plant species immediately after project construction.

11. The Sanpete Water Conservancy District (SWCD) would have primary responsibility for implementation of all wildlife measures described in chapter 2 of the Narrows Project, Supplemental Draft Environmental Impact Statement (SDEIS). SWCD would be responsible for funding this action and acquiring all lands and easements. SWCD would provide native seed to supplement the U.S. Department of Agriculture Forest Service (USDA Forest Service) native seed mixture for the watershed and range improvement project identified as mitigation. SWCD would fund and construct all improvements, such as fencing for the range improvement project on USDA Forest Service land. This work would be performed concurrently with construction of other project facilities such as the dam, tunnel rehabilitation, and pipelines. All lands and rights-of-way would be acquired, and initial construction of wildlife measures would be completed prior to initial filling of the reservoir. SWCD also would be responsible for funding the mitigation monitoring. SWCD would be responsible to enter into memorandum of agreements (MOAs) with the Utah Department of Wildlife Resources (UDWR), USDA Forest Service, and other appropriate agencies for all wildlife measures. The MOAs clearly would define the roles and responsibilities of the SWCD, UDWR, USDA Forest Service, and other parties for implementation and maintenance of the wildlife measures.

12. SWCD would have primary responsibility for implementation of the wetlands measures described in chapter 2 of the SDEIS. SWCD would be responsible for funding this action and acquiring all lands and rights-of-way. SWCD would provide and transplant any native plantings needed. SWCD would be responsible to ensure that all fences are in good repair and are maintained properly. SWCD would also be responsible to install and maintain any diversion and/or irrigation

facilities. This work would be performed concurrently with construction of other project facilities, such as the dam, tunnel rehabilitation, pipelines, and canals. All lands and rights-of-way would be acquired and initial construction of wetlands measures would be completed prior to initial filling of the reservoir. SWCD also would be responsible to fund the monitoring of the wetland mitigation. SWCD would be responsible to enter into MOAs with UDWR, USACE, and other appropriate agencies for all wetlands measures. The MOAs would clearly define the roles and responsibilities of SWCD, UDWR, USACE, and other parties for implementation and maintenance of the wildlife measures.

13. SWCD would have primary responsibility for implementation of all fishery measures described in chapter 2 of the SDEIS. SWCD would be responsible for funding this action and acquiring all lands and rights-of-way. SWCD would fund and construct all improvements, such as fencing and stream channel improvements. SWCD would provide water from its water rights or enter into operating agreements for all instream flows described in chapter 2 of the SDEIS. This work would be performed concurrently with construction of other project facilities, such as the dam, tunnel rehabilitation, pipelines, and canals. All lands and rights-of-way would be acquired, and initial construction of fishery measures would be completed prior to initial filling of the reservoir. SWCD would be responsible to fund all operation and maintenance costs of mitigation facilities. SWCD would be responsible to enter into a MOA with the UDWR and other appropriate agencies for all fishery measures. The MOA would clearly define roles and responsibilities of SWCD, UDWR, and other parties for implementation, monitoring, and maintenance of the fishery measures.

14. SWCD would comply with all existing policies and regulations requiring the preparation, submittal, and implementation of a water conservation plan for the Narrows Project.

15. SWCD has adopted a policy that would require all recipients to implement conservation practices to be eligible for project water.

16. Re-initiation of the Section 7 consultation process would be required to discuss additional Endangered Species Act conservation measures in the event sufficient progress has not been achieved under the Recovery Implementation Program.