RECLAMATION
Managing Water in the West

East Canyon Reservoir Water Intake Structure Final Environmental Assessment and Finding of No Significant Impact

PRO-EA-08-003
PRO-FONSI-08-004

Weber Basin Project, Morgan County, Utah
Upper Colorado Region
Provo Area Office

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

September 2009

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.

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

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Chapter 1 – Need for Proposed Action and Background

1.1 Introduction

Summit Water Distribution Company (SWDC) has asked the Bureau of Reclamation (Reclamation) to approve its proposal to implement what is called Option 5, the East Canyon Pipeline, as analyzed and presented in the *Park City and Snyderville Basin Water Supply Study Special Report* (Reclamation 2006).

In March 2006, the Bureau of Reclamation, Provo Area Office distributed to the interested public, a report analyzing water supply options that might provide for future municipal and industrial water supplies for the Park City and Snyderville Basin area of Summit County, Utah. This report was completed as directed and authorized by the U.S. Congress; Reclamation was the primary author in preparing this report, with the Utah Division of Water Resources contributing to the study effort. In this report, Option 5 (East Canyon Pipeline) and Option 7 (Lost Creek Canyon Pipeline) were identified as preferred water supply options recommended for implementation.

Weber Basin Water Conservancy District (WBWCD) requested and Reclamation completed an environmental assessment which analyzed the impacts related to the development of Option 7, as analyzed in the water supply study. This option, providing for delivery of up to 7,500 acre-feet per year from Rockport Reservoir to the Signal Hill Water Treatment Plant via the Lost Creek Canyon pipeline, was authorized in February 2008 and is now in operation.

Through the WBWCD, SWDC asked Reclamation to undertake additional engineering and environmental analyses related to implementation of Option 5, the East Canyon pipeline. Some components of this option have already been planned and built by SWDC. A plan to divert up to 12,500 acre-feet per year of water from East Canyon Reservoir into facilities already built or under construction requires Reclamation authorization. This proposed action includes a water intake structure, a pump station, a booster station, 23.6 miles of powerline and transformers/substation, and 7.7 miles of 30-inch diameter pipeline. The pipeline would convey water from East Canyon Reservoir to an existing 30-inch pipeline built by SWDC at the Morgan/Summit County line on the East Canyon Road, and from there to Summit's East Canyon Water Treatment Plant in the Jeremy Ranch area of Summit County, Utah.

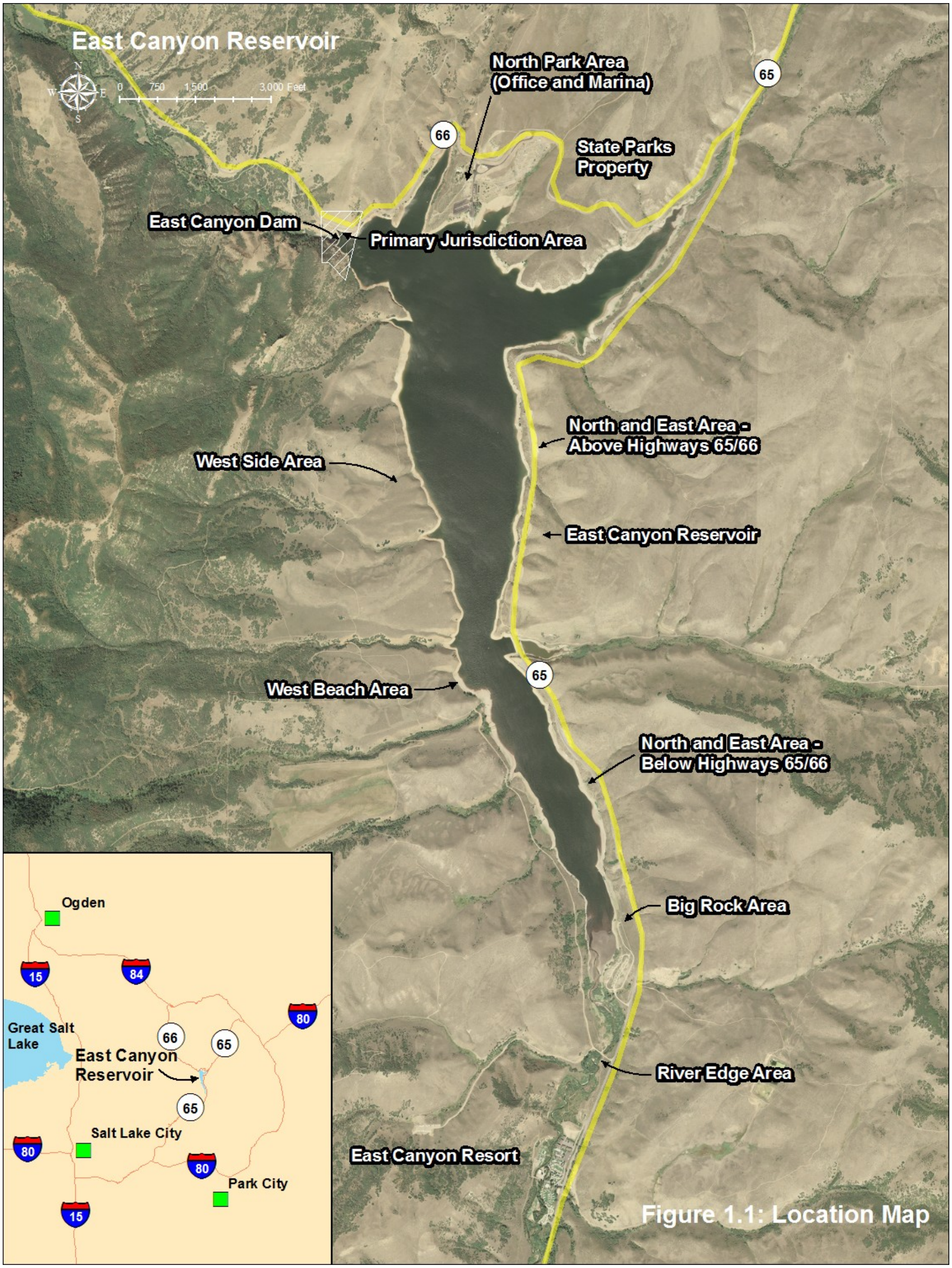
In order to analyze this proposed action, Reclamation has prepared this EA as required by the National Environmental Policy Act (NEPA), the Council on Environmental Quality, and U.S. Department of the Interior regulations implementing NEPA. This EA analyzes the potential impacts of Reclamation approving SWCD's proposal. As required by the NEPA implementing regulations, if potentially significant impacts to the human environment are identified, an environmental impact statement (EIS) will be prepared. If no significant impacts are identified, Reclamation will issue a Finding of No Significant Impact.

1.2 Background

East Canyon Reservoir, located in Morgan County, is on East Canyon Creek, a tributary of the Weber River in northern Utah, 9 miles south of the City of Morgan and 15 miles northeast of Salt Lake City (Figure 1.1). The reservoir rests at the 5,705 foot elevation and has a 681-acre surface area, with a 3.5-mile reach, and a width of about 2,000 feet. On the eastern side of the Wasatch Mountains, the climate in the vicinity of the reservoir is semiarid with dry summers and cold, snowy winters.

The original dam on East Canyon Creek was completed in 1899 by the Davis and Weber Counties Canal Company (DWCCC), to provide downstream irrigation water during the latter part of the growing season. In 1900 and 1902, the canal company raised the dam 25 and 17 feet, respectively, to a total dam height of 145 feet above bedrock. In 1916, an arched reinforced-concrete dam was completed just below the original dam, to further increase the reservoir's storage capacity. This dam served the area until 1964, when deterioration of the concrete necessitated the need for a new dam.

The current East Canyon Dam, completed in 1966 by Reclamation, is the fifth dam construction project in the East Canyon Creek Reservoir area. This dam was constructed as part of the Weber Basin Project, authorized by Congress on August 29, 1949 (63 Stat. 677), for the purposes of supplying irrigation water to lands, both new and presently irrigated; supplying municipal, industrial, and domestic water; controlling floods; and generating and selling electric energy and for other beneficial purposes (including, but without limitation, the control and catchment of silt, improvement of the general quality of the water, the preservation and propagation of fish and wildlife, and the provision and improvement of recreation facilities). The Secretary of the Interior authorized reimbursement of costs for constructing, operating, and maintaining (including reasonable provision for replacement) for irrigation, power, municipal, and other water supply purposes but flood control, recreation, and fish and wildlife purposes are nonreimbursable and nonreturnable.


East Canyon Reservoir
0 750 1,500 3,000 Feet
North Park Area
(Office and Marina)
65
66
State Parks
Property
East Canyon Dam
Primary Jurisdiction Area
North and East Area -
Above Highways 65/66
West Side Area
East Canyon Reservoir
65
West Beach Area
North and East Area -
Below Highways 65/66
Big Rock Area
River Edge Area
East Canyon Resort
Ogden
15
84
80
Great Salt
Lake
66
65
East Canyon
Reservoir
65
Salt Lake City
80
80
Park City
15
Figure 1.1: Location Map

Water released from East Canyon Dam is returned back to East Canyon Creek, where it flows to the Weber River and is diverted for domestic and irrigation uses. The present dam nearly doubled the East Canyon Reservoir water storage capacity from 28,800 acre-feet to 51,200 acre-feet. The DWCCC, through an agreement with Reclamation and the WBWCD, operates and maintains East Canyon Dam.

East Canyon reservoir is unique in that it stores both private and Federal water rights. By contract DWCCC stores and uses the first 28,000 acre-feet of storage per year under their private water rights in East Canyon Reservoir. Reclamation can store and use up to 23,200 acre-feet of storage per year depending on Federal water right priority dates and hydrologic yield of the reservoir (see table 3.3).

1.3 Purpose and Need and Scope of Analysis

The purpose of the proposed action is to authorize SWDC to build and operate facilities to deliver water to the Park City/Snyderville Basin area (Figure 1.2). The need for the proposed action is a growing demand for water in the Park City/Snyderville Basin area due to population growth and increased development of recreation facilities and vacation homes.

The scope of analysis in this EA is limited to consideration of whether or not Reclamation should authorize SWDC to proceed with their proposed new intake structure and pipeline and appurtenant facilities on Reclamation property. A number of studies over the years, most recently the February 2006 Special Report, published by Reclamation, have discussed and analyzed how to meet the growing demand for water in this area over the next 50 years. There are a number of possibilities for providing new sources of water for the Park City/Snyderville Basin area, which might involve Federal, state, or local government entities, or which could be developed by the private sector. These alternative water sources are also available to meet the need and growth trends if Reclamation did not grant SWDC permission.

The proposed action does not require significant changes to the operation of East Canyon Dam. Dam operations would continue within the wide range of historic operations.

1.4 Authorizing Actions, Permits, and Licenses

Implementation of the proposed action could require a number of authorizations or permits from State and Federal agencies. These are summarized below.

- Reclamation authorization needed under Section 10 of the Reclamation Project Act, August 4, 1939, to construct and operate facilities on Reclamation lands (25 year license agreement).

- Private land authorization needed to construct and operate facilities on or across private lands.

- State of Utah (State Engineer) authorization needed to allow DWCCC and Weber Basin Project water rights to be diverted from the new point of rediversion (the State Engineer has already approved the Exchange Application for the proposed action).

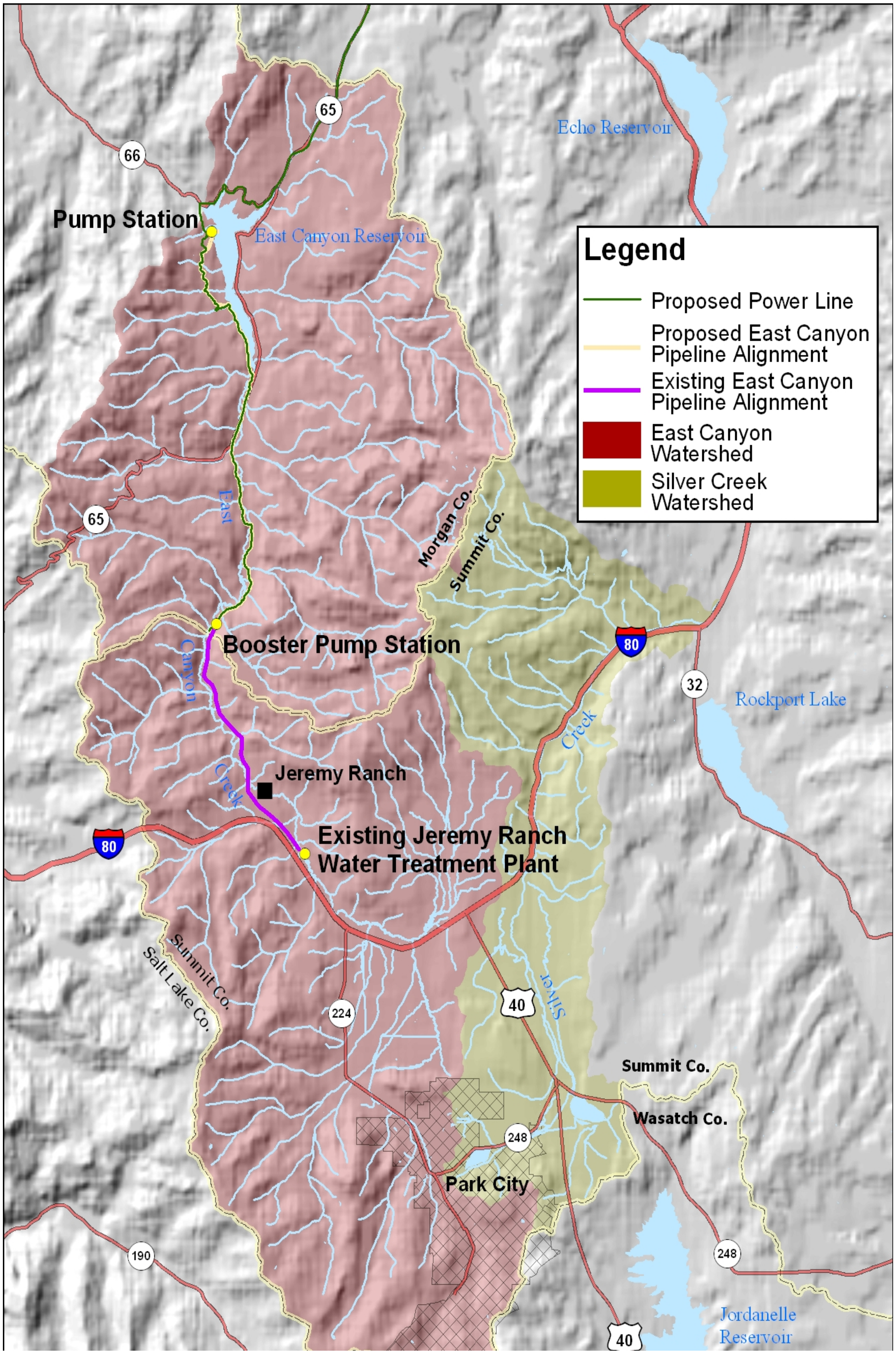
- Permit from the U. S. Army Corps of Engineers (USACE) in compliance with Section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act, as amended, would be obtained by SWDC.

- A Utah Pollutant Elimination System Permit from the State of Utah would be obtained by SWDC.

- A stream alteration permit from the State of Utah, Division of Stream Alteration would be obtained by SWDC.

- Water purchase agreement with or between Park City and SWDC.

- SWDC, if design alignment requires, would obtain the necessary easements or rights-of-way to connect the proposed pump station to the existing 30-inch pipeline.


Legend
Proposed Power Line
Proposed East Canyon Pipeline Alignment
Existing East Canyon Pipeline Alignment
East Canyon Watershed
Silver Creek Watershed
Pump Station
East Canyon Reservoir
Echo Reservoir
Booster Pump Station
Jeremy Ranch
Existing Jeremy Ranch Water Treatment Plant
East Canyon Creek
Silver Creek
Morgan Co.
Summit Co.
Salt Lake Co.
Wasatch Co.
Rockport Lake
Park City
Jordanelle Reservoir
65
66
80
32
224
40
248
190

1.5 Relationship to Other Projects

- Park City and Snyderville Basin Water Supply Study Special Report. As discussed in Section 1.3 above, the proposed action analyzed in this EA was discussed as Option 5 in the February 2006 Special Report.

- Change of Water Use in Willard Reservoir Final Environmental Impact Statement (EIS), January, 1989 (conversion over time of 30,000 acre-feet from agriculture water to municipal and industrial water). This EIS not only focused on conversion of water stored primarily in Willard Bay, but described how the WBWCD operates all Weber Basin Project facilities in a coordinated manner to assume that water rights are met and instream flows are maintained where applicable.

- Park City Municipal Corporation & Mountain Regional Water Special Service District Water Pipeline Interconnection & Water Treatment Plant. This project is for construction of a water pipeline designed to deliver raw water from Signal Hill Pond (which receives water from Rockport Reservoir), to Quinn's Junction to a planned water treatment plant for treatment prior to final delivery to Park City. This project is an extension of the Option 7 (Lost Creek Canyon Pipeline), identified as the other preferred option recommended for implementation in Reclamation's "Park City and Snyderville Basin Water Supply Study Special Report, February 2006." In that report, Option 5 (East Canyon Pipeline) and Option 7 (Lost Creek Canyon Pipeline) were identified as preferred options recommended for implementation.

Chapter 2 – Proposed Action and Alternatives

2.1 Introduction

The proposed action analyzed in this EA is Reclamation's authorization for SWDC to construct a new water intake structure at East Canyon Reservoir and pipeline crossing Reclamation lands. The EA will be used to determine the potential effects to the human environment and will serve to guide Reclamation's decision, along with other pertinent information, whether to implement the proposed action.

If Reclamation decides to implement the proposed action, SWDC, after obtaining the appropriate authorizations or permits (Section 1.4), would be authorized to proceed with its proposed project. A new water intake would be constructed in East Canyon Reservoir and the necessary pipeline, powerline, pumping station, and booster station would be constructed in order to convey this water to an existing 30-inch pipeline, built by SWDC at the Morgan/Summit County line on the East Canyon Road.

The proposed action would be designed with the capacity to withdraw up to 12,500 acre-feet per year of water from East Canyon Reservoir into facilities already built or under construction. The 12,500 acre-feet is expected to be a combination of Federal and private water with the private water being subject to valid water rights granted by the state engineer.

If authorized to proceed, initially SWDC would construct, operate, and maintain this new system with the potential for WBWCD or Reclamation operating the system in the future.

A number of action alternatives have been identified and considered in preparing this EA, along with a no action alternative to facilitate comparison of potential effects of the proposed action.

2.2 No Action Alternative

Under the no action alternative, Reclamation would not authorize SWDC to construct the proposed water intake structure, pumping station, and other project features at East Canyon Reservoir.

Development would continue and existing water rights would be fully utilized in an effort to satisfy the increasing demand for water, although, available water supplies are already behind the projected demand curve. The no action alternative would have no change in project features.

2.3 Action Alternative

The action alternative proposed by SWDC is a Lake Tap intake structure and pipeline to withdraw water from the reservoir. Up to 12,500 acre-feet of water per year would be delivered via this pipeline to the existing Jeremy Ranch water treatment plant. Of this water to be developed, 5,000 acre-feet of private water would come from a long term lease agreement from DWCCC to SWDC, approximately 2,000 acre-feet of private water would come from existing shares held by SWDC, and 5,500 acre-feet of private or Federal water could come from additional water acquisitions from the Weber Basin Project or DWCCC. In addition to the 12,500 acre-feet of project water, SWDC would voluntarily dedicate 2 cfs of the pipe capacity for non-consumptive water deliveries to help improve the East Canyon Creek fishery (Section 3.2.2.1).

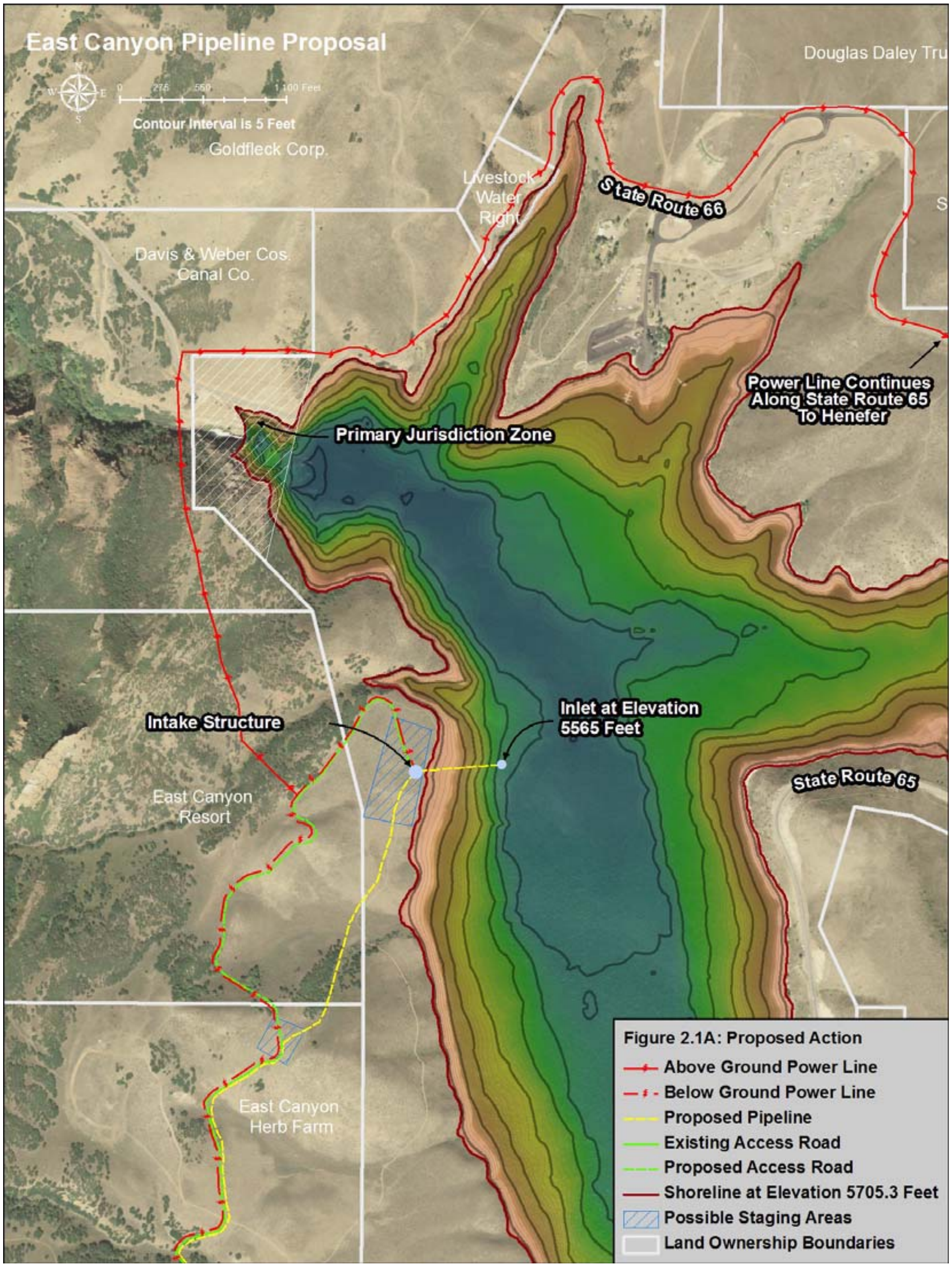
2.3.1 Lake Tap with Vertical Shaft Intake Structure

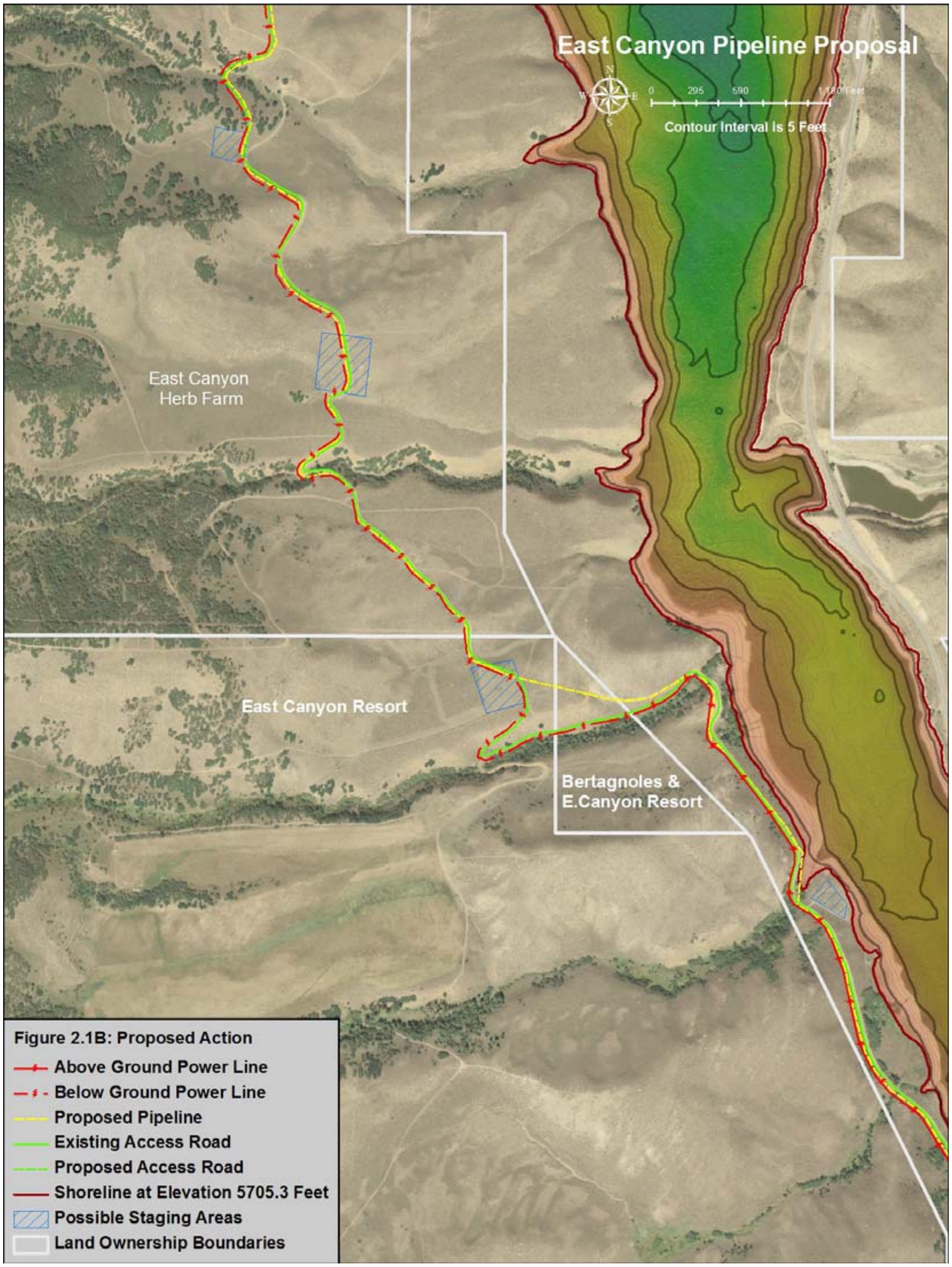
Reclamation is considering granting the necessary easements and approvals for the construction of facilities to pump water from East Canyon Reservoir and convey it upstream approximately 5 miles south of the East Canyon Resort (Figures 2.1A-2.1F).

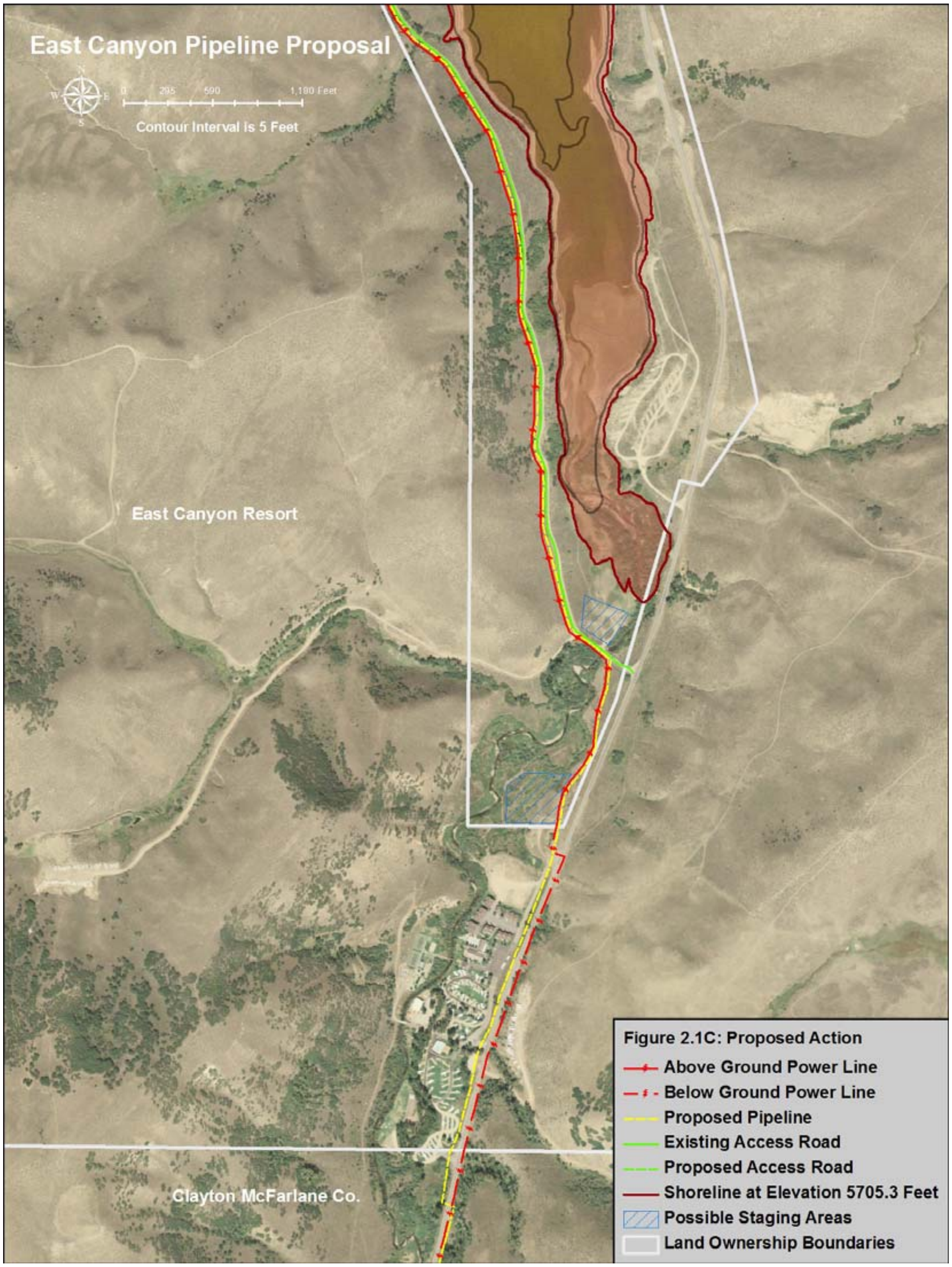
This action alternative would involve the construction of a large diameter vertical shaft that is connected to East Canyon Reservoir with a lateral (horizontal) tunnel. A vertical shaft with a lateral inlet tunnel, commonly referred to as a “lake tap,” is an established construction method that has been successfully implemented for several water supply projects, including those in Lake Havasu City, Arizona, and Las Vegas, Nevada.

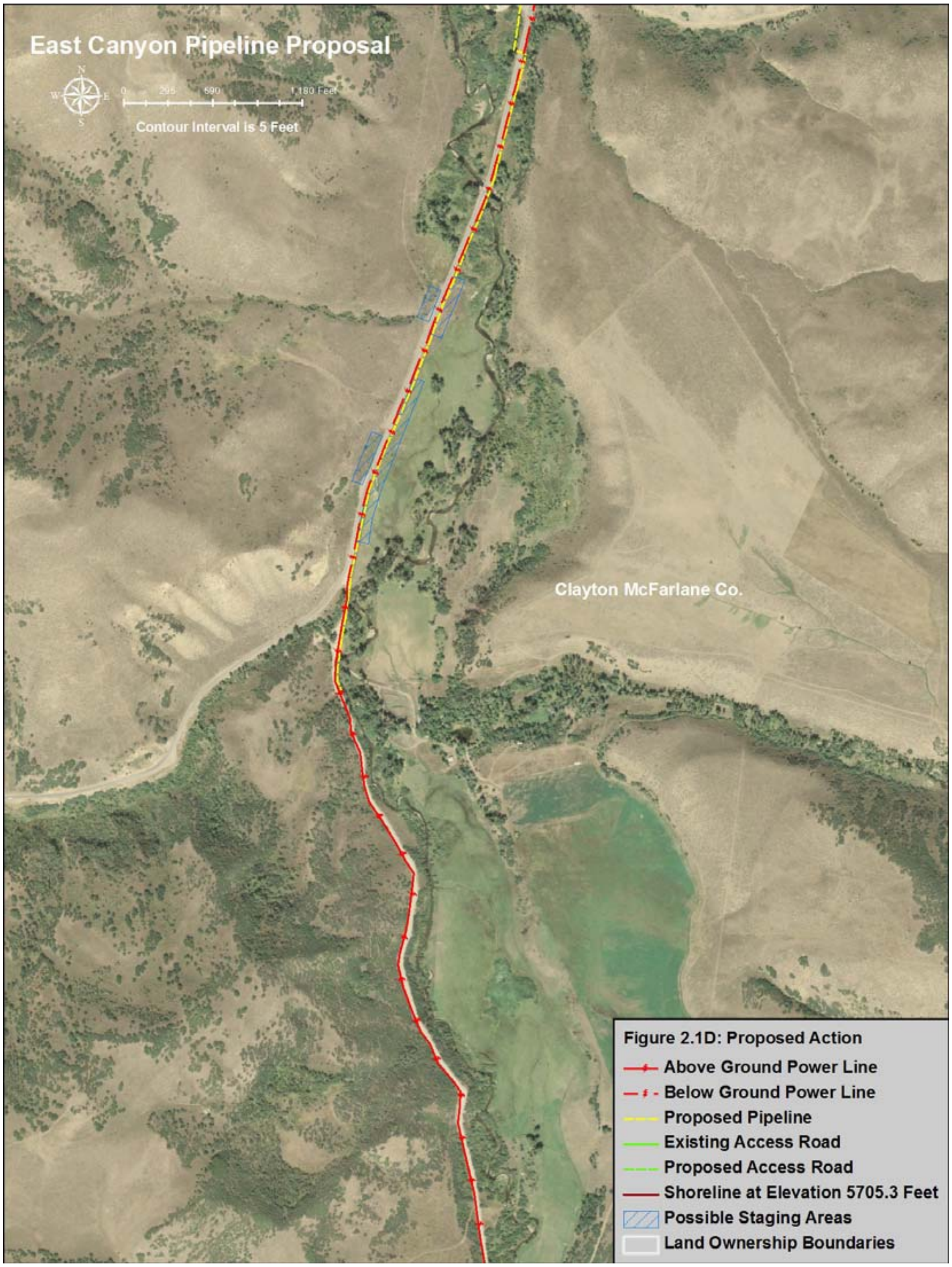
The preferred location for the lake tap structure is approximately 1/3 mile south of East Canyon Dam on the West Side bank of the reservoir (Figure 2.2). The lake tap structure would consist of a 15 to 20 foot diameter vertical shaft drilled at the edge of the reservoir roughly 160 feet deep. The lateral tunnel would be drilled at the bottom of the vertical shaft due east into the bottom of the reservoir. A 48-inch pipe would be extended through the lateral tunnel into the reservoir (Figure 2.3).

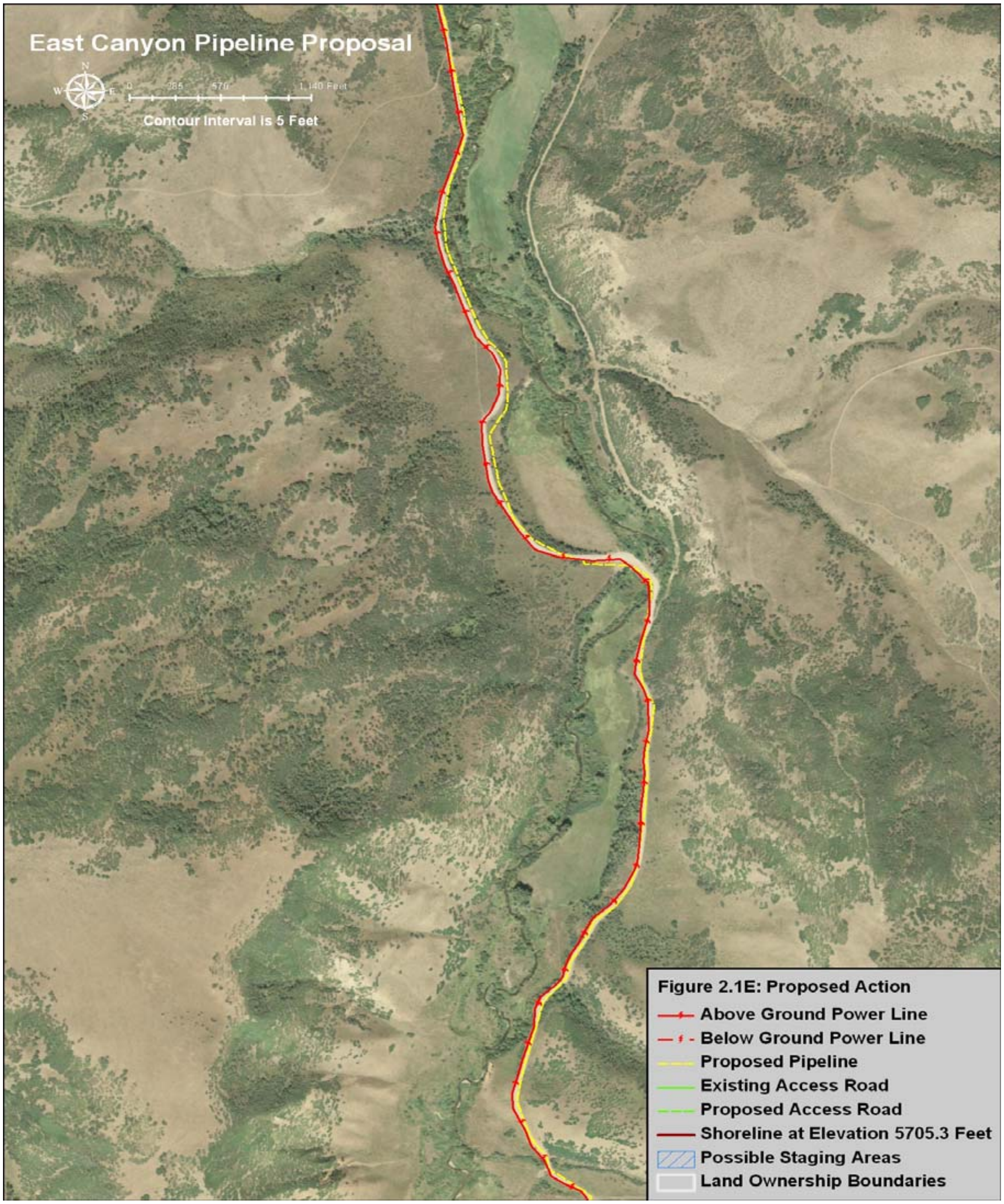
In order to obtain a consistent supply of water, the intake would be placed at elevation 5,565 feet which corresponds to half a foot above the top of dead pool and 12 feet below the top of inactive storage. The intake would be screened and a minimum of 15 feet off the reservoir bottom.

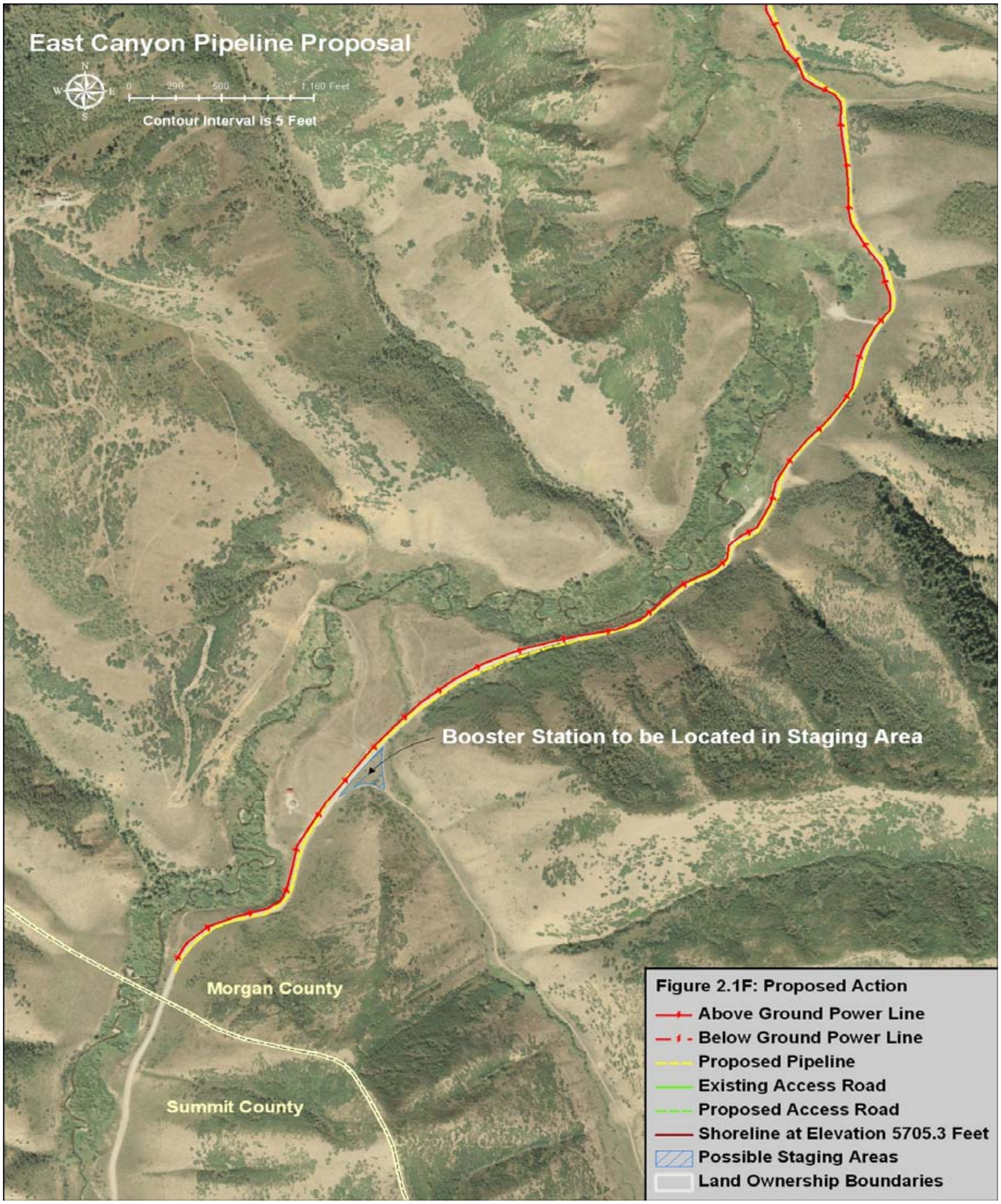

East Canyon Pipeline Proposal
Contour Interval is 5 Feet
Goldfleck Corp.
Livestock Water Right
State Route 66
Douglas Daley Tru
Davis & Weber Cos. Canal Co.
Power Line Continues Along State Route 65 To Henefer
Primary Jurisdiction Zone
Intake Structure
Inlet at Elevation 5565 Feet
State Route 65
East Canyon Resort
East Canyon Herb Farm
Figure 2.1A: Proposed Action
Above Ground Power Line
Below Ground Power Line
Proposed Pipeline
Existing Access Road
Proposed Access Road
Shoreline at Elevation 5705.3 Feet
Possible Staging Areas
Land Ownership Boundaries


East Canyon Pipeline Proposal
0
295
590
1,180 Feet
Contour Interval is 5 Feet
East Canyon
Herb Farm
East Canyon Resort
Bertagnoles &
E.Canyon Resort
Figure 2.1B: Proposed Action
Above Ground Power Line
Below Ground Power Line
Proposed Pipeline
Existing Access Road
Proposed Access Road
Shoreline at Elevation 5705.3 Feet
Possible Staging Areas
Land Ownership Boundaries


East Canyon Pipeline Proposal
0
295
590
1,180 Feet
Contour Interval is 5 Feet
East Canyon Resort
Clayton McFarlane Co.
Figure 2.1C: Proposed Action
Above Ground Power Line
Below Ground Power Line
Proposed Pipeline
Existing Access Road
Proposed Access Road
Shoreline at Elevation 5705.3 Feet
Possible Staging Areas
Land Ownership Boundaries


East Canyon Pipeline Proposal
Contour Interval is 5 Feet
Clayton McFarlane Co.
Figure 2.1D: Proposed Action
Above Ground Power Line
Below Ground Power Line
Proposed Pipeline
Existing Access Road
Proposed Access Road
Shoreline at Elevation 5705.3 Feet
Possible Staging Areas
Land Ownership Boundaries


East Canyon Pipeline Proposal
Contour Interval is 5 Feet
Figure 2.1E: Proposed Action
Above Ground Power Line
Below Ground Power Line
Proposed Pipeline
Existing Access Road
Proposed Access Road
Shoreline at Elevation 5705.3 Feet
Possible Staging Areas
Land Ownership Boundaries


East Canyon Pipeline Proposal
Contour Interval is 5 Feet
Booster Station to be Located in Staging Area
Morgan County
Summit County
Figure 2.1F: Proposed Action
Above Ground Power Line
Below Ground Power Line
Proposed Pipeline
Existing Access Road
Proposed Access Road
Shoreline at Elevation 5705.3 Feet
Possible Staging Areas
Land Ownership Boundaries

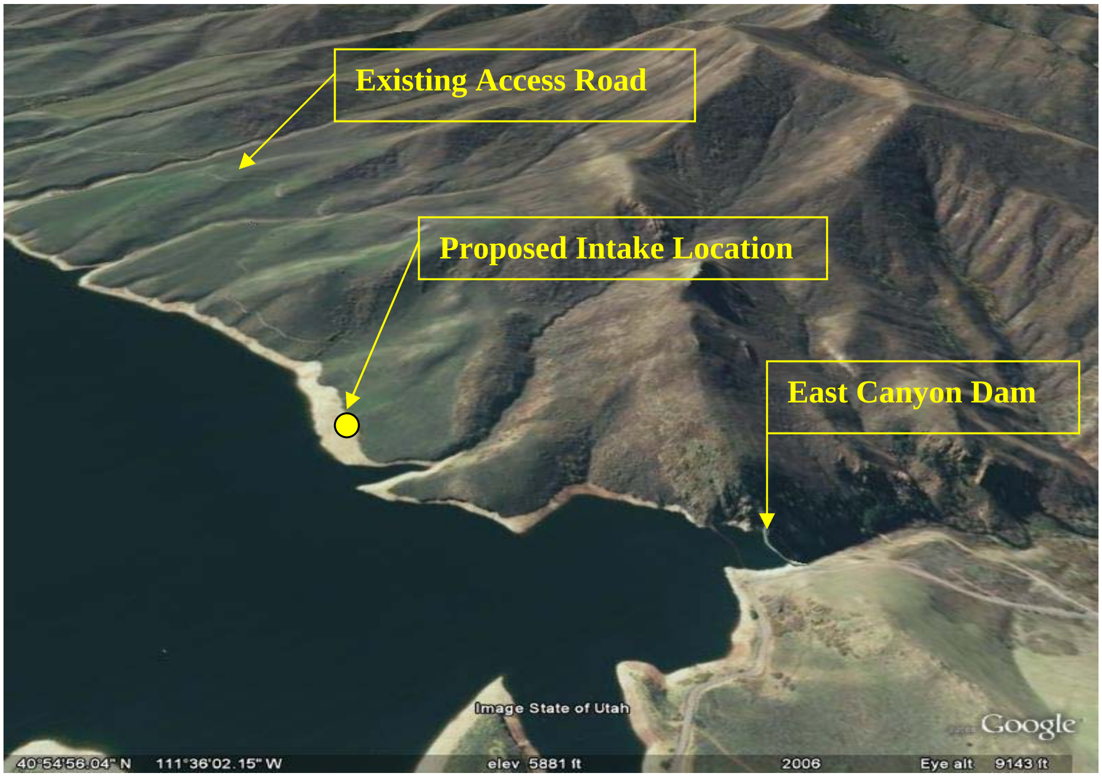


Figure 2.2: Intake Location

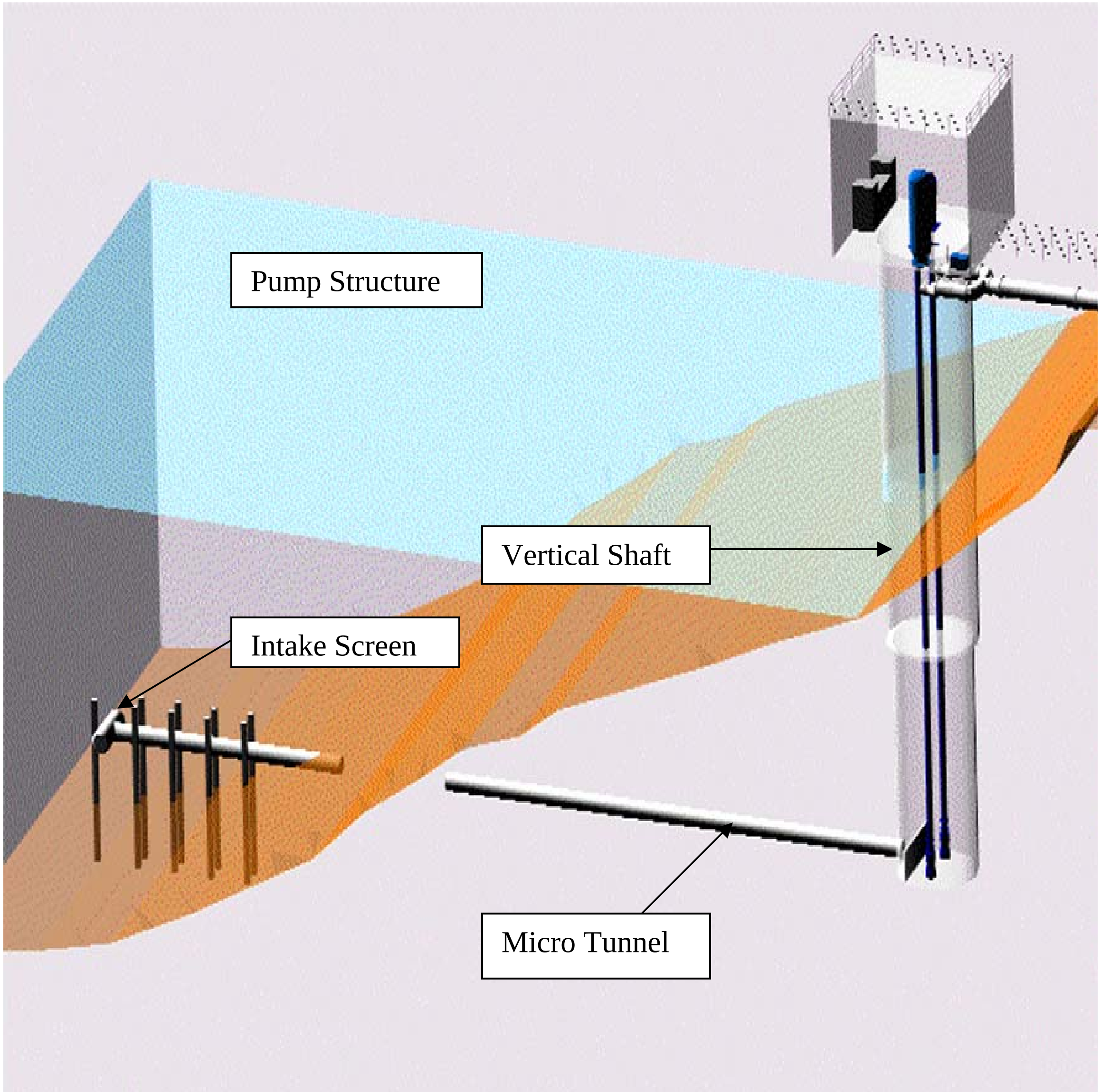


Figure 2.3: Lake Tap Structure

A pump station would be installed on top of the vertical shaft and the reservoir water would be pumped into a buried 30-inch pipe that would mainly follow the access road on the West Side of the reservoir. The buried pipe would follow the access road to where it tees with State Road 65, at which point the pipe would travel along the west shoulder of State Road for 1.5 miles to the intersection of the state road with East Canyon Road. From the intersection it would be buried in the East Canyon Road approximately 4 miles upstream to the Morgan/Summit County line and tie into an existing 30-inch pipe built and owned by SWDC.

The pipeline would require both a temporary and permanent 50 foot wide easement for construction, operation, and maintenance. Actual pipeline construction within the berm of the highway would result in 10 foot width of surface disturbance and 20 foot width of surface disturbance when constructed within the dirt road. Temporary staging areas along the pipeline would be required, including a large staging area (about 120 by 400 feet) at the intake site, and about 9 additional smaller staging areas along the pipeline. A permanent 120 by 200 foot easement would be required at the intake site which would include a power substation. The west access road would be a 28 foot wide paved road (for county road standards) and additional 15 feet width adjacent to the road required for powerline clearance, resulting in a temporary and permanent easement of 100 feet wide. Construction of the west access road and pipeline along the steep mountain terrain would require some large cuts and fills which would temporarily disturb a large area. The buried powerline (when not along the existing road) would need a 20 foot wide temporary easement and a 10 foot wide permanent easement. Most of the overhead powerline would be built in the existing road rights-of-way. The booster station would require 1.0 acre of temporary disturbance and 0.5 acres of permanent disturbance. Figure 2.4 summarizes surface disturbance from the proposed action.

Figure 2.4: Proposed Action Surface Disturbance

Project Feature	Length (miles)	Construction Disturbance (acres)	Preexisting Disturbance (acres)	New Disturbance (acres)	Temporary Disturbance (acres)	Permanent New Disturbance (acres)
pipeline (within road)	7.1	8.6	8.6	0	NA	NA
Pipeline	0.6	1.5	0	1.5	1.5	0
staging areas		35.1	15.1	20.0	35.1	0
lake tap, pump station, power substation		3.0	0	3.0	2.0	1.0
west access road	1.2	14.5	2.3	12.2	9.3	2.9
powerline (underground)	3.7	9.0	0	9.0	9.0	0
powerline (underground next to road)	3.0	7.3	7.3	0	NA	NA
powerline (overhead)	16.9	1.0	0	1.0	0.5	0.5
booster pump station		1.0	0	1.0	0.5	0.5
TOTAL		81.0	33.3	47.7	57.9	4.9

2.4 Alternatives Considered but Eliminated from Further Study

SWDC evaluated a number of alternatives in 1999 to develop a water supply of 5,000 acre-feet per year for the Snyderville Basin area. These alternatives are described in their report titled "East Canyon Pipeline Project, Environmental Assessment (Morgan and Summit Counties, Utah), September 1999." Their proposed action was called the West Side Alignment, and included a diversion facility consisting of five diversion intake pipes extending into the reservoir between the 1896 rock-fill dam and the 1916 concrete dam. This alternative is referred to as the 1999 Intake Structure and Upper Alignment.

SWDC also looked at the following options:

East Side Alignment – Alternative A
Development of Existing Water Rights
Direct Diversion from East Canyon Creek near Jeremy Ranch
East Side Alignment – Alternative B
East Side Alignment – Alternative C
West Side Alternatives – several pipeline alignments

Reclamation did not re-evaluate the alternatives already studied in detail by SWDC. However, during the Value Engineering study effort, the following additional ideas/alternatives were considered, but eliminated from further study. These alternatives could also function to locate a reliable source of water and to lift water.

2.4.1 1999 Intake Structure and Upper Alignment

The intake structure was proposed to be located in Reclamation's primary jurisdiction zone and may not be allowable because of security concerns. The pipeline alignment was contested by the affected landowners and other publics.

2.4.2 Use Old Dam as an Anchor for Intake Structure

This alternative would require costly investigation and access would be difficult. It is also within Reclamation's primary jurisdiction zone and may not be allowed because of security concerns.

2.4.3 Floating Intake Structure

This alternative would not provide enough capacity for the head required and ice could pose a significant problem as well as public safety concerns.

2.4.4 Tap into Dam Outlet Works

This alternative was physically and economically difficult. A longer pipeline would be required, and it would be difficult to place the pipeline out of the steep canyon and around the dam. It would result in greater expense rather than savings.

2.4.5 River Intake Structure

This alternative was determined to be unreliable because of insufficient flows upstream of the reservoir Ice build up during winter operation could pose a problem for a river diversion.

2.4.6 Place an Intake Structure on the East Side of the Reservoir

This alternative was initially considered and eliminated from consideration because placing a pipeline along the east side of the reservoir would have required that a significant portion of Highway 65 be replaced. The reconstruction costs associated with rebuilding Highway 65 made an East Side pipeline alignment unfeasible.

2.5 Preferred Action Alternative

As a result of the analysis presented in this EA and other studies, Reclamation considers the Lake Tap with Vertical Shaft to be the preferred action alternative.

Chapter 3 - Affected Environment and Environmental Effects

3.1 Introduction

This chapter describes the environment potentially affected by the no action alternative, the action alternative, and the predicted impacts of the alternatives. These impacts are discussed under the following resource issues: water resources; Weber Basin Project operations; water rights; water quality; public safety, access, and transportation; recreation; visual resources; socioeconomics; cultural resources; paleontological resources; wetlands and vegetation; wildlife resources; and threatened, endangered and sensitive species. The present condition or characteristics of each resource is discussed first, followed by a discussion of the predicted impacts under the no action and action alternative. The environmental effects are summarized in Table 3.9 at the end of this chapter.

3.2 Affected Environment

3.2.1 Water Resources

East Canyon Reservoir is one of the features of the Weber Basin Project located in Northern Utah. As a multi-purpose storage reservoir, East Canyon provides irrigation, municipal and industrial water for DWCCC and the Weber Basin Project. The water is primarily delivered to areas on East Canyon Creek, the Weber River, and through the Gateway Canal to the Weber and Davis Canals and Aqueducts for lands and communities in Morgan, Weber, Summit, Box Elder and Davis Counties in the Great Salt Lake Valley.

Coordinated releases from Lost Creek, Rockport, A.V. Watkins, Causey, and Pineview Reservoirs from the Weber Basin Project, Smith and Morehouse Reservoir owned by the WBWCD, and Echo Reservoir from the Weber River Project, provide irrigation and domestic water to lands along the Upper Weber and Ogden River Valleys and eastern slopes and lower valley lands of Weber, Davis, Morgan, Summit and Box Elder Counties. Table 3.1 depicts the average annual water quantities for the Weber Basin Project.

East Canyon Reservoir is operated in conjunction with the seven other reservoirs listed above and in addition to the dams, there are seven project well sources that were drilled and equipped by Reclamation to be used by WBWCD as backup for municipal and industrial demand in the system. The maximum flow through the wells is 46.64 cfs (cubic feet per second) with an annual capacity of 33,761 acre-feet (see Table 3.2).

In full operation, the Weber Basin Project provides an average of 206,900 acre-feet of water annually for irrigation and municipal and industrial use in heavily populated and industrialized areas. This water is supplied from WBWCD system storage capacity of 385,126 acre-feet. Additionally, there is 33,761 acre-feet capacity available from the project wells that can be utilized to meet project demands.

Table 3.1: Weber Basin Project Average Annual Water Quantities

	Active Capacity (Acre-feet)	WBWCD Capacity (Acre-feet)	April-July Inflow (Acre-feet)
Weber River Basin	**408,720**	**312,028**	**371,600**
East Canyon	48,110	20,110	32,000
Echo	73,940	6,288	180,000
Lost Creek	20,010	20,010	17,200
Rockport	60,860	60,860	138,000
Smith & Morehouse	7,600	6,560	4,400
Willard Bay	198,200	198,200	off-stream dam
Ogden River Basin	**117,020**	**73,098**	**135,300**
Causey	6,870	6,870	2,300
Pineview	110,150	66,228	133,000
Total	**525,740**	**385,126**	**506,900**

Table 3.2: Weber Basin Project Wells

Well Name	Capacity (cfs)
Riverdale	6.64
S. Weber #1	10
S. Weber #2	10
Laytona	5
Clearfield #1	5
Clearfield #2	5
Bountiful 500 West	5
Total	**46.64**

3.2.2 Weber Basin Project Operations

East Canyon Reservoir is a multiple purpose storage unit of the Weber Basin Project. Filling and release procedures conform with the downstream water requirements, serving needs for irrigation, municipal, industrial, power, and flood control. Storage and distribution of project waters are regulated in accordance with the Weber Basin Project Operating Criteria. Water exchange agreements have been executed between the DWCCC and the downstream direct flow users.

Releases are generally determined in the following manner:

1. The DWCCC and the WBWCD provide authorization for water deliveries of their respective storage rights prior to the irrigation season, or whenever changes are required pursuant to their contract obligations.

2. The Weber River Water Commissioner, through his authorized Deputy Water Commissioner, takes delivery orders on a demand basis.

3. The Water Commissioner ascertains the maximum anticipated needs, including minimum fish and wildlife requirement, on a demand basis, and either personally makes or orders these releases to be made accordingly.

Most of the water is stored in East Canyon Reservoir from October to May. During this period, low releases are restricted to 5 cfs minimum flow. The remainder of the year, releases generally equal inflows plus storage releases. The reservoir stores water under the priority of the water rights (no time limits are associated with the water rights).

Forecasts of inflow to East Canyon Reservoir are made jointly by the National Weather Service and The Natural Resources Conservation Service. The forecasts are published as of the first of each month from January to June. The forecast numbers provide a basis for planning reservoir and project operations prior to and during the flood season and permit optimization and coordination of water supply and other reservoir functions.

Flood control regulations for East Canyon Reservoir have been developed by Reclamation and approved and issued by the USACE, as a comprehensive plan for flood control operations of the Weber Basin Reservoirs. The regulations provide that when water is stored within the flood control reservation of the reservoir, releases will be made as fast as possible without exceeding non-damaging capacities of the downstream channels. East Canyon Creek has a safe capacity of 200 cfs below the dam and 450 cfs at the mouth of East Canyon Creek.

Figure 3.1: East Canyon Reservoir Water Elevation

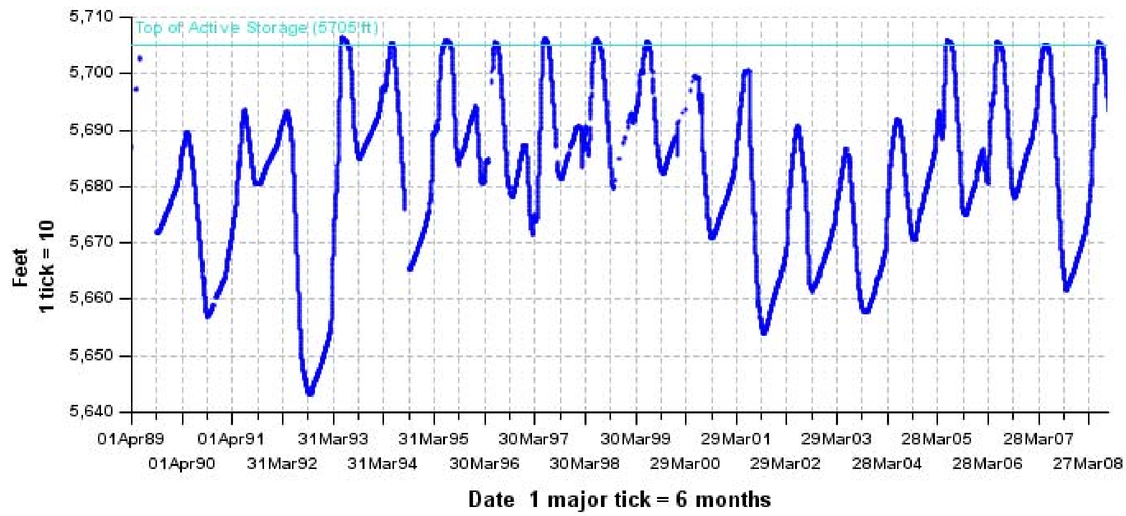


Figure 3.2: East Canyon Reservoir Total Water Storage

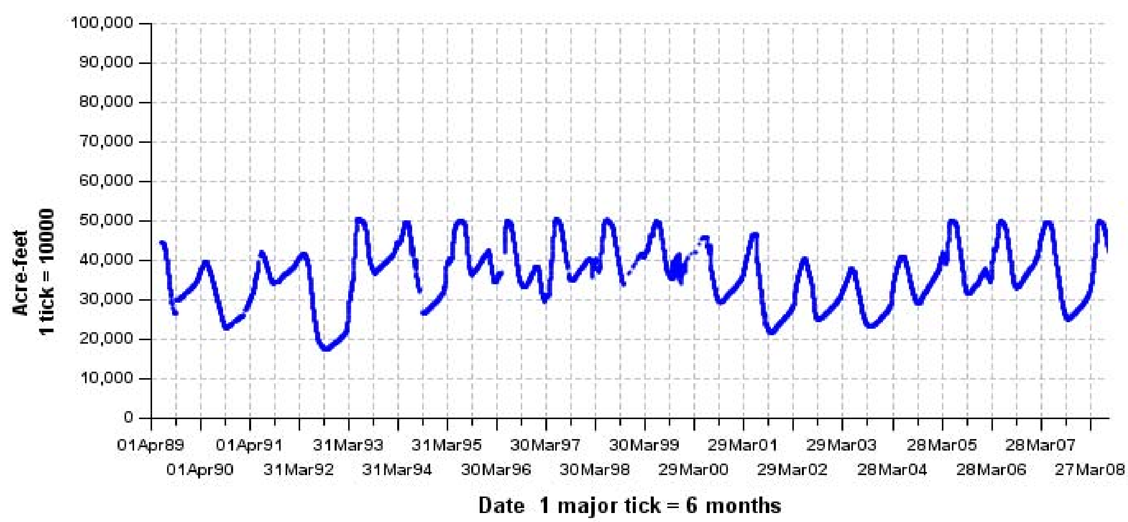


Figure 3.3: East Canyon Reservoir Inflows

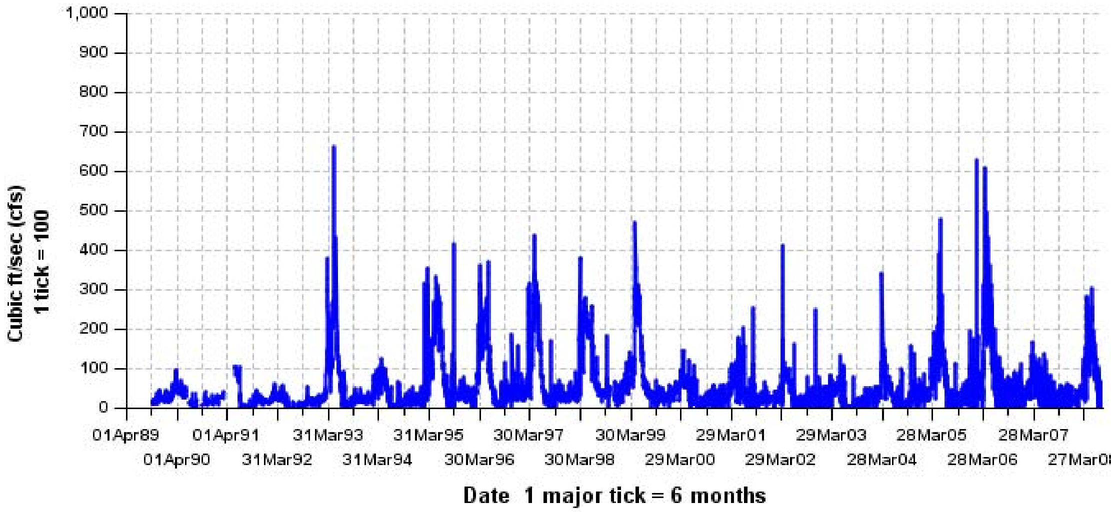
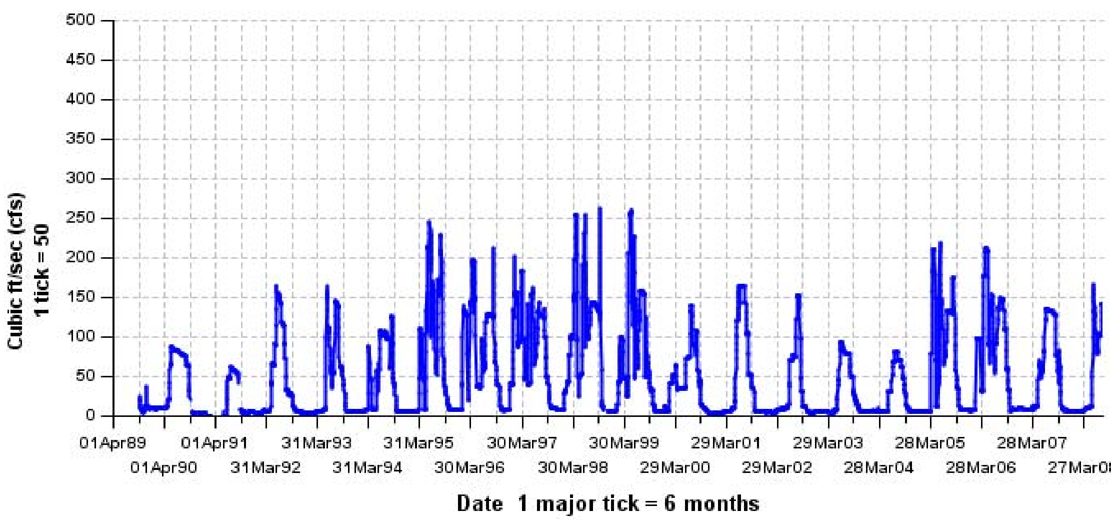


Figure 3.4: East Canyon Reservoir Releases



Historically, East Canyon Reservoir fills about half of the years, and storage drawdown typically does not go below elevation 5660, which is 83 ft above the bottom of active storage at 5577. When the reservoir is filling (October through May) inflows are generally high and can exceed 400 cfs, but during drought years, inflows can fall below 5 cfs. When the reservoir is filling, dam releases are generally low to store water and can go down to 5 cfs when inflows are low. When the reservoir is releasing water for late season irrigation (June through

September), inflows are generally low and releases are generally high from 10 cfs to above 150 cfs.

East Canyon reservoir is unique in that it stores both private and Federal water. By contract DWCCC stores and uses the first 28,000 acre-feet of storage per year under their private water rights in East Canyon Reservoir. This private water is almost exclusively used for agricultural irrigation and secondary water systems within cities along the Wasatch Front. Reclamation can store and use up to 23,200 acre-feet of storage per year depending on Federal water right priority dates and hydrologic yield of the reservoir (see table 3.3). Federal water is used for authorized Weber Basin Project purposes such as municipal and industrial and agricultural irrigation and secondary water. Much of this water is exchanged to mitigate for impacts from new private wells both upstream and downstream of the reservoir within the Weber River drainage.

3.2.2.1 East Canyon Fish Flow Water

In 1998, SWDC entered into an agreement with the Utah Division of Wildlife Resources (UDWR), to increase stream flows in East Canyon Creek and improve the fishery and natural steam environment of the creek above the reservoir. One of the significant provisions of the agreement was the voluntary dedication by SWDC of 2.0 cfs of pipeline capacity in the East Canyon Pipeline Project to UDWR, which allows UDWR to pump up to 2 cfs of water from East Canyon Reservoir to East Canyon Creek, in the Jeremy Ranch area of Summit County. Water from the dedicated capacity of the pipeline for non-consumptive flow of water would be released to East Canyon Creek near the SWDC East Canyon Water Treatment Plant to augment stream flows during periods of low flow and reduce water temperatures in the creek. Water used by UDWR for flow augmentation would be diverted for instream flow purposes and would be released at the discretion of UDWR. It is anticipated that flow augmentation would primarily occur during the late irrigation season when natural flows in East Canyon Creek are at their lowest.

Under another provision of the agreement, SWDC has also agreed to establish minimum instream flows above the reservoir at their water treatment plant point of diversion in East Canyon Creek under all of its water rights in the Snyderville Basin. Under the terms of the agreement, SWDC will not divert water from East Canyon Creek when flows in the creek are below 3.5 cfs, as measured at the East Canyon Water Treatment Plant. Following completion of the East Canyon Pipeline Project, the minimum instream flow limitation would be increased to 6.0 cfs, above the reservoir which is the minimum stream flow determined necessary to sustain a viable fishery in East Canyon Creek,

Because UDWR flow augmentation water would be pumped from the reservoir and released directly back into East Canyon Creek (which in turn flows directly back to East Canyon Reservoir), this water was not considered in the hydrology for the East Canyon Pipeline Project but was considered in the water quality modeling.

3.2.3 Water Rights

Water is stored in East Canyon Reservoir under water rights held by Reclamation and by DWCCC. Table 3.3 below summarizes these water rights. Because East Canyon Reservoir was enlarged several times since it was originally built, these water rights span a wide range of priority dates. These rights are allowed to store water in the reservoir only when all downstream senior water rights are satisfied.

Table 3.3: Summary of East Canyon Reservoir Storage Water Rights

WR Number	Owner	Priority Date	Annual Diversion Limit (acre-feet)
35-8389 (Decree)	D&WCCC	1896	13,000
35-8400 (Decree)	D&WCCC	8/16/1912	15,000
35-830 (A27611)	Reclamation	10/08/1955	17,000
35-1213 (A32372)	Reclamation	9/29/1960	6,200
Total			**51,200**

During the non-irrigation season, East Canyon Reservoir is able to store the entire inflow, minus a 5 cfs minimum release for downstream fishery purposes in East Canyon Creek. During the irrigation season, the reservoir is able to store a significant portion of the peak spring runoff, minus 35-50 cfs needed to satisfy irrigation water rights along East Canyon Creek downstream of the dam.

Currently East Canyon Reservoir fills when runoff is at or above normal. During times of multiyear drought, the reservoir may not completely fill (Figure 3.1). The reservoir is operated in a manner to ensure sufficient water deliveries are made from the reservoir and to bring the water storage below 35,000 acre-feet in the fall to allow adequate room in the reservoir for the incoming spring inflows.

Water stored in East Canyon Reservoir is used by DWCCC shareholders and WBWCD water users, in conjunction with other water rights and storage reservoirs. Table 3.4 lists the water rights DWCCC holds for the direct diversion from the Weber River into the Davis and Weber Counties Canal. DWCCC is able to meet their full water demand under these water rights until mid-June during drought years and mid-July during wet years. DWCCC calls for their storage water when they can't meet their full demand with the direct flow rights. In addition to their 28,000 acre-feet in East Canyon Reservoir, DWCCC is entitled to 40 percent (or 29,600 acre-feet) of the storage in Echo Reservoir on the Weber River. DWCCC has the right and can use water from either reservoir to supplement their water needs. Historically, DWCCC water uses from these two reservoirs has generally followed the ratio of two-thirds Echo water to one-third East Canyon water.

Table 3.4: Summary of DWCCC Direct Flow Water Rights

WR Number	Priority Date	Annual Diversion Limit (cfs)
35-8044 (Decree)	1881	46.15
35-8048 (Decree)	1889	36.923
35-8058 (Decree)	1902	46.15
35-8068 (Decree)	10/06/1909	215.0

WBWCD uses its portion of the stored water in East Canyon Reservoir in conjunction with the stored water at six other Weber Basin Project and WBWCD reservoirs. Additionally, WBWCD can use high Weber River flows under Water Right No. 35-835, which allows up to an 825.0 cfs diversion at the Slaterville Diversion Dam and has a September 8, 1955 priority date.

WBWCD and DWCCC have under the current operation procedures how they individually meet their water demands and they may soon have additional flexibility to trade water between them. In 2006, DWCCC filed Change Application No. a31535 to allow their water rights to be diverted into Weber Basin Project facilities and used within the WBWCD service area. Likewise, at the same time, WBWCD and Reclamation filed Change Application No. a31534 to allow Weber Basin Project water rights to be diverted into the Davis and Weber Counties Canal. Although neither of these change applications have been approved, the Utah Division of Water Rights has advertised both of them and they were not protested. WBWCD currently has the necessary pumps installed to deliver water from the Slaterville Diversion Dam to the Davis and Weber Counties Canal. If these change applications become approved, WBWCD can exchange project water at the Slaterville Diversion Dam for water stored in East Canyon Reservoir under the DWCCC water rights.

East Canyon Reservoir water supply does not appear to be fully utilized at this time. DWCCC records show that during the past ten years a large portion of their rental shares have not been fully used. Reclamation estimates that in any given year there are a large number of shares in the DWCCC system not being fully used. Additionally, WBWCD has not sold all the water available under the Weber Basin Project. WBWCD has indicated that they may have at least 5,000 acre-feet of additional water they could sell out of East Canyon Reservoir. Given the population growth along the Wasatch front and in the Weber River Valleys, Reclamation anticipates that over the next 50 years WBWCD will sell all the water available under the Weber Basin Project and that DWCCC water will be nearly fully used.

3.2.4 Water Quality

East Canyon Reservoir is classified and protected by the State of Utah for the following beneficial uses:

Class 1C - Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water.

Class 2A - Protected for primary contact recreation such as swimming.

Class 2B - Protected for secondary contact recreation such as boating, wading, or similar uses.

Class 3A - Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.

Class 4 - Protected for agricultural uses including irrigation of crops and stock watering.

The Weber River and tributaries, from Stoddard Diversion to headwaters, is classified for the following beneficial uses: Classes 1C, 2B, 3A, and 4. The Utah Division of Water Quality's "Utah 2006 Integrated Report Volume I:305(b) Assessment" dated June 15, 2006, states: "The major concern for the main stem of the Weber River is the possible impairment by total phosphorus. The periphyton community is changing to nutrient tolerant species which may cause a shift in the fisheries.[1] The Report also states regarding East Canyon Creek: "Total phosphorus is the major issue on this stream. The Utah Division of Water Quality (DWQ) required Snyderville Waste Water Treatment Plant to implement processing methods which would reduce the amount of phosphorus that was being discharged into the creek. A permit limit was set and monitoring is on going to determine if the limit will have a significant impact on the stream's aquatic vegetation, periphyton, and dissolved oxygen levels".

The Report also indicates that East Canyon Creek and tributaries from East Canyon Reservoir to the headwaters do not support their Beneficial Use Class 3A due to organic enrichment and low dissolved oxygen.

The DWQ is currently in the process of developing new or updated Total Maximum Daily Loads (TMDLs) for both the reservoir and the stream. The East Canyon Reservoir and East Canyon Creek TMDLs-Public Draft (East Canyon TMDLs, 2008) was made available in October 2008.

3.2.4.1 East Canyon Reservoir

The pollutants of concern for East Canyon Reservoir are low dissolved oxygen and excess total phosphorus. The defined targets/endpoints are expanded as follows (East Canyon TMDLs, 2008):

[1] Utah 2006 Integrated Report Volume I:305(b) Assessment, Department of Environmental Quality, Division of Water Quality, Salt Lake City, Utah

Trophic Status and Algae

In-reservoir mean seasonal chlorophyll a of 8 µg/L

Nuisance algal threshold of 30 µg/L not to be exceeded >10% of the season.

Algal dominance other than blue-green species

Dissolved Oxygen (DO)

Mixed reservoir periods: 4.0 mg/L DO throughout at least 50% of the water column

Stratified reservoir periods: 2 meter layer throughout the reservoir in which DO is maintained above 4 mg/ and temperature below 68ºF

Phosphorus

Mean total phosphorus concentration of 0.031 mg/L

Mean dissolved phosphorus concentration of 0.021 mg/L

In order to understand the targets of the East Canyon Reservoir TMDL it is important to understand certain reservoir processes and conditions described below such as thermal stratification, mixing periods, dissolved oxygen and phosphorus distribution, productivity, heavy metals, and discharges from the dam.

Thermal Stratification & Mixing

Thermal stratification in the reservoir begins when surface waters of the reservoir are heated by the sun and warmer air, typically in April of each year. Stratification is fully developed when there are three distinct thermal layers in the reservoir. The warm, upper layer is known as the epilimnion, the bottom colder layer is known as the hypolimnion, and the middle layer, known as the metalimnion, is a transition zone between the epilimnion and hypolimnion. Figure 3.5 illustrates these layers in a temperature profile from East Canyon Reservoir. Full development of stratification in the reservoir typically occurs by July. Due to density differences between the stratified layers little wind-driven mixing occurs between the layers. Turnover begins as days become shorter and air temperatures begin to cool, typically in September at East Canyon. As the epilimnion cools it begins to mix with the metalimnion. Eventually there are no distinct thermal layers and the reservoir becomes completely mixed, usually in December. Winds are able to mix the reservoir through the entire water column during this period. During the winter, East Canyon stratifies as surface water cools to less than 39°F and then freezes. Wind-driven mixing does not occur after the reservoir has frozen over. After the spring thaw the reservoir is again completely mixed for a period before stratification begins anew.

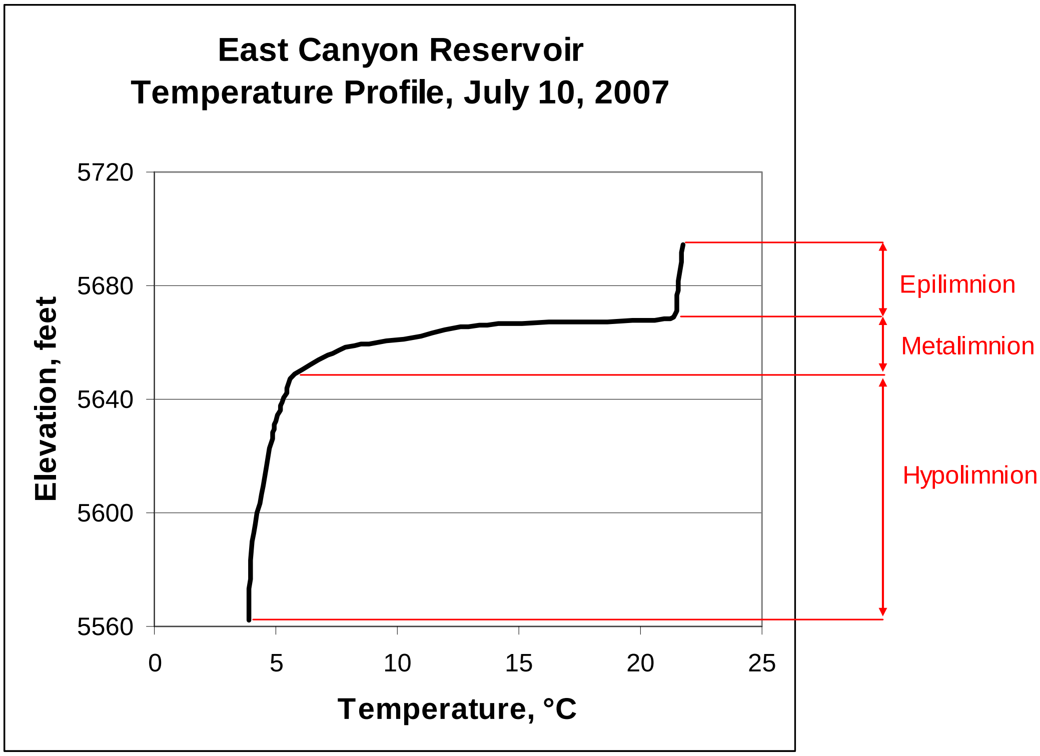


Figure 3.5: East Canyon Reservoir temperature profile illustrating thermal stratification.

Dissolved Oxygen Distribution

The minimum dissolved oxygen concentration required for a cold water fishery is 4.0 mg/L. Concentrations below this limit occur routinely in East Canyon Reservoir (East Canyon TMDLs, 2008). The distribution of dissolved oxygen in East Canyon Reservoir typically changes along with thermal stratification, turnover, and complete mixing. Before stratification begins to develop and after turnover dissolved oxygen concentrations in the water column are typically above the 4 mg/L threshold. This is because the reservoir is re-aerated from top to bottom by wind-driven mixing. Once stratification develops, re-aeration of surface waters does not mix through the water column. The hypolimnion is not re-aerated and decay processes begin to deplete the dissolved oxygen until the entire hypolimnion becomes anoxic. The anoxic conditions typically begin in June and persist until turnover begins in September.

Phosphorus

The State of Utah established total phosphorus criteria for lakes and reservoirs of 0.025 mg/L. Total phosphorus in East Canyon Reservoir exceeded the criteria in 52% of samples. Major sources of phosphorus loading to East Canyon Reservoir include discharge from East Canyon Water Reclamation Facility (ECWRF), forest and ski area management, runoff from agricultural lands, stormwater runoff, septic systems, natural background sources, and internal reservoir loading. In response to increased treatment at the ECWRF and nonpoint source pollution control efforts phosphorus concentrations in East Canyon Reservoir have declined since 2001 (East Canyon TMDL, 2008).

Productivity
Plankton growth, density, and distribution are important to the DO dynamics within the reservoir. They both produce and consume oxygen through photosynthesis, respiration, and decay. The anoxic conditions which develop in East Canyon Reservoir following stratification are largely due to the decay of dead algal cells. Phytoplankton are also an important part of the nutrient cycle, as they uptake phosphorus, nitrogen, and other nutrients before returning these nutrients to the water column through excretion or decay of dead algal cells.

Metals
Results of samples from East Canyon Reservoir do not indicate any violation of water quality criteria for the elements arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, or silver. In particular, sample analyses for cadmium, mercury, selenium, and silver resulted in non-detection of the elements. Results for other elements were below limits established to protect water for domestic uses, for cold water aquatic life, and for agricultural uses (East Canyon TMDL, 2008).

Dam Discharge
Water quality in East Canyon Reservoir and in East Canyon Creek below the dam is influenced by discharges from the dam. Water is discharged from East Canyon Dam through one of three features, a spillway, the outlet works, and a bypass. The spillway is an uncontrolled crest at elevation 5,705 feet. The outlet works withdraws water from an elevation of 5,535 feet. The bypass is at elevation 5,540.75 feet. The paths by which water flows before being discharged from the dam are unusual and complex due to existing submerged earthen and concrete dams located upstream of East Canyon Dam. Water discharged from East Canyon Dam must flow over the submerged earthen dam at an elevation of 5,573 feet and then either through a 5-foot diameter hole in the submerged concrete dam at elevation 5,567 feet or over its crest at 5,660 feet. Water discharged from the outlet works, therefore, is determined by reservoir elevations and by the flow paths over and through the submerged features.

3.2.4.2 East Canyon Creek
The pollutant of concern for East Canyon Creek is low dissolved oxygen associated with physical stream characteristics causing light and temperature pollution. The defined targets/endpoints are expanded as follows (East Canyon TMDLs, 2008):

1. Macrophyte biomass of 6.3 mg/cm^2 (Ash-free biomass)

2. Minimum dissolved oxygen no less than 4.0 mg/L

The factors contributing to impairment in East Canyon Creek are lack of shade and riparian vegetation along the creek, channel widening resulting in shallow reaches, and low stream velocity and flow during summer months.

Aquatic Vegetation
Dense aquatic vegetation in East Canyon Creek in the form of macrophytes and periphyton causes large daily swings in dissolved oxygen concentrations and results in dissolved oxygen concentrations less than 4.0 mg/L (East Canyon TMDLs, 2008). The lack of shade along the creek, shallow creek depths, and low velocities and flows in the creek contribute to the growth of aquatic vegetation in East Canyon Creek.

Nutrients
Among the conclusions of the TMDL's is phosphorus. Phosphorus is not the primary factor contributing to low dissolved oxygen in the creek and reducing phosphorus concentrations in the creek is unlikely to reduce aquatic vegetation (East Canyon TMDLs, 2008).

3.2.5 Public Safety, Access, and Transportation
The towns and communities of Morgan and Summit Counties are located in high mountain valleys between the Uinta and Wasatch Mountains. In addition to Park City, area towns include Morgan, Henefer, Coalville, Wanship, and other small communities. Major Highways serving the county include I-80, I-84, SR-65, and SR-66. SR-65 extends northerly from I-80 past the proposed project construction site. SR-65 divides into SR-65 and SR-66 which extend northerly to I-84.

3.2.6 Recreation
Recreational facilities at East Canyon State Park are managed by the Utah Division of Parks and Recreation under agreement with Reclamation. The managed season is all year with high use. The most preferred activities include boating, camping, fishing, and day use. The greatest numbers of fish caught are Rainbow Trout, Smallmouth Bass, and Brown Trout, respectively. Recreation facilities include at the more developed north end a boat ramp, boat storage area, day use, camping (including 4 yurt structures) rest rooms (wet and dry), sewage dump station and some facilities for the disabled. At the south end of the reservoir there is located two more smaller campgrounds.

Recreation use in 2006-07 totaled 109,446 and use in 2007-08 totaled 70,707. The majority of visitors come from the Wasatch Front.

3.2.7 Visual Resources
Reclamation uses the Forest Service's Visual Management System (VMS) to analyze and classify the existing visual opportunities that may be experienced by East Canyon reservoir visitors.

Visual integrity is the naturalness or, conversely, the state of disturbance created by human activity or alteration. Visual integrity is developed by combining

Scenic Quality Ratings assigned to a given use area with the User's Sensitivity Rating. Possible visual levels include the following:

Very High Integrity
Generally management allows for ecological changes only.

High Integrity
Management allows for man-made facilities and disturbances which are not evident to the casual visitor.

Moderate Integrity
Management allows for man-made facilities and disturbance which would appear visually subordinate to the natural landscape and should blend with or complement it.

Low Integrity
Management allows for man-made facilities and disturbances which visually dominate the natural landscape when viewed from up to a five-mile distance. The result of the activity should, however, blend with or compliment the natural landscape.

Very Low Integrity
Management allows for man-made facilities and disturbances which visually dominate the natural landscape and may not blend with or compliment the natural landscape when viewed from up to a five-mile distance.

In the case of East Canyon Reservoir, the majority of management areas are identified as having a moderate Visual Integrity Level, which indicates that the long-range results of humankind's activities within the specific area should remain visually subordinate to the natural-appearing landscape and should borrow naturally established line, form, color, and texture. The remaining management areas are classified as having low integrity, meaning that the long-range results of humankind's activities may dominate the natural-appearing landscape but borrow naturally established line, form, color, and texture. Table 3.5 summarizes the resultant visual integrity levels for the management areas identified at East Canyon Reservoir.

Table 3.5: Management Area Visual Integrity Rating

MANAGEMENT AREA	RESULTANT VISUAL INTEGRITY
Primary Jurisdiction Area	Moderate
North & East Area – above Hwys. 65/66	Moderate
North Park Area	Low
North & East Area – below Hwys. 65/66	Moderate
Big Rock Area	Low
River Edge Area	Moderate
West Side	Moderate
West Beach Area	Moderate
Reservoir Inundation Area (Full Reservoir)	Moderate
Reservoir Inundation Area (Empty Reservoir)	Very Low
State Parks Property	Moderate

3.2.8 Socioeconomics

As a water resource, East Canyon Reservoir has an active capacity of 48,110 acre-feet of project water for use by irrigators, municipalities, and other users in Morgan, Weber, and Davis County and other areas within the Weber Basin Project. As stated in the February 2006 Special Report, the population of the Park City/Snyderville Basin area is expected to grow from 23,859 to 86,327 by the year 2050. This represents a projected total future demand of approximately 30,600 acre-feet/year of water by the year 2050. The proposed action was one of two water supply options in the February 2006 Special Report, recommended for implementation to meet municipal and industrial needs in the immediate and near future.

East Canyon Reservoir serves as a significant source of recreation with the majority of visitors coming from the Wasatch front and from East Canyon Resort, located immediately upstream. Based upon visitation information, provided by the Utah Division of Parks and Recreation, and mean consumer surplus data for camping, fishing, and boating for State Parks in the Intermountain West taken from Kaval (2007), the annual benefit from recreation associated with East Canyon Reservoir over the past 5 years, was estimated to be approximately $3.8 million per year.

3.2.9 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, Native American and other sacred places, and artifacts and documents of cultural and historic significance.

Section 106 of the National Historic Preservation Act of 1966 (NHPA), mandates 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). Potential effects of the described alternatives on historic properties are the primary focus of this analysis.

3.2.9.1 Cultural History

Planning of the Weber Basin Project began in 1942 and was discontinued during World War II. It was resumed in 1946 when it became apparent that the marked increase of population drawn to the area by military installations during the war became permanent. An acute demand for municipal and industrial and irrigation water precipitated Congressional authorization of the project in August 1949. East Canyon Dam and Reservoir was completed in 1966.

3.2.9.2 Cultural Resources Status

According to the Section 106 regulations, 36 CFR Part 800 ("Protection of Historic Properties"), of the NHPA, the affected environment for cultural resources is identified as the APE (area of potential effects). The APE is the geographic area or areas within which a Federal undertaking may directly or indirectly cause alterations in the character or use of historic properties.

The APE defined in the action alternative analyzed for the proposed action, has been the subject of 100 percent pedestrian Class I and Class III cultural resource inventories by the Provo Area Office archaeologist in July, August, and September 2008, as well as May 2009. A total of 81 acres were inventoried. No historic properties were located. In compliance with 36 CFR 800.4(d)(1) and 36 CFR 800.11(d), a cultural resource inventory report and determination of no historic properties affected for the undertaking were submitted to the Utah State Historic Preservation Office (SHPO) for consultation and concurrence. In addition, copies of the report were also sent to tribes and additional consulting parties for consultation in compliance with 36 CFR 800.2.

3.2.10 Paleontological Resources

A paleontological file search was conducted for the project area by the Utah Geological Survey (UGS). Martha Hayden, Paleontological Assistant with the UGS, was consulted regarding the potential for encountering previously documented and presently unknown, paleontological resources in the vicinity of the project area.

The UGS reply, dated September 3, 2008, on file at the Provo Area Office, Bureau of Reclamation, stated that the Quaternary and Recent alluvial deposits and the Tertiary Norwood Tuff that are exposed along this project right-of-way have a low potential for yielding significant fossil localities.

3.2.11 Wetlands and Vegetation

Riparian Habitat

Riparian habitat exists along East Canyon Creek, both upstream and downstream of East Canyon Reservoir. This habitat varies from approximately 50 to over 100 feet in width and consists mostly of young willow (*Salix spp)*, some Nebraska sedge *(Carex nebrascensis*) and in places an overstory of narrow leaf cottonwood. Smooth brome (*Bromus inermus*), timothy (*Phleum pratense*) as well as several other introduced and native grass species (mostly wheat grasses) exist in and above the riparian corridor. Canada thistle (*Cirsium arvense*) has invaded the area in small patches. The proposed construction would occur parallel to this creek upstream of the reservoir within the berm of the existing road.

Upland Habitat

Both nonnative and native species of vegetation are found within the project area. Upland habitat consist mainly of big sagebrush (*Artemisia tridentata*), rabbit brush (*Chrysothamnus* spp.), and snowberry (*Symphoricarpos oreophilus*) with an overstory of Gambel oak (*Quercus gambelii*). Other species present include yellow sweet clover (*Melilotus officinalis*), houndstongue (*Cynoglossum officinale*), broom snakeweed (*Gutierrezia sarothrae*), golden currant (*Ribes aureum*), wild rose (*Rosa woodsii*), basin wildrye (*Elymus cinereus*), Rocky Mountain aster (*Aster adscendens*), Indian paintbrush (*Castilleja angustifolia*), field wormwood (*Artemisia campestris*) and curlycup gumweed (*Grindelia squarrosa*). Crested wheatgrass (*Agropyron cristatum*) has been seeded in previously disturbed areas.

Reservoir Habitat

Wetlands occur in limited locations around the perimeter of East Canyon Reservoir where intermittent and perennial creek drainages convey fine-textured sediment to the reservoir. Jurisdictional waters include the area defined by the high waterline of the reservoir and streams feeding the reservoir.

Most of the reservoir's perimeter consists of sagebrush, rock, or bare ground. A few areas of cottonwood trees exist along the shoreline. East Canyon Creek has developed a delta of willow habitat as it enters the reservoir. These areas require periodic inundation that provide sufficient hydrology to support these habitats.

Exposed reservoir bottom (existing during seasonally low reservoir levels) consists of muddy and rocky substrates, depending on the topography of the exposed shoreline. Large expanses of muddy exposed reservoir bottom typically occur where perennial creek drainages deposit fine-textured sediment into the reservoir.

Lands immediately surrounding the reservoir are infested with weed species including: broadleaf dock (*Rumex obtusifolius*), houndstongue (*Cynoglossum officinale*), cheatgrass (*Bromus tectorum*), Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), common sunflower (*Helianthus annuus*), common mallow (*Malva neglecta*), silversheath knotweed (*Polygonum argyrocoleon*), common cocklebur (*Xanthium strumarium*), lambsquarter (*Chenopodium album*), burdock (*Arctium minus*), black henbane (*Hyoscyamus niger*), Russian thistle (*Salsola tragus*), field bindweed (*Convolvulus arvensis*), wooly mullein (*Verbascum thapsu),* prickly lettuce (*Lactuca serriola*), white horehound (*Marrubium vulgare*), broadleaf plantain (*Plantago major*), prostrate vervain (*Verbena bracteata*), and salisfy (*Tragopogon dubius*).

3.2.12 Wildlife Resources

Wildlife resources within the general area of the project include fish, big game, smaller mammals, raptors, water birds, and upland game birds, with a variety of other birds, reptiles, and amphibians.

Fish

East Canyon Creek was formerly a very productive cold-water fishery into the1980s. However, important habitat parameters have been compromised including: lowered base flow level, increased water temperatures, decreased dissolved oxygen concentrations, and elevated phosphorous levels.

The fishery below East Canyon Reservoir consists mainly of brown trout (*Salmo trutta*) with lower numbers of mountain white fish (*Prosopium williamsoni*), rainbow trout (*Oncorhynchus mykiss*), and Bonneville cutthroat trout (*Oncorhynchus clarkii*). This reach is an important spawning tributary of the Weber River (UDWR 1998). A 5 cfs minimum release flow delivered to this reach from East Canyon Reservoir provides needed water during the critical months of fish egg incubation. Fall and winter flows are critical for successful spawning by brown trout.

East Canyon Creek above the reservoir has very few cutthroat trout. The rainbow trout population has also declined in the last few decades. A good population of brown trout is present in the reach. Kokanee (*Oncorhynchus nerka*) are no longer present.

The Kimball Creek fishery has been stocked with brown trout, but that will be discontinued and sterile tiger trout will be stocked in the future.

East Canyon Reservoir was the primary put-grow-take trout fishery in northern Utah from the late 1960’s to the late 1980’s (UDWR 1998). The reservoir also had a self-sustaining Kokanee population. Poor quality water and reduced inflow to the reservoir has reduced trout populations and eliminated the Kokanee population. Currently, catchable-size sterile rainbow trout and sub-catchable-size tiger trout are stocked by the UDWR in order to sustain a put-grow-and-take trout fishery. There are smallmouth bass and black crappie that were illegally stocked in the reservoir that are reproducing and contributing to the fishery.

Non-game fish, including Utah Sucker (*Catostomus ardens*), Utah chub (*Gila atraria*) and redside shiner (*Richardsonius balteatus*) reproduce in the reservoir and serve as forage fish for game species.

Big Game
The foothills and mountains surrounding the reservoir are covered mostly with sagebrush, grassland, juniper, and Gambel oak (*Quercus gambelii*) communities. This area provides summer and winter habitat for deer (*Odocoileus hemionus*) and elk (*Cervus elaphus nelsoni*). Moose (*Alces alces*) are occasionally observed along stream drainages near the reservoir. Mountain lion (*Felis concolor*), black bear (*Ursus americanus*), and coyote (*Canis latrans*) are present in the area.

Other Mammals
Other mammals common within the area include: yellow-bellied marmot *(Marmota plaviventris*), badger (*Tasidea taxus*), least chipmunk (*Eutamias minimus*), meadow vole (*Microtus montanus*), northern pocket gopher (*Thomomys talpoides*), deer mouse (*Peromyscus maniculatus*), porcupine *(Erethizon dorsatum*), and striped skunk (*Mephitis mephitis*). Furbearers such as beaver (*Castor canadensis*), mink (*Mustela vison*), and muskrat (*Ondatra zibethicus*), and ringtail cat (*Bassariscus astutus*) use the wetland and riparian habitat around the reservoir and embankments of creeks. Bobcat (*Lynx rufus*), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), Uinta ground squirrel (*Spermophilus armatus*), mountain cottontail (*Sylvilagus nuttallii*), and various species of shrews (*Sorex spp.*), voles (*Microtus spp.*), and bats (*e.g. Myotis app., Eptesicus fuscus*) occupy the area.

Raptors
Birds of prey (raptors) have been observed within or adjacent to the project area. Cottonwood trees along the river and the edge of the reservoir provide nesting habitat for raptors such as the golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis*), osprey (*Pandion haliaetus*), and roosting sites for the great horned owl (*Bubo virginianus*) bald eagle *(Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*). Winter months are the best time to view bald eagles near the reservoir. Other raptors observed in the area are the American kestrel (*Falco sparverius*), barn owl (*Tyto alba*), western screech owl (*Otus kennicottii*), great horned owl (*Bubo virginianus*), and turkey vulture (*Cathartes aura*).

Water Birds
Numerous water birds occur in the project area such as waterfowl, shore birds, and other wading birds typically associated with wetlands and open water. The reservoir provides high quality habitat for water birds due to the prevalence of emergent wetlands near the mouth of small drainages around the reservoir. These areas provide important forage and cover sites for waterfowl and wading birds.

East Canyon Reservoir serves as a migratory stopover for birds in the fall and spring. Emergent vegetation around the reservoir provides nesting habitat for a variety of waterfowl from mid-March to mid-July. Brood rearing begins mid-July to Mid-August. Mud flats exposed in late summer and fall provide foraging areas for shore and wading birds.

Water birds commonly observed include the pied-billed (*Podilymbus podiceps*), eared (*Podiceps caspicus*), and western grebes (*Aechnophorus occidentalis*), gadwall (*Anas strepera*), mallard (*Anas platyrhynchos*), cinnamon teal (*Anas cyanoptera*), northern shoveler (*Spatula clypeata*), lesser scaup (*Aythay affinis*), green-winged teal (*Anas carolinensis*), northern pintail (*Anas acuta*), common loon (*Gavia immer*), American white pelican (*Pelecanus erythrorhynchos*), double crested cormorant (*Phalacrocorax auritus)*, American coot (*Fulica Americana*), ring billed gull (*Larus delawarensis*), California gull (*Larus californicus*), great blue heron (*Ardea herodias*), killdeer (*Charadrius vociferous*), and Canada goose (*Branta canadensis*).

Upland Game Birds
Upland game birds occurring in the area include the ring-necked pheasant *(Phasianus colchicus*), mourning dove (*Zenaida macroura*), California quail (*Lophortyx californicus*), and sage-grouse (*Centrocercus urophasianus*).

Other Birds
The most common birds found within the project area are songbirds. Western kingbirds (*Tyrannus verticalis*), yellow warbler (*Dendroicapetechia*) and mountain bluebird (*Sialia currucoides*) are among the various species of songbirds that use the riparian and wetland habitat.

Corvids, including jays (*Cyanocitta spp.*), the black-billed magpie (*Pica pica*), and the common raven (*Corvus corax*), exist in the area. Tree swallow (*Tachycineta bicolor*), violet-green swallow (*Tachycineta thalassia*), northern rough-winged swallow (*Stelgidopteryx serripennis*), and cliff swallows (*Hirundo pyrrhonota*) all occur within the area. Of these, the most abundant are the cliff swallows. In open, shrub-dominated habitats goldfinch (*Carduelis tristis*), western meadowlark (*Sturnella neglecta*), common nighthawk (*Chordeiles minor*) sage thrasher (*Oreoscoptes montanus*), green-tailed towhee (*Pipilo chlorurus*), and rufous-sided towhee (*P. erythrophthalmus*) occur.

Reptiles and Amphibians
Reptiles and amphibians with potential to occur in the project area include the tiger salamander (*Ambystoma tigrinum*), boreal chorus frog (*Pseudacris triseriata*), great plains toad (*Bufo cognatus*), northern leopard frog (*Rana pipiens*), Great Basin gopher snake (*Pituophis melanoleucus deserticola*), and the Great Basin rattlesnake (*Crotalus viridis*). Historically, boreal toad (*Bufo boreas*) and Columbia spotted frog (*Rana lutieventris*) occurred in the area but have not been documented within the project area recently.

3.2.13 Threatened, Endangered, and Sensitive Species

Federal agencies are required to ensure that any action federally authorized or funded, would not adversely affect a federally listed threatened or endangered species. Several species listed as threatened or endangered occur within Morgan County or within the East Canyon Creek Drainage. These species are discussed below.

The bald eagle (Haliaeetus *leucocephalus*) (Formerly Threatened) is a winter resident of the area and is currently a Utah State species of concern. This species is protected under the Bald Eagle Protection Act. Bald eagles roost primarily in forested canyons or tall cottonwoods along streams and reservoirs. Migration of bald eagles from breeding areas generally takes place between September and December. These eagles use cottonwood trees and snags near open water as winter roosting sites.

Canada Lynx (*Lynx canadensis*) (Threatened), although they have not been seen, could possibly use forested areas and wetlands within or near the project area. The western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) (Candidate) may use the area during their breeding season but has not been seen in the area.

The State of Utah maintains a list of species of special concern. These species that may occur within the project area and are managed under conservation agreements are the Bonneville cutthroat trout (*Oncorhynchus clarkii utah*), Columbia spotted frog (*Rana luteiventris*), bluehead sucker (*Catostomus discobolus*), and northern goshawk (*Accipiter gentilis*). Other species of special concern that may occur within the area but are not managed under a conservation agreement are: bobolink (*Dolichonyx oryzivorus*), deseret mountainsnail (*Oreohelix peripherica*), ferruginous hawk (*Buteo regalis*), grasshopper sparrow (*Ammodramus savannarum*), greater sage-grouse (*Centrocercus urophasianus*), Lewis's woodpecker (*Melanerpes lewis*), lyrate mountainsnail (*Oreohelix haydeni*), sharp-tailed grouse (*Tympanuchus phasianellus*), western pearlshell (*Margaritifera falcate*), and boreal toad (*Bufo boreas*).

3.3 Environmental Effects of Alternatives

Assumptions applied in analyzing the effects of both the no action and the action alternative in this EA include the following: (a) analysis of the no action alternative assumes existing water rights would be fully used in the future to satisfy the increasing demand for water; and (b) normal dam operations within historic flexibility would continue during construction and after the project is completed.

3.3.1 Water Resources

3.3.1.1 No Action Alternative

The no action alternative would have no effect on water resources, except for lower operating water levels (average 25 to 35 feet below historic levels) in East Canyon Reservoir resulting from satisfying increased future downstream demands.

Under the no action alternative, other water delivery options would likely occur to satisfy demands, but which of these other options might be implemented cannot be determined at this time.

3.3.1.2 Action Alternative

The up to 12,500 acre-feet of water to be diverted to Park City and Snyderville Basin represents 3 percent of WBWCD total project storage rights. There is a contract agreement in place between SWDC and DWCCC, that DWCCC will immediately supply 5,000 acre-feet per year, which represents 17.86 percent of DWCCC storage water rights in East Canyon Reservoir, to SWDC upon completion of their East Canyon Reservoir Water Supply System. The existing contact was renewed this year. SWDC plans to use this water supply first, with subsequent water coming from their shares, additional water from DWCCC, or contracting with WBWCD for the remaining demand. SWDC is working with both entities to develop agreements to meet their long term needs.

The SWDC has 6,787 acre-feet of DWCCC water and may need up to an additional 5,713 acre-feet from WBWCD. Due to the number of storage facilities and the flexibility of operations within the project to meet demand, annually redirecting 5,713 acre-feet to the basin above the East Canyon Reservoir would not generate significant shortages for WBWCD and its water users on a project wide basis.

Flows in East Canyon Creek above the reservoir would be augmented by the proposed action increasing return flows. Immediate downstream releases may be reduced during dry periods to 5 cfs for a longer time. Return flows will increase inflow to the reservoir so releases will not fall to 5 cfs as often as the no action alternative. Spring releases will be slightly lower than the no action alternative (Figures 3.6 and 3.7).

Reservoir elevations may periodically exceed the no action alternative elevations due to return flows (Figure 3.8). Figure 3.8a shows that the proposed action average reservoir elevation is slightly higher than the no action average reservoir elevation. There would be no significant difference between the no action and proposed action alternatives.

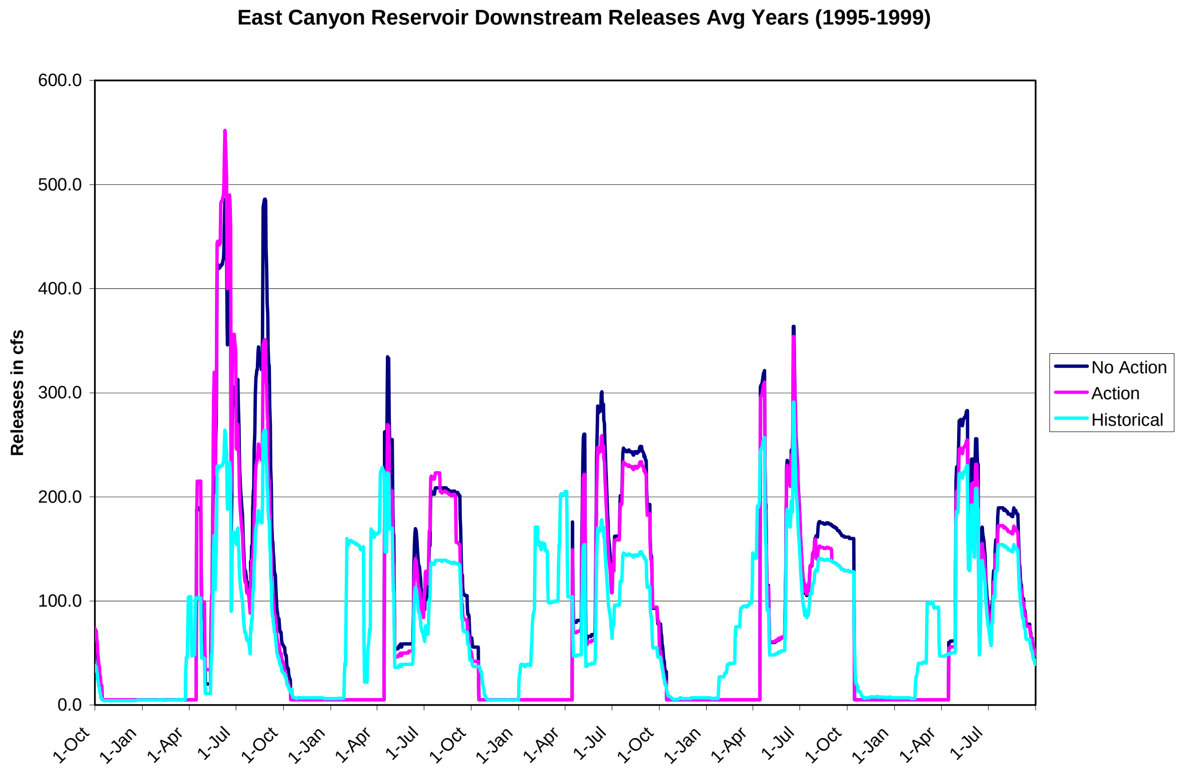


Figure 3.6

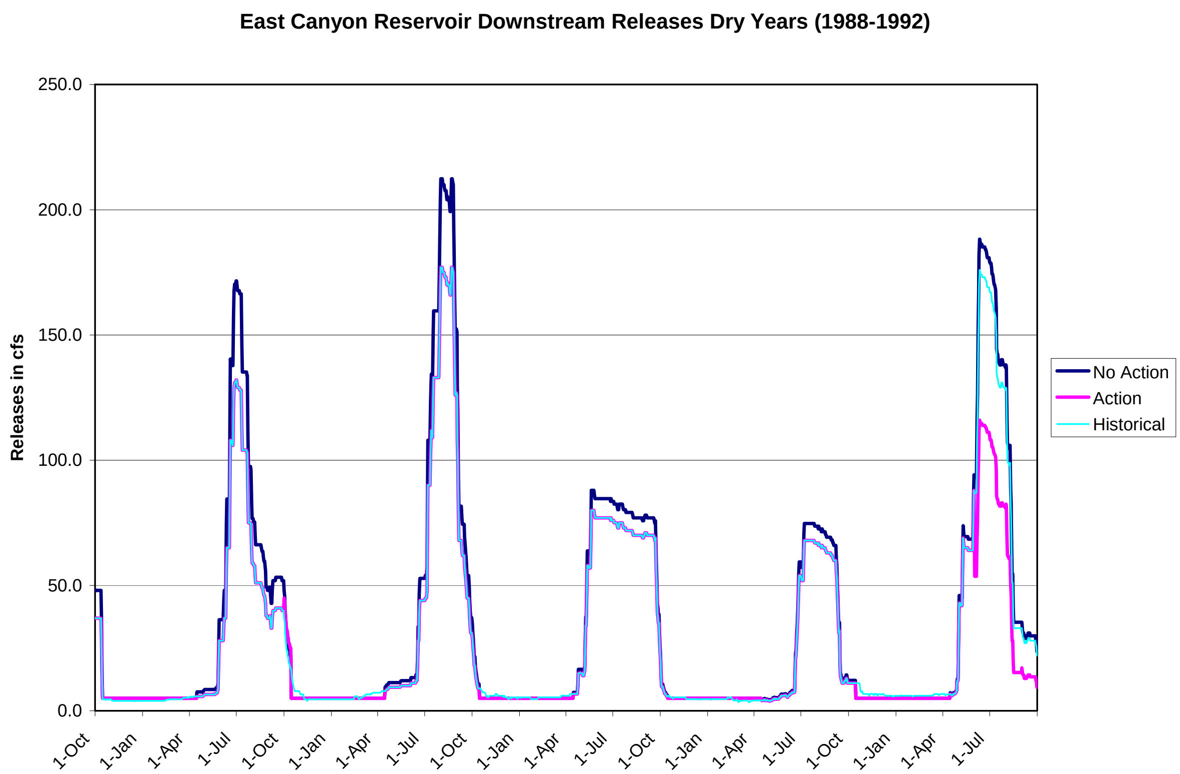


Figure 3.7

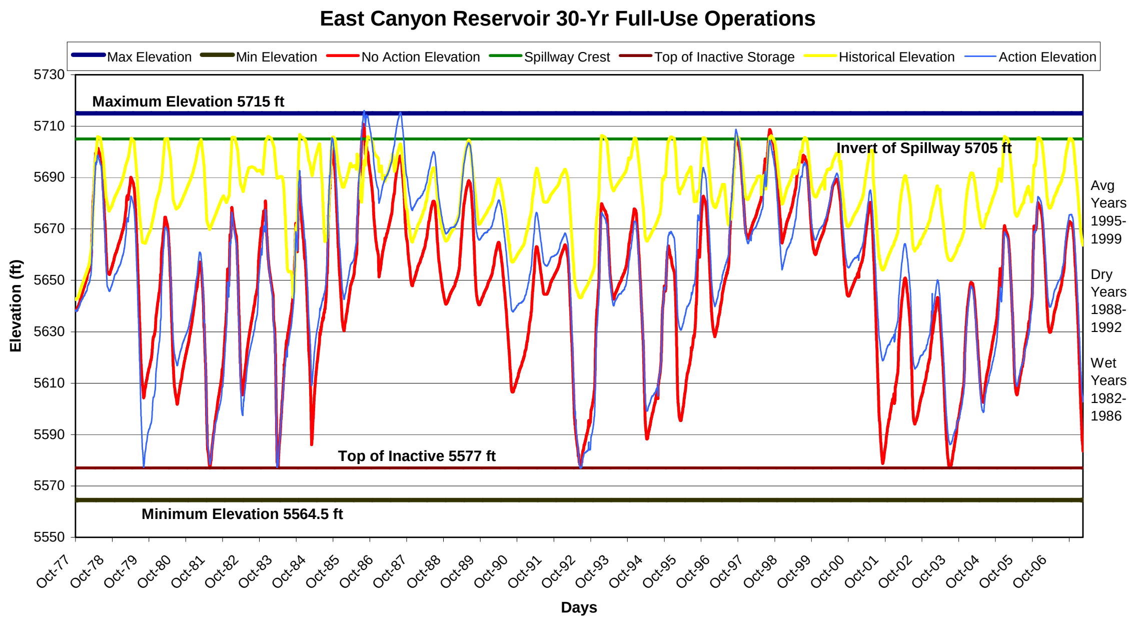


Figure 3.8

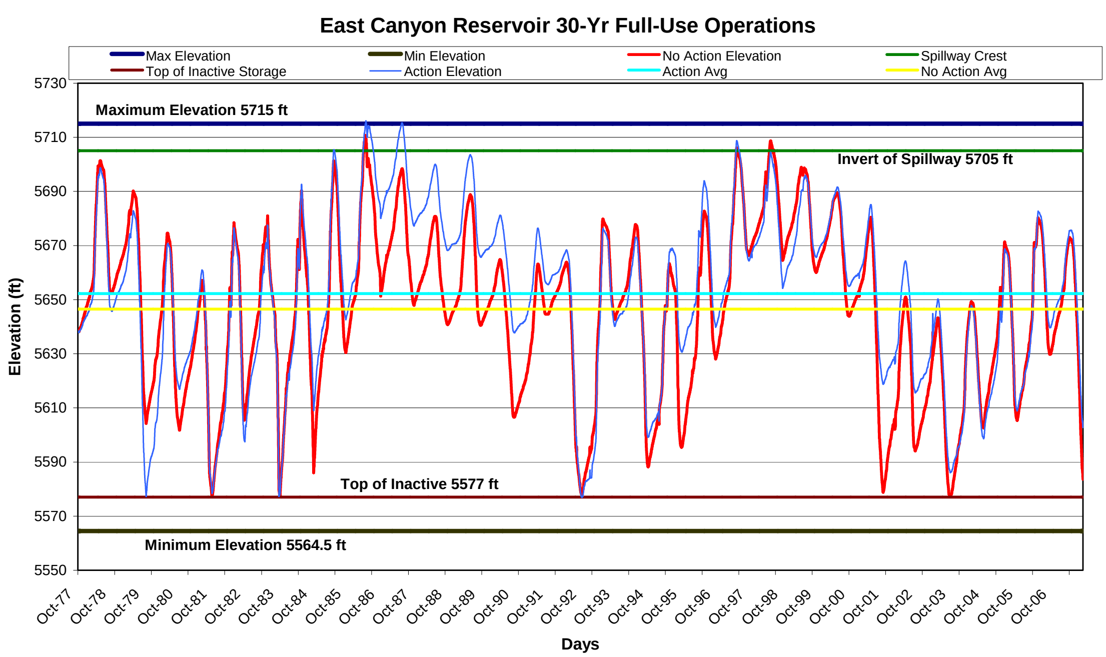


Figure 3.8a

3.3.2 Weber Basin Project Operations

3.3.2.1 No Action Alternative

It is unknown what adjustments would be required as water use increases under the no action alternative. However, the no action alternative would probably not affect existing Weber River Project operations, because of the wide range of flexibility within current operations.

Under the no action alternative DWCCC private water would continue to be used for agricultural, irrigation and secondary water systems. It is likely that additional agriculture water would be converted into secondary water system and domestic water systems downstream of the reservoir to meet increasing demands. Under the no action alternative more of the Federal water would be used for municipal and industrial, secondary irrigation, and domestic use. The Federal water would be delivered directly to downstream users or by exchange to local ground water and surface sources.

Historically, East Canyon Reservoir fills about half of the years, and storage drawdown typically does not go far below elevation 5660, which is 83 ft above the bottom of active storage at 5577 (Figure 3.1). At full development of Weber Basin Project water, the reservoir would fill less often and storage drawdown may reach the bottom of active storage regularly during dry periods. Average reservoir levels would be much lower than historical (or present) levels (see Figure 3.8).

3.3.2.2 Action Alternative

The impact to Weber Basin Project operations of either alternative is the same as full development of Weber Basin Project water occurs. The total volume of up to 12,500 acre-feet (3 percent of Weber Basin Project water) that could be diverted annually would not significantly impact the current operations of East Canyon Dam.

Under the action alternate at least 5000 af of DWCCC private water would be delivered into the pipeline to the Snyderville Basin upstream of the reservoir. Downstream delivers of DWCCC water would be decreased by the same amount of water deliver upstream in the pipeline excluding return flows. It is likely a portion of the Federal water (up to 5000 af) would be delivered to the pipeline for use within the SWDC service area for municipal and industrial purposes and snow making. Downstream delivers of Federal water would be reduced by the amount equivalent to the amount being piped upstream excluding the return flows.

Under the action alternative, the reservoir would reach slightly higher levels and maintain a higher average than the no action alternative. Reservoir elevations would probably fluctuate more under the action alternative. Stream flows in East Canyon Creek above the reservoir would increase due to return flows of the pipeline water. Releases would increase in the non-storage season to match inflows. Peak releases should increase in average years but the duration of lower flows would be longer so average release flow would be less under the action alternative.

3.3.3 Water Rights

3.3.3.1 No Action Alternative

Under this alternative, the proposed project would not be constructed. Therefore, no effects would occur to the existing water rights. The East Canyon Reservoir water right would be more fully used in the future, as WBWCD contracts for all the water available in the Weber Basin Project and as DWCCC shares are committed to the growing municipalities.

3.3.3.2 Action Alternative

To date, SWDC has entered into a perpetual lease agreement, dated October 13, 1999, with DWCCC for 5,000 acre-feet per year. Change Application a21859 (35-10539), that has been approved by the State Engineer, is based on the decree water rights held by DWCCC and allows the leased water to be diverted from East Canyon Reservoir for use in the Snyderville basin area of Summit County.

In addition to the 5,000 acre-feet committed under the water lease contract, there is the potential for SWDC to acquire up to an additional 7,500 acre-feet of storage rights for the project by dedicating some or all of its DWCCC shares to the project, acquiring additional DWCCC shares, and/or entering into a contract with WBWCD.

Water rights supporting the diversion and use of water under the proposed action would be based on existing storage rights in East Canyon Reservoir. There would be no effect to downstream water right holders.

3.3.4 Water Quality

Water quality impacts were evaluated using a two-dimensional hydrodynamic and water quality model, CE-QUAL-W2 of East Canyon Reservoir. This model is best-suited for long, narrow reservoirs such as East Canyon. A calibrated historic model of the reservoir was used to simulate both the no action and action alternatives. Simulating the no action alternative provides baseline conditions with which to compare results from the action alternative. Please refer to Appendix B for more information on the historic, no action, and action CE-QUAL-W2 models used in this analysis.

3.3.4.1 No Action Alternative

Since no construction would occur, there would be no temporary construction-related water quality impacts. However, as development occurs in the Weber River Basin, waters currently unused to meet existing water rights would no longer be stored in the East Canyon Reservoir, but could be used upstream or downstream from East Canyon Reservoir, resulting in future long-term water quality impacts in East Canyon Reservoir and downstream, with or without the proposed action. No impacts to water quality in East Canyon Creek upstream of the reservoir are anticipated.

East Canyon Reservoir

Results from reservoir water quality modeling of the no action alternative are generated by simulating the no action hydrology scenario from 1991-2007 in the CE-QUAL-W2 model. All other inputs used in the CE-QUAL-W2 no action alternative model are historic 1991-2007 values. These values do not reflect future conditions as it is not possible to anticipate climatic changes or other changes in the watershed which may impact water quality or other parameters. Rather, the results provide a baseline condition of water quality in East Canyon Reservoir for the no action alternative hydrology scenario.

<u>Thermal Stratification and Mixing</u>

When dam releases are controlled by the hole in the submerged concrete dam, water is withdrawn initially from the hypolimnion layer and then from the metalimnion or epilmnion layers as reservoir elevations decline. Model results indicate that these changes will result in a smaller volume of water in the hypolimnion and will also draw the metalimnion down. Water temperatures are warmer in the smaller hypolimnion. The stratification period will be reduced as the smaller reservoir enables turnover to occur earlier in the fall.

<u>Dissolved Oxygen Distribution</u>

In the no action alternative shorter durations of stratification will reduce the duration of anoxic conditions in the hypolimnion. Model results indicate that the frequency of meeting the TMDL target for temperature and dissolved oxygen in stratified periods is largely dependant on hydrology. The targets are least likely to be met during drought periods, a conclusion which was also reached in a separate modeling investigation (Miller, 2008). During mixed periods the smaller reservoir volume enables more mixing from the surface and dissolved oxygen near the bottom of the reservoir may be higher as a result.

<u>Phosphorus</u>

Phosphorus retention and distribution in East Canyon Reservoir may be affected by lower reservoir elevations in the no action alternative. Retention of phosphorus in the reservoir may be reduced when elevations are below 5,660 feet. Below this elevation, water is only withdrawn through the borehole in the submerged concrete dam and could increase export of high phosphorus water. The reduced duration of stratification and smaller hypolimnion volume also could reduce leaching of phosphorus from the bottom sediments.

<u>Productivity</u>

Effects to the productivity of phytoplankton in the no action alternative will be influenced by smaller reservoir volumes and changes in the distribution of nutrients. Smaller reservoir volumes will shift the productive zones further downstream though the location of phytoplankton in the reservoir is greatly influence by the wind (East Canyon TMDL, 2008). Earlier turnover of the reservoir which mixes nutrients from the hypolimnion layer may result in earlier fall algal blooms, but the blooms could be smaller in size as a result of the smaller hypolimnion volume from which relatively higher nutrient concentrations are mixed.

<u>Metals</u>
In the no action alternative effects on the distribution or concentration of metals in East Canyon Reservoir are expected to be minimal. The reduced duration of anoxic conditions in the reservoir will reduce the period when leaching of metals from bottom sediments can occur.

<u>Dam Discharge</u>
Historically discharges from the dam are a mix of water withdrawn from over the crest and through the 5-foot hole of the submerged concrete dam. Reservoir elevations in the no action alternative will be lower than historic reservoir elevations (see Figure 3.8). The no action hydrology simulation results show that reservoir elevations drop below 5,660 feet in 28 out of 30 years. Below this elevation releases from the reservoir are controlled by the 5-foot diameter hole through the submerged concrete dam.

During periods of thermal stratification in the no action alternative when reservoir elevations are above 5,660 feet, discharges are a blend of warmer, lower nutrient water from the epilimnion or metalimnion, and colder, higher nutrient water from the hypolimnion. When reservoir elevations drop below 5,660 feet, discharges from the dam flow through the 5-foot diameter hole in the submerged concrete dam. When this initially occurs during thermal stratification, the releases from the dam will be colder and have higher nutrient concentrations. As reservoir elevations decline and more of the hypolimnion volume is exported, release temperatures increase and nutrient concentrations decrease until turnover begins in the fall. Release temperatures will be highest when reservoir elevations are near the inactive storage elevation. Dissolved oxygen concentrations in the dam discharge are expected to be near saturation because the discharge is open to the atmosphere and there is a freefall from the outlet to the stream bed.

East Canyon Creek
In the no action alternative, effects to water quality in East Canyon Creek above the reservoir will not occur. Water quality in East Canyon Creek below the reservoir is dependant on water quality of dam releases, with most of the effects evident during the summer and fall. Under the no action alternative, temperature in East Canyon Creek will vary with reservoir elevation as previously explained. Temperatures could be colder during the summer if dam discharges withdraw water from only the hypolimnion of the reservoir. Temperatures could potentially reach or exceed 68°F in the creek if reservoir elevations declined to near the inactive storage pool before fall turnover begins to cool the reservoir. Reservoir elevations near that level most often occur during September and October when

fall turnover has begun and reservoir temperatures have cooled to below 68°F. Nutrient concentrations in the creek will be higher when discharges from the dam withdraw water from the hypolimnion of the reservoir.

3.3.4.2 Action Alternative

Implementation of the action alternative will require construction activities related to installation of pipeline and the intake structure in the East Canyon Reservoir basin. Potential water quality effects from construction include disturbance and mobilization of soils along the pipeline corridor and sediments in the submerged area surrounding the intake structure. Applicable State and/or County Best Management Practices (BMPs) would be implemented during construction to reduce the disturbance and mobilization of soils and sediments should be employed during construction. Following construction, the affected area should be restored to its prior condition as much as practical and monitored to assure recovery of the area. Disturbed sediments in the reservoir basin should be monitored in the water column with a turbidity meter prior to, during, and following construction of the intake. Operation of the intake should not begin until turbidity in the withdrawal zone of the intake has returned to pre-construction levels, with an increase of no more than 10 nephlometric turbidity units (NTU).

East Canyon Reservoir

Under expected operations of the action alternative, an intake structure will withdraw water from the hypolimnion of East Canyon Reservoir at an elevation of about 5,565 feet. The expected water quality of the withdrawal is estimated using samples collected by DWQ near the intake location and depth. Data for the samples are summarized in Table 3.6. Raw water will be treated at the SWDC East Canyon Water Treatment Plant for phosphorus removal and filtered before distribution. Water used for snowmaking will also be treated at the SWDC facility. Total phosphorus will be reduced to 0.1 mg/L after treatment (Campbell, personal communication, 2009). The instream fish flows of up to 2 cfs will not be treated at the SWDC East Canyon Water Treatment Plant but will flow through packed column degassing structures before discharged directly to East Canyon Creek (agreement between UDWR and SWDC, May 26, 1998). Phosphorus concentrations for these flows were assumed to be the same as in the reservoir. The majority of return flow to East Canyon Creek will be treated at the Snyderville Basin Water Reclamation District (SBWRD) East Canyon Water Reclamation Facility (ECWRF). Treatment and phosphorus removal at the ECWRF reduces total phosphorus concentrations from an influent concentration of approximately 6 mg/L to an effluent concentration of 0.1 mg/L or lower (SBWRD data 2002-2008). All return flows were assumed to have a phosphorus concentration of 0.1 mg/L based on treatment at the SWDC treatment facility and ECWRF. The instream fish flows of up to 2 cfs would not be treated at the SWDC East Canyon Water Treatment Plant but would flow through packed column degassing structures before discharge directly to East Canyon Creek (agreement between the UDWR and SWDC, May 26, 1998). Phosphorus concentrations for these flows were assumed to be the same as in the reservoir.

Table 3.6: Summary of East Canyon Reservoir water quality samples at elevation 5,565 feet, +/- 30 feet, 2002-2007 (source – EPA STORET database)

Constituent	Mean	Minimum	Maximum
Temperature, °C	5.1	3.6	6.7
Dissolved Oxygen, mg/L	1.4	0.0	4.7
pH	7.5	6.9	7.9
Specific Conductance, µS/com	929	828	1039
Total Phosphorus, mg/L	0.11	0.05	0.20
Dissolved Phosphorus, mg/L	0.09	0.03	0.18
Ammonia, mg/L	0.11	Non-detect	0.36
Nitrate/Nitrite, mg/L	0.25	Non-detect	0.43

Results from reservoir water quality modeling of the action alternative are generated by simulating the action hydrology scenario from 1991-2007 in the CE-QUAL-W2 model. Water quality of the return flows are based on treatment methods and permit limits. All other inputs used in the CE-QUAL-W2 action alternative model are historic 1991-2007 values. These values do not reflect future conditions as it is not possible to anticipate climatic changes or changes in the watershed which may impact water quality or other parameters.

Water quality effects resulting from implementation of the action alternative, are determined by comparing water quality modeling results of the action alternative model to baseline conditions which were determined from the result of the no action alternative model. The specific criteria used to determine whether the action resulted in a negative impact are the targets of the 2008 East Canyon Reservoir TMDL (see Section 3.2.4.1). The methods are further explained in Appendix B.

Results presented in this section are qualitative for the purpose of evaluating the impacts to water quality, if any, of the action alternative. The results are based on hydrologic scenarios, historical water quality in the reservoir and creek, and projected water quality of return flows and 2 cfs instream flows associated with the action alternative. These results are useful for comparing the water quality of the assumed no action alternative with the water quality of the action alternative. They do not project water quality in any future scenario, with or without the action alternative, as it is not possible to account for other possible changes to variables such as the climate, development in the watershed, etc.

<u>Thermal Stratification and Mixing</u>

Modeling results from the action alternative were compared to the no action alternative to determine effects on thermal stratification in the reservoir. Reservoir water surface elevations are typically higher in the action alternative than in the no action (see Figure 3.8a). When reservoir elevations are below 5,660 feet, which is the crest elevation of the submerged concrete dam, all releases from the dam are controlled by the borehole in the submerged concrete dam which is located at an elevation of 5,567 feet. Withdrawals through the intake in the action alternative are made at an elevation of 5,565 feet, or two feet lower than the elevation of the borehole in the submerged concrete dam. Considering the frequency that reservoir elevations in the no action alternative are below 5,660 feet the withdrawals in the action alternative are similar. Comparisons of thermal stratification during periods when the reservoir water surface is drawn below elevation 5,660 feet, show that the action alternative often results in cooler temperatures throughout the water column due to the higher reservoir water surface elevations (see Figure 3.9).

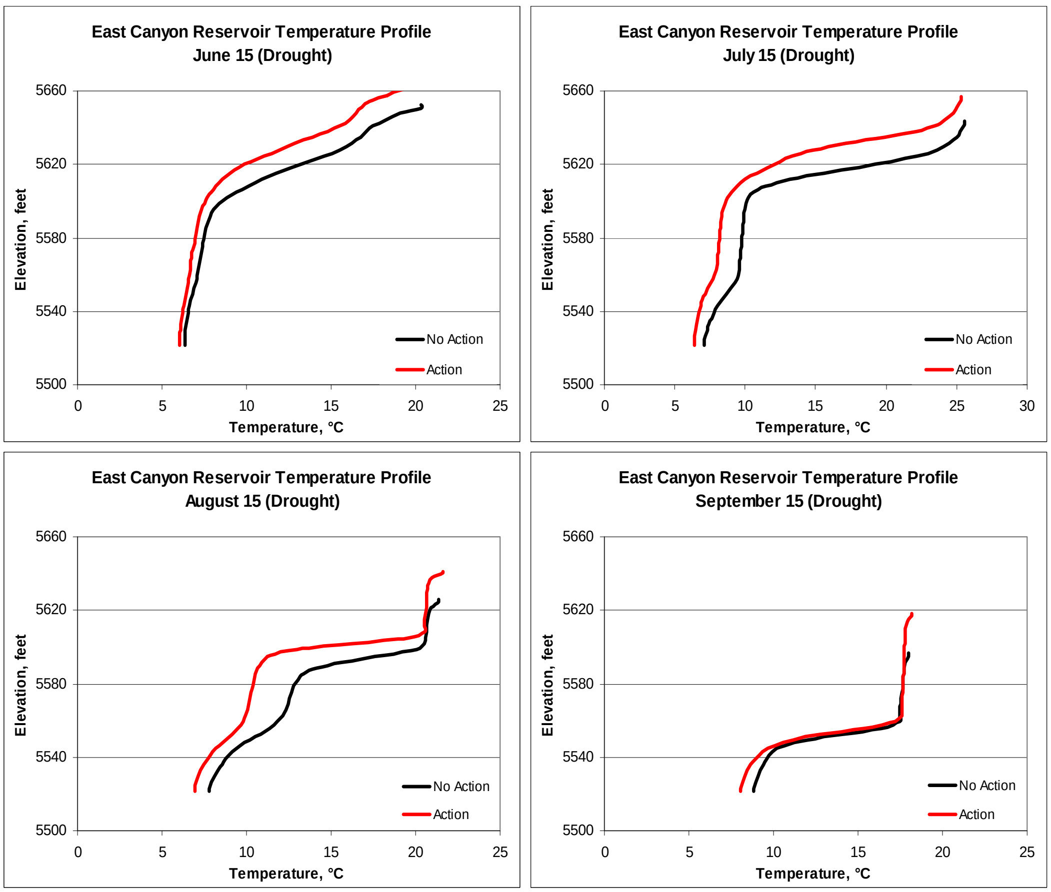


Figure 3.9: Comparison of thermal stratification in East Canyon Reservoir for the No Action and Action Alternatives during drought conditions.

At times the action alternative elevations are lower than or equal to, the no action alternative. These instances do not occur as frequently as the reverse scenario described in the previous paragraph. During these periods, water temperatures of the action alternative are higher in both the metalimnion and hypolimnion of the reservoir. Although water temperatures in the action alternative are higher during these instances, the dissolved oxygen concentrations in the action alternative are also higher throughout the water column (see Figure 3.10). The action alternative contains more water which meets the TMDL target for dissolved oxygen and temperature during stratified periods.

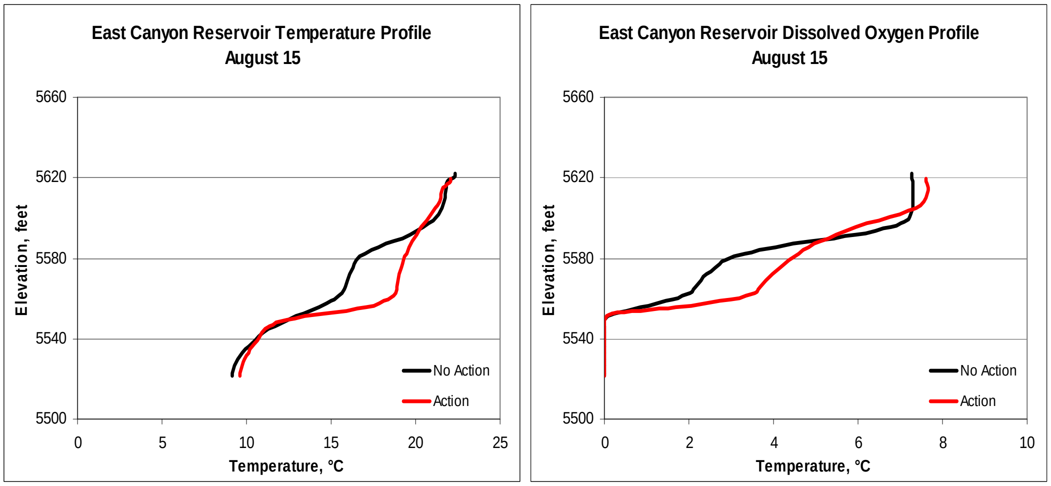


Figure 3.10: Comparison of thermal stratification and dissolved oxygen in East Canyon Reservoir, No Action and Action alternatives.

Dissolved Oxygen Distribution

Modeling results for dissolved oxygen content of the reservoir for the action alternative do not show significant effects when compared to the no action alternative. Table 3.7 shows the percent of profiles from each location and for each alternative which meet the TMDL target for dissolved oxygen for the mixing periods. A slightly higher percentage of mixed profiles in the action alternative meet the target than in the no action alternative. Table 3.8 shows the percent of profiles from each location and for each alternative which meet the TMDL target of dissolved oxygen and temperature for the stratified periods. A slightly lower percentage of stratified profiles in the action alternative meet the target than in the no action alternative, but further examination of the profiles shows there is an increase in the total volume of water in the action alternative which meets the TMDL targets for dissolved oxygen and temperature during stratified periods. This is due to the increased reservoir storage in the action alternative compared with the no action alternative (see Figure 3.8).

Table 3.7: Percent of monthly profiles that meet the TMDL dissolved oxygen target for mixed periods (1991-2006)

Location	*No Action*	*Action*
Above Dam	98%	99%
Mid-Lake	100%	100%
Upper Lake	94%	98%

Table 3.8: Percent of monthly profiles that meet the TMDL dissolved oxygen and temperature target for stratified periods (1991-2006)

Location	*No Action*	*Action*
Above Dam	94%	93%
Mid-Lake	92%	92%
Upper Lake	86%	84%

Phosphorus

Modeling results for dissolved phosphorus for the action alternative including the 2 cfs instream flow, show a decrease of 12% (an improvement) when compared to the no action alternative. Figure 3.11 displays the daily average dissolved phosphorus in the reservoir for the two alternatives. Based on the targets in the 2008 TMDL for phosphorus there are not any significant effects resulting from implementation of the action alternative.

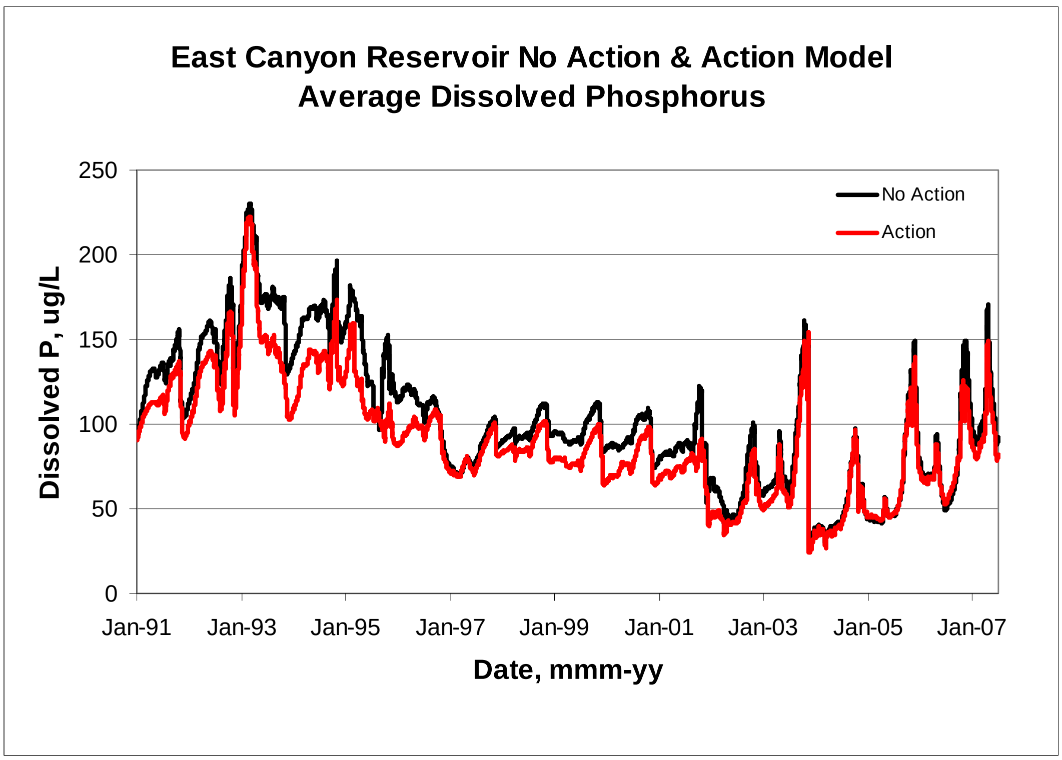


Figure 3.11: East Canyon Reservoir average dissolved phosphorus, no action and action alternatives.

The TMDL recommends efforts to reduce internal phosphorus loads should be focused in the late summer and early fall. The withdrawal of water from the hypolimnion of the reservoir through the intake in the action alternative will potentially minimize internal phosphorus loading in East Canyon Reservoir and was recommended as a possible method to improve water quality in the reservoir in the report on reservoir water quality modeling for the TMDL (Miller, 2008). A number of lakes and reservoirs employ a withdrawal of water from the hypolimnion, as a restoration technique (Cooke et al., 2005). The benefits of this technique include increased export of nutrients and decreased periods of low dissolved oxygen levels. The water intake in the action alternative will export relatively nutrient rich waters from the bottom of the reservoir and reduce the low dissolved oxygen period by increasing the flushing rate in the hypolimnion. This will reduce internal phosphorus loading in East Canyon Reservoir in several possible ways. Withdrawals from the reservoir will be treated for phosphorus removal at the SWDC treatment facility before distribution for municipal and industrial uses, and return flows from the ECWRF will also be treated for phosphorus removal. This will result in a net reduction in phosphorus concentrations and loads. Phosphorus could also be reduced through shorter anoxic or low dissolved oxygen periods in the reservoir when phosphorus is leached from bottom sediments (East Canyon TMDL, 2008). Decreasing the duration of anoxic periods in the reservoir will decrease the amount of nutrients leached from the reservoir sediments. Additionally, the increased flushing rate of the hypolimnion will increase the response time of the reservoir to external load reductions from the TMDL implementation plan (East Canyon TMDL, 2008).

Productivity

Modeling results for phytoplankton for the action alternative show a decrease in both chlorophyll a concentrations and blue-green biomass from the no action alternative. Chlorophyll, a concentrations decrease by 14 percent (an improvement) from the no action to the action alternative. Figure 3.12 displays the daily average chlorophyll concentrations in the reservoir for the two alternatives. Blue-green algae biomass decrease by 21 percent (an improvement) from the no action to the action alternative. Figure 3.13 displays the daily average blue-green algae biomass in the reservoir for the two alternatives.

Metals

The action alternative is not expected to affect the concentration or distribution of metals in the reservoir. Anoxic conditions in reservoirs can promote the release of metals from sediments (Cooke, 2008). With implementation of the action alternative, release of metals from reservoir sediments will be reduced due to the decreased duration of low dissolved oxygen levels in the reservoir hypolimnion.

The withdrawal of water through the intake will not cause resuspension of sediments on the reservoir bottom. The intake will be located a minimum of 15 feet above the reservoir bottom. The velocity of water passing through the screen will not exceed 0.5 feet per second (fps) and the velocities at a distance of 15 feet from the intake, assuming uniform flow will be approximately 0.02 fps during the maximum flow rate of 31 cfs (Appendix A – 29 cfs flow rate in July plus 2 cfs instream flow). Equations of sediment erosion were used to determine if scour will occur at a water velocity of 0.04 fps for non-cohesive sediments with a very fine clay particle size of 0.5 µm and particle density of 1600 kg/m^3, and for cohesive sediments with a bed bulk density 5 percent greater than the density of water. No erosion is anticipated to occur under those conditions.

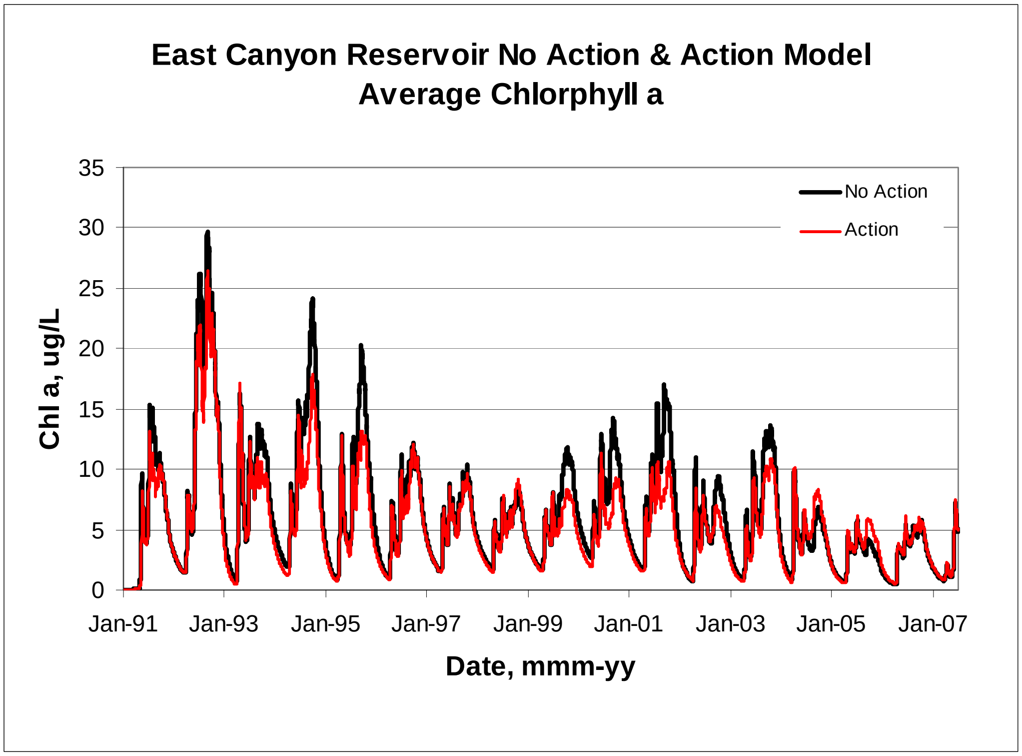


Figure 3.12: East Canyon Reservoir average chlorophyll a, No Action & Action Alternatives.

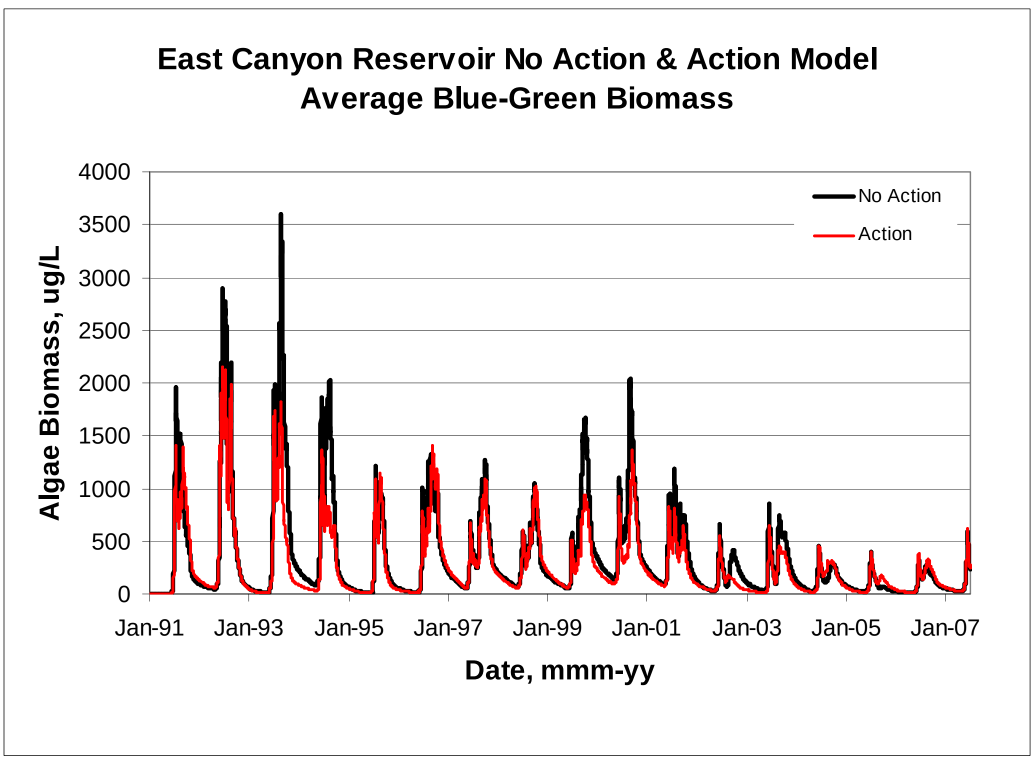


Figure 3.13: East Canyon Reservoir average blue-green algae biomass, No Action and Action Alternatives.

Dam Discharge
Water quality effects from the action alternative on dam discharges were evaluated by comparing model results for the action and no action alternatives. Water quality in dam discharges for both alternatives was similar and differences between the water quality appears to occur when reservoir elevations in one of the alternatives drops below 5,660 feet. This occurs more frequently in the no action alternative. The water temperature of dam discharges in the action alternative is also less likely to be near 68°F based on higher average reservoir elevations.

East Canyon Creek
Implementation of the action alternative will increase flow in East Canyon Creek from the ECWRF outfall to the reservoir. SWDC will also increase the instream minimum flow which determines when diversions to the water treatment facility are made as discussed in Section 3.2.2.1. These effects will contribute to improved conditions in East Canyon Creek by helping to achieve objectives of the TMDL for streamflow (East Canyon TMDL, 2008). Phosphorus concentrations in the return flow, even with treatment to reduce concentrations to 0.1 mg/L, could increase phosphorus concentrations in East Canyon Creek. Mitigation measures include reducing non-point source loading of phosphorus through informing and educating the community to maintain and improve water quality in the watershed.

The East Canyon TMDL recommends implementing flow augmentation immediately because it has the greatest potential for meeting TMDL targets immediately. The East Canyon Creek Implementation Plan in the TMDL, identified several options for flow augmentation, including pumping water from East Canyon Reservoir. Up to 2 cfs of instream flows provided as part of this project will be discharged to the creek downstream of the location recommended location, but will still provide flow augmentation through critical reaches as identified in the TMDL (East Canyon TMDL, 2008). This water will not be treated at the SWDC treatement facility but will flow through a packed column degassing structure before being discharged to the creek. The degassing structure will increase dissolved oxygen of the water to near saturation. Addition of 2 cfs to East Canyon Creek will increase phosphorus concentrations in the creek based on reservoir concentrations (Table 3.6). According to the TMDL, low dissolved oxygen in the creek and macrophytes are not controlled by water column nutrients. but increasing channel velocity and flow during critical summer periods will contribute to higher dissolved oxygen concentrations and other targets (East Canyon TMDL, 2008). Because there is uncertainty of the effect of higher phosphorus concentrations resulting from instream flows anytime, water pumped from East Canyon Reservoir is used for flow augmentation monitoring of dissolved oxygen and aquatic vegetation distribution in the creek from the discharge location to the ECWRF effluent point should be conducted at least initially.

Water quality in East Canyon Creek below the reservoir is determined by water quality in the reservoir. Comparing model results of the action and no action alternatives for water quality of reservoir does not indicate that the action alternative will have significantly different water quality. Additionally, reservoir elevations in the action alternative will be near the inactive storage pool elevation of 5,577 feet less frequently and there will be a lower possibility of water temperature in the creek reaching or exceeding 68°F.

3.3.5 Public Safety, Access, and Transportation

3.3.5.1 No Action Alternative

This alternative would have no effect on access, transportation, or public safety.

3.3.5.2 Action Alternative

This alternative would require the transport of heavy equipment, pipe, and concrete, to construction sites and construction near roadways. Although the intake structure and some of the pipeline alignment are not along major roadways, some of the proposed pipeline and powerline alignments are along SR-65 and SR-66. For safety reasons, flagmen may be required as trucks enter and exit the construction sites, and for potential lane closures for construction near roadways. Traffic delays would occur creating an inconvenience and a safety concern.

This alternative would create minor public safety, access, and transportation impacts.

3.3.6 Recreation

3.3.6.1 No Action Alternative

The no action alternative, due to the prospects of having water rights eventually fully used, could see the reservoir elevation at certain times of the year 25-35 feet lower than has generally been seen to date (Figure 3.8). This situation would affect recreation. Less surface area would make East Canyon Reservoir less attractive to visitors and could result in a decline in visitor use.

3.3.6.2 Action Alternative

Under the action alternative, it is anticipated that over half of the pumped-out water would find its way back to East Canyon Reservoir. This would affect elevation levels in the positive. Figure 3.8a shows the average reservoir elevation a little higher under the action alternative in comparison to the no action alternative. With water elevations slightly higher, recreation would be at about the same level when comparing the no action and action alternatives.

3.3.7 Visual Resources

3.3.7.1 No Action Alternative

The no action alternative would remain in the Moderated Integrity Level on the West Side area of the reservoir where the project would be built. Management at Moderate Integrity Level allows for man-made facilities and disturbance which would appear visually subordinate to the natural landscape and should blend with or complement it. Under this alternative, the visual integrity would probably not change even with the expected lower reservoir levels as water rights are used and more exposed shore line would occur in the future.

3.3.7.2 Action Alternative

Construction impacts on the West Side of the reservoir related to burying the power and pipeline in the existing gravel road would, in themselves, be minimal. However, enlarging the road to two-lanes will mar the hillside and views to the west from Utah State Route 65. Over time the road cut and fills would improve as they revegetate. The pump house and parking area around the pump house would be designed to blend in to the existing area; however, these impacts would lower the Visual Integrity Level from Moderate to Low.

Long term impacts within the North Shore area, when done responsibly, would be absorbed in the existing Low Integrity Level which allows for man-made facilities and disturbances which visually dominate the natural landscape when viewed from up to a five-mile distance. The result of the activity should, however, blend with or compliment the natural landscape.

3.3.8 Socioeconomics

The potential socioeconomic effects focus upon the changes in water supply, water quality, water use, and recreation.

3.3.8.1 No Action Alternative

This alternative would not significantly affect the existing socioeconomic conditions in the short-run; however, with available water supplies already behind the projected demand curve, the no action alternative would lessen the likelihood of meeting time constraints imposed by rapid growth in the Park City/Snyderville Basin area. Without sufficient water supply, future development may be limited, and in the broad sense, may indirectly affect conditions of the regional economy in the long-run.

Under the no action alternative as the water is fully utilized, reservoir levels would be much lower. It is likely that the economic activity stimulated by recreation, may be negatively impacted in the future when the water is fully used.

3.3.8.2 Action Alternative

The action alternative would temporarily increase the economic activity in the area due to construction activities. Without a further extensive economic study, the actual estimates are not available. With the increasing demand for the water downstream, it is expected that the water available will eventually be diminished and the economic activity will be impacted in the long term with or without the proposed action alternative. There is no significant difference between the action and no action alternatives.

3.3.9 Cultural Resources

3.3.9.1 No Action Alternative

Under the no action alternative, there would be no effect to historic properties. SWDC would not construct the action alternative, and there would be no need for ground disturbance for any potential borrow or staging areas, spoils deposit areas, or new roads. The existing conditions would remain intact and would not be affected.

3.3.9.2 Action Alternative

For the APE included in the alternatives, a 100 percent cultural resource inventory has been completed by the Provo Area Office archaeologist. Although several cultural resources lie near the proposed project area, there were no historic or prehistoric archaeological sites located within the APE. Reclamation submitted a determination of no historic properties affected for the proposed project to the SHPO. Reclamation received concurrence on the determination of no historic properties affected in letters dated November 20, 2008 and July 1, 2009. Under the action alternative, there would be no effect to historic properties.

3.3.10 Paleontological Resources

3.3.10.1 No Action Alternative

Under the no action alternative, there would be no effect to paleontological resources. SWDC would not construct the action alternative, and there would be no need for ground disturbance for any potential borrow or staging areas, spoils deposit areas, or new roads. The existing conditions would remain intact and would not be affected.

3.3.10.2 Action Alternative

A file search for the APE, as presently designed, of the action alternative by the UGS in Salt Lake City, was completed on September 3, 2008. The geological formations present in the proposed APE, have a low potential for yielding significant fossil localities. Unless fossils are discovered as a result of construction activities, the UGS determined that this project should have no impact on paleontological resources.

3.3.11 Wetlands and Vegetation

3.3.11.1 No Action Alternative

Under this alternative, the proposed project would not be constructed. Over time, as the water rights are fully used to meet future demands, dam releases would be the minimum 5 cfs more often, and minor impacts would occur to riparian habitats below the dam.

3.3.11.2 Action Alternative

Riparian Habitat

Under the proposed action alternative, the historic wide flexibility in the operation of East Canyon Dam would continue. Therefore, riparian and riverine habitats below the dam would have the same impacts as the no action alternative.

The proposed pipeline and powerline would be built within the berm of the existing road and very little disturbance would occur beyond the berm. The road crosses the East Canyon Creek and small perennial drainages several times over existing culverts. Approximately 0.04 acres of riparian habitat adjacent to the road would be temporarily disturbed.

All disturbed riparian habitats would be recontoured and reseeded with appropriate native vegetation during the final stages of construction activities. Over time, the disturbed riparian areas would revegetate and provide appropriate habitat again.

Since eventual recovery of all riparian habitats disturbed by this project is expected, no long term detrimental effects from the proposed project are expected.

Upland Habitat

The proposed intake structure, powerline, and pipeline construction would temporarily disturb 57.86 acres (57.9-0.04 riparian acres =57.86) and permanently displace 4.9 acres of upland habitat (Figure 2.4). Much of this habitat is presently degraded with a high concentration of weeds. All disturbed habitats would be recontoured and reseeded with appropriate native vegetation (including a component of forb species) during the final stages of construction activities. Over time most disturbed areas would revegetate and provide appropriate habitat again.

3.3.12 Wildlife Resources

3.3.12.1 No Action Alternative

Under this alternative, the proposed project would not be constructed. Over time, as the water rights are fully used to meet future demands, dam releases would be the minimum 5 cfs more often and the reservoir elevation would experience large fluctuations with a lower average reservoir level (25 to 35 feet lower). Impacts could occur to wildlife resources using shoreline and downstream habitats.

3.3.12.2 Action Alternative

This alternative may temporarily disturb trout spawning beds in East Canyon Creek above the reservoir (limited in number due to prior habitat degradation), as a result of sediment released by construction activities. Best management practices (BMPs) would be employed to minimize the effects. These spawning beds should be restored naturally to their previous condition after spring runoff, following construction activities. Flows within the creek above the reservoir should slightly increase over the no action alternative and remain at levels sufficient to support the current fishery. Fish populations within East Canyon Reservoir and East Canyon Creek below the reservoir would likely remain at the same levels as with the no action alternative.

Wildlife habitats would be temporarily disturbed during construction. Big game would be able to obtain water and any other needs provided by undisturbed riparian habitat in other nearby areas. Only a relatively small riparian area will be temporarily disturbed (0.04 acres). Big game may be temporarily displaced from small areas during actual construction activities, but would move back in a short period of time. Due to the relatively small extent of disturbance, big game would not be measurably affected and other mammals existing in riparian areas where construction occurs would be temporarily excluded from these areas.

Osprey use cottonwood trees in the area for roost, nest, and observation perches. Removal of these trees either living or dead should be avoided. It is not anticipated that any of these trees would need to be removed because most of the work is within existing roads. However, loss of a tree would only move these birds to other nearby trees and not reduce the overall capacity of the area to support the current population. Conversely, the construction of power poles in the project area could increase raptor populations above natural levels. Higher raptor populations could negatively impact sage-grouse populations. Therefore, power poles would be constructed with appropriate structures to discourage their use as raptor perches or nesting sites.

Construction activities could temporarily disturb other bird species from preferred breeding, nesting, or foraging habitat. These effects would be limited to a relatively small area, and birds would be capable of moving to very similar habitat nearby. This would also be true for any sage-grouse that may use the area.

Construction associated with this alternative could disturb reptiles and amphibians from preferred habitat. These effects would be limited to a relatively small area (0.04 acres) and these disturbed areas would return to suitable habitat after they are revegetated.

Noise from the pump station would be well insulated and exist as a minor disturbance to people, but could be audible to wildlife for the life of the project. Wildlife would eventually become accustomed to the noise and likely use most of the area as they did prior to the installation of the station. Noise from periodic maintenance of the proposed facilities would have short term impacts on resident wildlife populations to a lesser degree than the initial construction disturbance.

After construction, disturbed areas would be contoured and vegetated with native plants. A process of vegetative succession would then begin. This process would eventually establish a vegetative community favorable to native species and provide appropriate wildlife habitat once again. Effects to wildlife would be temporary.

Entrainment of reservoir fish through the water intake structure is a concern. Presently the low oxygen levels on the reservoir bottom likely deter the presence of fish. However, as the project is implemented it is possible the oxygen levels could improve and increase the chance of fish occurring on the bottom of the reservoir. The withdrawal of water through the intake should be designed such that flow velocities are low and fish are not entrained.

3.3.13 Threatened, Endangered, and Sensitive Species

3.3.13.1 No Action Alternative

Under this alternative, the proposed project would not be constructed. Over time as the water rights are fully used to meet future demands, dam releases would be the minimum 5 cfs more often and the reservoir elevation would experience more fluctuations with a lower average elevation than present. No effects are expected to occur to any threatened, endangered, candidate, or state sensitive species.

3.3.13.2 Action Alternative

Bald eagles are winter residents of this area and may be displaced by construction activities (noise and habitat disturbance). Cottonwood trees and dead snags would be avoided during construction. However, loss of one or several trees may occur, this could displace eagles. These effects would be short term or very limited in extent and would have no significant negative effects since these birds would be able to use abundant similar roost sites or other habitat elements in the immediate vicinity of the project. All winter construction activities occurring within ½ mile of any bald eagle roost site would be restricted to hours between 9:00 a.m. and 4:00 p.m., from November 1st to March 31st and into April, if necessary, until all bald eagles have left the area.

Canada lynx may have occurred in the general area in the past, but have not been seen in the area for many years; therefore, no effects would occur to them.

The Western yellow-billed cuckoo has not been observed within the area affected by this alternative. However, a few individuals may migrate through the area, or even possibly use the area for some segment of their life cycle. The extent of disturbance associated by this project would leave a large area of suitable habitat unaffected, allowing any possible use by these birds to occur in these adjacent areas.

Fish species managed under conservation agreements (i.e., bluehead sucker, Bonneville cutthroat trout, Columbia spotted frog, Northern goshawk) may temporarily be disturbed within areas where construction activities affect riparian or riverine habitats. These species would likely move to areas unaffected by the proposed project, either upstream or downstream of the reservoir. Sedimentation of the river below constriction areas would disturb spawning and feeding beds temporarily until flushing flows restore these habitats.

Spotted frogs have not been found in the area. Any other frogs that are present would be displaced by construction activities in riparian and wetland habitats until these areas recover.

Northern goshawk may use habitats within the area of disturbance. The extent of disturbance associated by this project would leave large areas of suitable habitat unaffected, allowing any possible use by these birds to occur in these adjacent areas. Therefore, affects to them would be negligible.

Greater sage-grouse are present within the project area. The proposed construction of an above ground powerline would likely increase the available perching sites for raptors which prey on these birds. All power poles should be constructed with raptor perch-deterrent devices. Sage-grouse accomplish breeding and brood rearing activities from March through June. The nearest known lek (sage-grouse breeding area) is 4 miles from the project area and would be unaffected by construction or operation.

A ‘No Effect’ determination is made for all species listed under the Endangered Species Act.

3.4 Summary of Environmental Effects

Table 3.9 describes environmental effects under the no action alternative and the action alternative.

Table 3.9: Summary of Environmental Effects

Resource Issue	Alternatives No Action Alternative	Action Alternative
Water Resources	With future full water-right use and no augmented inflow, reservoir elevation is expected to decline.	With future full water-right use and expected return flow of 60-80%, reservoir levels are expected to be higher than the no action alternative. Flow in East Canyon Creek above the reservoir would be augmented by the proposed action. Downstream of East Canyon Dam releases are expected to decrease but will maintain required minimum fish flow.
Weber Basin Project Operations	No effect	The effect to Weber Basin Project operations of either alternative is the same. The total volume of up to 12,500 acre-feet that would be diverted annually would not significantly impact the operations of East Canyon Dam.
Water Rights	No effect	No effect to downstream water right holders.
Water Quality	As water rights are fully utilized there are potential effects from future use of this same project water when used elsewhere.	Minimal temporary effects during construction. Water quality is expected to slightly improve when compared to the no action alternative.
Public Safety, Access, and Transportation	No effect	Minor traffic delays are expected during construction activities.
Recreation	As average reservoir elevation declines impacts could occur to recreation	Minimal effects are expected during construction activities. Long term effects are expected to be similar to the no action alternative.
Visual Resources	The reservoir level will fluctuate more frequently as the water rights are fully used. Minor visual impacts are expected.	There is potential for visual resources impacts as the West Side road is enlarged with cuts and fills. These will heal over time. However, the visual integrity is expected to decrease from Moderate to Low on the West Side of the reservoir. Mitigative actions will be taken to ensure the structures blend in with the existing environment.
Socioeconomics	Potential effects continue to exist in the long term because available water supplies are already behind the projected demand.	Minimal temporary impacts to socioeconomics are expected in the short term. No effect on socioeconomics beyond those described for the no action alternative.
Cultural Resources	No effect	Potential effect to subsurface cultural material during construction.
Paleontological Resources	No effect	No effect to paleontological resources is expected.
Wetlands and Vegetation	Minimal effects	Minimal and temporary effects during construction. Long term impacts will be minor and mitigated. Similar long term effects as the no action alternative due to lower reservoir elevations.
Wildlife Resources	Minimal effects	Minimal and temporary effects during construction. Same long term effects as the no action alternative.
Threatened and Endangered Species	No effect	No effect.

3.5 Cumulative Effects

In addition to project-specific impacts, Reclamation analyzed the potential for significant cumulative effects to resources affected by the proposed action and by other past, present, and reasonably foreseeable activities in the watershed including the no action alternative. According to the Council on Environmental Quality's regulations for implementing NEPA (50 CFR §1508.7), a "cumulative impact" is an impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. It focuses on whether the proposed action, considered together with any known or reasonable foreseeable actions by Reclamation, other Federal or state agencies, or some other entity combined to cause an effect. There is no defined area for potential cumulative effects.

The no action alternative was analyzed under the assumption that full utilization of Weber Basin Project water rights would be utilized in the future. Based on Reclamation resource specialists' review of the proposed action alternative, Reclamation has determined that this proposed action alternative would not have a significant adverse cumulative affect on any resources.

3.5 Indian Trust Assets

Indian Trust Assets are legal interests in property, held in trust by the United States for Federally recognized Indian tribes or Indian individuals. Assets can be real property, physical assets, or intangible property rights, such as lands, minerals, hunting and fishing rights, and water rights. The United States has an Indian trust responsibility to protect and maintain rights reserved by or granted to such tribes or individuals, by treaties, statutes, and executive orders. These rights are sometimes further interpreted through court decisions and regulations. This trust responsibility requires that all Federal agencies take all actions reasonably necessary to protect trust assets. Reclamation would carry out its activities in a manner which protects these assets and avoids adverse impacts when possible.

When impacts cannot be avoided, Reclamation would provide appropriate mitigation or compensation. Implementation of the proposed action would have no foreseeable negative impacts on Indian Trust Assets.

3.6 Environmental Justice

Executive Order 12898 established environmental justice as a Federal agency priority, to ensure that minority and low-income groups are not disproportionately affected by Federal actions. East Canyon Reservoir is located in Morgan County. As of 2006, the population of Morgan County was 8,134, consisting of 374 individuals living below poverty level and 309 individuals belonging to various minority groups. Statistics for the year 2006 are the most recent available (Utah Governor's Office of Planning and Budget).

Implementation of the proposed action would not disproportionately (unequally) affect any low-income or minority communities within the project area. The reason for this is that the proposed project would not involve major facility construction, population relocation, health hazards, hazardous waste, property takings, or substantial economic impacts. This action would therefore have no adverse human health or environmental effects on minority and low-income populations as defined by environmental justice policies and directives.

Chapter 4 - Environmental Commitments

The following environmental commitments will be implemented as an integral part of the proposed action.

1. Standard Best Management Practices (BMPs)--Applicable State, County, and/or Standard Reclamation BMPs will be applied during construction activities to minimize environmental effects, reduce disturbance and mobilization of soils and sediments. These practices will be implemented by SWDC. Such practices or specifications include report on public safety, dust abatement, air pollution, noise abatement, water pollution abatement, waste material disposal, erosion control, archaeological and historical resources, vegetation, and wildlife.

   Following construction, the affected area will be restored to its prior condition as much as practical, and monitored for 10 years to assure recovery of the area. Disturbed sediments in the reservoir will be monitored in the water column with a turbidity meter prior to, during and following construction of the intake. Initial operation of the intake will not begin until turbidity in the withdrawal zone of the intake has returned to preconstruction levels, with an increase of no more than 10 nephlometric turbidity units (NTU).

2. Additional Analyses--If the proposed action were to change significantly from that described in the EA because of additional or new information, such as drawing down the reservoir to low levels (beyond normal operations), or if other spoil, gravel pit, or work areas are required outside the project area as analyzed in this EA, additional environmental analysis including cultural and paleontological analyses, will be conducted as necessary.

3. Before beginning construction activities, SWDC will obtain from the USACE, a 404 Permit, Clean Water Act of 1977 (P.L. 217), and from the Department of Natural Resources, a State Stream Alteration Permit. These permits will include discharges of dredged or fill material into the waters of the United States, including wetlands. Such activities associated with this project could include cofferdams, disposal sites for excavated material or construction material sources, and rebuilding dam embankments. The conditions and requirements of the 404 Permit will be strictly adhered to SWDC.

SWDC will fully mitigate any loss of jurisdictional wetland with appropriate in-basin, in-kind mitigation as determined in consultation with the USACE and the State of Utah, and as required for obtaining a Corps 404 Permit and a State Stream Alteration Permit.

4. A Utah Pollutant Discharge Elimination System Permit will be obtained by SWDC from the State of Utah before any discharges of water, if such water is to be discharged as a point source into East Canyon Reservoir or East Canyon Creek above and below the dam. Appropriate measures will be taken to ensure that construction-related sediments will not enter the stream either during or after construction. Construction within or near streams will be restricted from occurring during trout spawning periods.

5. A Water Quality Certification and a Storm Water Discharge Permit will be obtained by SWDC if required--Under authority of the Clean Water Act, construction permits will be required from the DWQ a Section 401 Water Quality Certification and a Section 402 Storm Water Discharge Permit.

6. Water Quality Monitoring--The WBWCD has a well defined, ongoing water quality monitoring program of the Weber River system, which includes an assessment of water quality conditions and trends upstream and downstream of East Canyon Reservoir. The DWQ also has an ongoing monitoring program on East Canyon Creek and East Canyon Reservoir to determine if their TMDL targets are being met. Monitoring done prior to implementation of the proposed action will represent baseline water quality conditions. If monitoring identifies adverse water quality impacts resulting from implementation of the proposed action when compared to baseline conditions, SWDC will take appropriate steps to offset and mitigate project impacts.

7. Cultural Resources-- Any person who knows or has reason to know that he/she has inadvertently discovered possible human remains on Federal land, he/she must provide immediate telephone notification of the discovery to Reclamation’s Provo Area Office archaeologist. Work will stop until the proper authorities are able to assess the situation onsite. This action will promptly be followed by written confirmation to the responsible Federal agency official, with respect to Federal lands, and, with respect to tribal lands, to the responsible Indian tribe official. The Utah State Historic Preservation Office and Native American tribal representatives will be promptly notified by the Provo Area Office archeologist. Consultation will begin immediately. This requirement is prescribed under the Native

American Graves Protection and Repatriation Act of 1990 (43 CFR Part 10); the National Historic Preservation Act of 1966 (36 CFR 800); and the Archaeological Resources Protection Act of 1979 (16 U.S.C. 470).

The above process is listed on a "yellow card," to be placed in the cabs of heavy equipment used during construction of the proposed project. This card will be distributed to the equipment operators and verbal direction and description of possible inadvertent discovery scenarios will be given at a preconstruction meeting by the Provo Area Office archaeologist prior to any ground-disturbing activity.

8. Construction Activities Confined to Previously Disturbed Areas--Construction activities will be confined to previously disturbed areas, to the extent practicable, for such activities as work, staging, and storage; gravel pit; waste areas; and vehicle and equipment parking areas. Concrete trucks will be cleaned at a predetermined area approved in advance by Reclamation.

9. Riparian Area—Construction activities will avoid the riparian area located on Figure 2.1B, and any other areas identified by the USACE and Reclamation biologist as high functional value wetlands and important wildlife habitat (three areas have been flagged with blue flagging). All work in this area will only occur in upland areas or preferably in the existing road and berm at these sites. Prior to construction activities, a Provo Area Office biologist and project construction personnel will meet on-site and identify areas to be avoided. Any riparian area that does not revegetate appropriately as expected (determined by Reclamation biologist) will be mitigated by SWDC. Removal of cottonwood trees and snags will be avoided.

10. Construction Activities--All winter construction activities occurring within ½ mile of any bald eagle roost site will be restricted to hours between 9:00 a.m. and 4:00 p.m. from November 1st to March 31st and into April if necessary, until all bald eagles have left the area.

11. Immediately prior to vegetation removal, the area will be surveyed by Reclamation, Provo Area Office biologist to determine whether active migratory bird nests and young are present. Active nests will be left untouched until the young have fledged.

12. Greater sage-grouse are present within the project area. The proposed construction of an above ground powerline will likely increase the available perching sites for raptors and ravens which prey on these birds. Therefore, all power poles should be

constructed with raptor and raven perch and nest-deterrent devices. Sage-grouse accomplish breeding and brood rearing activities from March through June. If sage-grouse leks (breeding areas) are found near the project area prior to or during constriction, construction activities will be avoided during this time period.

13. Fish Flow--SWDC has entered into an agreement with the UDWR as part of the proposed action. The agreement contains measures designed to protect and enhance fishery values in East Canyon Creek set by the UDWR at achieving minimum stream flows above the Reservoir in East Canyon Creek of 6.0 cfs. Under the agreement, SWDC is contractually committed to respect minimum stream flows in East Canyon Creek by ceasing all surface diversions under vested water rights, when flows in the creek are at or below 6.0 cfs. The agreement also provides for use of 2 cfs of the pipeline capacity to deliver non-consumptive water rights held by UDWR to augment the natural stream flow in East Canyon Creek to maintain the fishery in the creek during periods of critical low flow. The effect of such release will be to augment existing low flows and lower water temperatures for the affected reaches of the creek. Prior to delivery of 2 cfs to East Canyon Creek packed column degassing structures are to be installed and operated by UDWR. A monitoring plan will be developed and implemented by UDWR which will monitor water quality and photo-document aquatic habitat in reaches where the 2 cfs is delivered to East Canyon Creek. The DWQ is to be consulted in the development of this plan.

14. Entrainment of reservoir fish-- The water intake structure will be designed as not to entrain fish. The intake will be located a minimum of 15 feet above the reservoir bottom. The velocity of water passing through the intake screen will not exceed 0.5 feet per second (fps) during the maximum flow rate.

15. Pump Station Design--The pump station and other permanent structures will be designed to blend in with the existing environment. The new pump station will be designed to reflect the traditions of historic architecture in the area. The pump station design plans must be reviewed and approved by WBWCD and Reclamation prior to construction.

16. Public Access--Construction sites will be closed to public access. Temporary fencing, along with signs, will be installed to prevent public access. WBWCD and SWDC will coordinate with landowners or those holding special permits and other authorized parties regarding access to or through the project area.

17. Private land authorization and agreements for the entire project must be obtained by SWDC prior to any surface disturbance to construct facilities on Federal lands. All environmental commitments will be strictly adhered to by SWDC, coordinating with Reclamation and WBWCD as appropriate. Copies of all agreements and permits necessary for the project must be submitted to Reclamation prior to project initiation.

18. Disturbed Areas--All areas disturbed by construction of the project will be smoothed, shaped, seeded, contoured, and rehabilitated to as near their pre-project construction condition as practicable. After completion of the construction and restoration activities, disturbed areas will be seeded at appropriate times with weed-free native seed mixes with an appropriate complement of forb species. The composition of seed mixes and seeding methodology will be coordinated and approved by Reclamation biologists prior to seeding. Weed control on all disturbed areas, rights of way, and all project features will be the responsibility of SWDC during the life of the project.

19. Nonpoint source reduction-- SWDC will inform and educate its water users and customers concerning nonpoint source pollution and the importance of maintaining and improving water quality within the watershed through annual newsletters and other methods

Chapter 5 - Consultation and Coordination

5.1 Introduction

This chapter details the consultation and coordination between Reclamation and other Federal, state, and local Government agencies, Native American Tribes, and the public, during the preparation of this EA. Compliance with NEPA is a Federal responsibility that involves the participation of all of these entities in the planning process. NEPA requires full disclosure about major actions taken by Federal agencies and accompanying alternatives, impacts, and potential mitigation of impacts.

5.2 Public Involvement

A public scoping period to provide to the interested public an opportunity to provide input regarding the scope of this EA was initiated on June 3, 2008, with a scoping letter mailed to over 100 municipalities, organizations, or agencies considered to have an interest in the proposed action. The scoping period ended on June 27, 2008, with 4 comment letters received. All comments received were given full consideration in defining issues to be analyzed in this EA.

The draft EA was made available for a 30-day public comment period with the deadline for comments indicated in the transmittal letter. Nine comment letters were received and considered in the final EA. During the 30-day comment period, a public meeting was scheduled in Morgan on January 13, 2009, to present a summary of the proposed project and answer questions, as well as receive written comments. The draft EA was mailed to over 70 municipalities, organizations, and agencies who indicated in response to the scoping letter that they would like to remain on the mailing list. The draft EA was also made available on the internet at www.usbr.gov/uc/endocs/index.html.

Comments received on the draft EA were reviewed and where appropriate, revisions to the final EA have been made based on comments received.

The Final EA can be found at the same internet web site above. Interested parties may receive a copy of the final EA by written request to Mr. Peter Crookston, Bureau of Reclamation, Provo Area Office. The address is 302 East 1860 South, Provo, Utah 84606-7317, or e-mail, pcrookston@usbr.gov.

5.3 Native American Consultation

Reclamation conducted Native American consultation throughout the public information process. Consultation letters and copies of the cultural resource inventory reports were sent by the Provo Area Office archaeologist to each tribe. Consulted tribes included the Ute Indian Tribe of the Uintah and Ouray Reservation, the Northwestern Band of Shoshoni Nation of Utah, the Confederated Tribes of the Goshute Reservation, and the Skull Valley Band of Goshute Indians of Utah. This consultation was conducted in compliance with 36 CFR 800.2(c)(2), on a government-to-government basis. Through this effort, the tribes are given a reasonable opportunity to (1) identify any concerns about historic properties; (2) advise on the identification and evaluation of historic properties, including those of traditional religious and cultural importance; (3) articulate their views on the undertaking's effects on such properties; and (4) participate in the resolution of adverse effects.

5.4 Coordination with Other Agencies

A paleontological report was requested from the UGS in September 2008. The UGS determined that unless fossils are discovered as a result of construction activities, this project should have no impact on paleontological resources.

Cultural resource inventory reports and a determination of no historic properties affected for the undertaking were submitted to the SHPO by the Provo Area Office archaeologist. SHPO concurred with Reclamation's determination of no historic properties affected.

Chapter 6 – Preparers

The following contributors to the EA are part of the U.S. Department of the Interior, Bureau of Reclamation, Provo Area Office and Salt Lake Regional Office.

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Appendix A

East Canyon Reservoir Hydrology Analysis

I. Introduction

East Canyon Reservoir is retained by East Canyon Dam and is one of the principal features of the Weber Basin Project, located in Northern Utah. As a multi-purpose storage reservoir, East Canyon provides irrigation, municipal and industrial water for areas on East Canyon Creek, the Weber River, and through the Gateway Canal to the Weber and Davis Canals and Aqueducts, and for land and communities in Weber, Morgan, Summit, Box Elder and Davis Counties in the Great Salt Lake Valley.

In combination with Lost Creek, Rockport, A.V. Watkins Reservoirs, and Echo Reservoir of the Weber River Project; the flow of the Weber River System is regulated. Additionally, Causey and Pineview Reservoirs located in the Ogden River Basin, the principle tributary of the Weber River, contribute water to the Weber Basin Project. Cooperative releases from each of these facilities provide irrigation and domestic water to lands along the Upper Weber and Ogden River Valleys and eastern slopes and lower valley lands of Weber, Morgan, Summit, Box Elder and Davis Counties.

Although the Weber Basin Project incorporates East Canyon and six other reservoirs, it was decided for simplicity, that only hydrology from the East Canyon watershed basin would be used to develop a working model for East Canyon Reservoir operations, with and without the proposed action alternative. A 30-year history of reservoir storage levels, elevations and releases was compiled, and inflows were calculated. Models were then run of the full 30-year period and 5-year cycles of average, dry, and wet conditions to determine if the pipeline project is manageable given maximum water usage subject to hydrologic limitations.

II. Data Descriptions

East Canyon Reservoir storage records for WY 1978- WY 2007, were obtained from the State of Utah Office of State Engineer ('78-'89) and the Utah Division of Water Rights Commissioner Reports ('89-'07). Reservoir release data for the same period was taken from USGS stream gauge No. 10134000, located on East Canyon Creek, ¼ mile downstream of East Canyon Dam.

Reservoir surface elevations from the same period were obtained from the Bureau of Reclamation's Hydromet Database system. Both storage and elevation had several missing days which were filled in with an Excel interpolation tool. Based on storage and release data, a 30-year inflow record was then calculated.

A Park City Demand Study submitted by the Park City Water Manager, was used to determine daily pipeline releases for the proposed action scenario. This study supplied a 5-year average of each month's percentage of yearly water use. These percentages were then used to translate the yearly 12,500 acre-feet usage to average daily cfs each month. Since the 12,500 acre-feet amount is to be allotted to the entire Snyderville Basin, a service area map from the SWDC was used to determine the percentage delivered to the East Canyon Basin.

Maximum available acre-feet data for snowmaking was obtained from the Snyderville Basin Water Reclamation District.

III Model Assumptions

For both no action and action alternative scenarios, full use of water rights during non-storage season is assumed, limited only by reservoir hydrology. Reservoir levels are maintained at or above top of inactive storage at 5577 feet. This scenario is at the extreme end of water usage; it is only employed to obtain the maximum yearly yield given hydrologic limitations. Actual full-use operations will likely witness much less storage fluctuation and higher overall elevations. Storage season is defined as October 15 through April 14; non-storage is April 15 through
October 14.

The 30-year historic inflows were studied to extract 5-year periods of average, dry, and wet conditions. Total April to July volumes were calculated to determine which years fell in these categories. While it is recognized that future hydrology may offer drier and wetter periods, model limitations assumes the extracted 5-year cycles to be representative of the extremes.

For the no action alternative scenario, these historical inflows remain unchanged for the model input. For the action alternative scenario, historical inflows are adjusted by the following: a 60/80 percent return flow (non-storage/storage) was added on; a multiplier of .9 was assigned to this return flow to represent the portion of the 12,500 acre-feet returning to the East Canyon Basin; and a snowmaking time-lag reduces return flow during snowmaking months and augments it during spring runoff.

Park City water demand monthly percentages are added to historical releases for the action alternative scenarios.

The return flow percentage is a figure adopted from area consumptive use tables calculated in a recent Utah State Engineer study[1]. The East Canyon basin multiplier was determined from the percentage of service area to East Canyon vs. Silver Creek drainage basins. A conservative 20 percent onsumptive/evaporation loss is used as determined from a 1988 study on Colorado Snowmaking[2].

Due to these assumptions and the limited tools of the models, actual reservoir operations may differ from those shown in the resulting graphs.

I Methodology

Microsoft Excel tools and spreadsheets were employed to create the reservoir operational model. Template models used for current East Canyon Reservoir operations were modified to allow the prediction of future storage and elevation, given inflow and release data for both no action and action alternative scenarios.

To maximize reservoir usage, historical releases are increased as much as possible to bring elevation down to the top of inactive, at 5577 feet, or as low as possible such that the following years are able to recover and remain above this level.

No action scenarios employ monthly multipliers to historical releases during the non-storage season to achieve an elevation of 5577 feet at the end of the water year. These "hindsight" reservoir operations are only possible with a view of future years; an upcoming dry cycle would preclude maintaining the reservoir at a level above 5577 feet, such that the reservoir could recover. Releases during wet years are thus likely much greater than needed by water users.

Releases for action alternative scenarios also use this multiplier, and are further increased by the monthly cfs pipeline addition, determined by the Park City demand study. Both scenarios reduce releases during storage season to maintain 5 cfs minimum required downstream flow (plus pipeline release for action scenario).

Historical inflows for action alternative scenarios are augmented by a 60 percent return flow during non-storage season and 80 percent during storage. Snowmaking acre-feet were translated into average cfs; this amount is deducted from December and January return flows and added to May inflow. Inflow for no action is unaltered historical inflow data. Both scenarios employ the .9 multiplier to the return flow to reflect the 10 percent loss of the 12,500 acre-feet to the Silver Creek watershed basin.

II. Analysis

The 12,500 acre-feet of water per year to be diverted to Park City and Snyderville Basin, represents 3 percent of WBWCD total project storage right. Due to the number of storage facilities and the flexibility of operations within the project to meet demand, annually redirecting 12,500 acre-feet to the basin above the East Canyon Reservoir, would not generate significant shortages for WBWCD and its water users on a project wide basis. With the proposed action alternative, immediate downstream releases may be reduced during dry periods (Figure 3.7 in EA). Reservoir elevations may periodically exceed the no action scenario elevations due to return flows (Figure 3.8 in EA).

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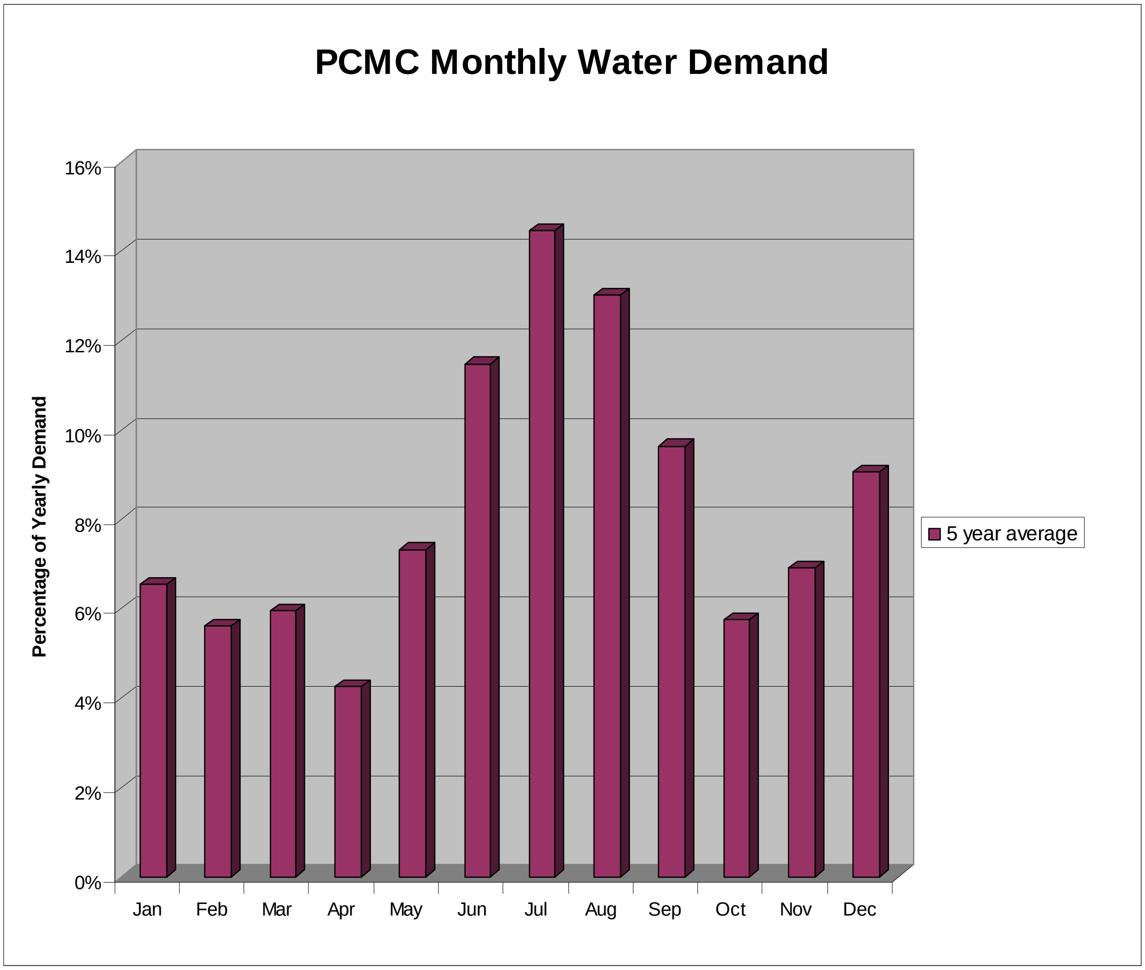

Table of Park City Monthly Water Demand Conversion to cfs/Day

	% of total	% of 12,500 acre-feet	Avg cfs/day
Oct	5.75%	718	12
Nov	6.90%	863	15
Dec	9.07%	1133	18
Jan	6.55%	818	13
Feb	5.62%	702	13
Mar	5.96%	744	12
Apr	4.25%	532	9
May	7.32%	915	15
Jun	11.48%	1435	24
Jul	14.45%	1807	29
Aug	13.02%	1627	26
Sep	9.64%	1205	20

Appendix B

Water Quality Modeling Using CE-QUAL-W2

Introduction
CE-QUAL-W2 (W2) is a two dimensional, longitudinal/vertical, hydrodynamic, and water quality model. Because the model assumes lateral homogeneity, it is best suited for relatively long and narrow waterbodies exhibiting longitudinal and vertical water quality gradients (Cole 2003). Development and evolution of CE-QUAL-W2 has spanned three decades. The USACE, J.E. Edinger and Associates (Edinger), and Dr. Scott Wells at Portland State University working with Mr. Tom Cole (USACE), have been the major developers in recent years.

Capabilities and Limitations
The CE-QUAL-W2 model is capable of predicting water surface elevations, velocities, temperatures, and a number of water quality constituents. Water is routed through cells in a computational grid where each cell acts as a completely mixed reactor for each time-step. Geometrically complex waterbodies can be represented through multiple branches and cells. Multiple inflows and outflows to the waterbody are represented through point/nonpoint sources, branches, precipitation, and other methods. Tools for modeling hydraulic structures, such as spillways and pipes are available. Output from the model provides options for detailed and convenient analyses.

The model uses several assumptions and approximations to simulate hydrodynamics, transport, and water quality processes. The model solves for gradients in the longitudinal and vertical directions and assumes lateral gradients are negligible. This assumption may be inappropriate for waterbodies with significant lateral variations. Turbulence is modeled through eddy coefficients of which the user must decide which scheme is most appropriate for an application. An algorithm for vertical momentum is not included and results may be inaccurate in waterbodies with significant vertical acceleration. Water quality processes are extremely complex and the model uses simplified approaches to reach solutions. Several water quality processes are not simulated including zooplankton, macrophytes, and a dynamic sediment oxygen demand (Cole, 2003).

Input Data
The model is limited by the quality and availability of input data. This includes meteorological, inflow and outflow, water temperature, water quality, and calibration data. These data most often determine the accuracy and usefulness of the application.
Bathymetry

The bathymetry file of a CE-QUAL-W2 model is the two-dimensional numeric representation of a waterbody and is also referred to as the computational grid. The two dimensions represented are the longitudinal and vertical dimensions, or the length and depth of a waterbody which are divided into longitudinal segments and vertical layers. The lateral dimension, or width, is not represented in the grid but an average width is computed and used to determine volume. Since the model grid is two-dimensional, all modeled parameters such as temperature, velocity, and water quality constituents can only vary in the longitudinal and vertical directions. This assumes that modeled parameters do not vary significantly in the lateral direction. This assumption has been found appropriate in relatively long and narrow waterbodies.

The components of the grid are from smallest to largest cells, segments, branches, and waterbodies. The cell is a single vertical layer within a single segment. Segments consist of one or more cells, branches are one or more longitudinal segments, and a waterbody is one or more branches. Bathymetry files are dimensions from a single waterbody.

The volume of the grid is computed by multiplying a cell's length, thickness, and width. The sum of all cells within the grid is then the total storage for the waterbody. The computational grid storage is compared to actual storage-capacity charts to verify the model bathymetry accuracy.

Calibration
Model calibration involves comparing observed data to modeled, or predicted, results. The observed values are typically vertical profile and reservoir discharge observations for temperature and other water quality parameters. Calibration statistics are generated by computing the absolute mean error (AME). This computation is the sum of the absolute value of the predicted value, minus the observed value divided by the total number of observations. This describes, on average, the difference between predicted and observed values.

East Canyon Reservoir Model

General Description
The East Canyon model used to simulate the no action and action alternatives is built from a model calibrated to the historic time period 1991-2007. The time period 1991-2007 was chosen to calibrate the model to because of the availability of input and calibration data needed to support the model. The historic model simulates reservoir hydrodynamics, thermal stratification, nutrient cycling, and phytoplankton growth and decay. It is calibrated for water surface elevations, reservoir temperatures, dissolved oxygen, and nutrient concentrations over the simulation time period. The model uses a geometric, computational grid and various input data to simulate these processes. Model input data were collected by several agencies including the U.S. Geological Survey (USGS), DWQ, Reclamation, and WBWCD.

Model development and calibration were performed by the Water Quality Group, Upper Colorado Region, of the Bureau of Reclamation. Model development is an ongoing process and is continuously updated as new CE-QUAL-W2 versions are released, more data is made available and better methods of simulating hydrodynamics and water quality are established. The current East Canyon Reservoir W2 model generally reproduces hydrodynamic and water quality patterns and processes as observed historically, and is a useful tool for evaluating possible reservoir water quality associated with the action and no action alternatives.

East Canyon Bathymetry

The CE-QUAL-W2 computational grid was generated from a 2008 bathymetric survey of East Canyon Reservoir. It consists of 4 branches, 35 segments, and 64 layers. Each layer is 1 meter thick. The computational grid is displayed in plan, profile, and cross section views in Figure B-1. In the figure, green segments and cells are upstream boundaries, blue segments and cells are downstream boundaries, and red segments and cells are tributary branch connections.

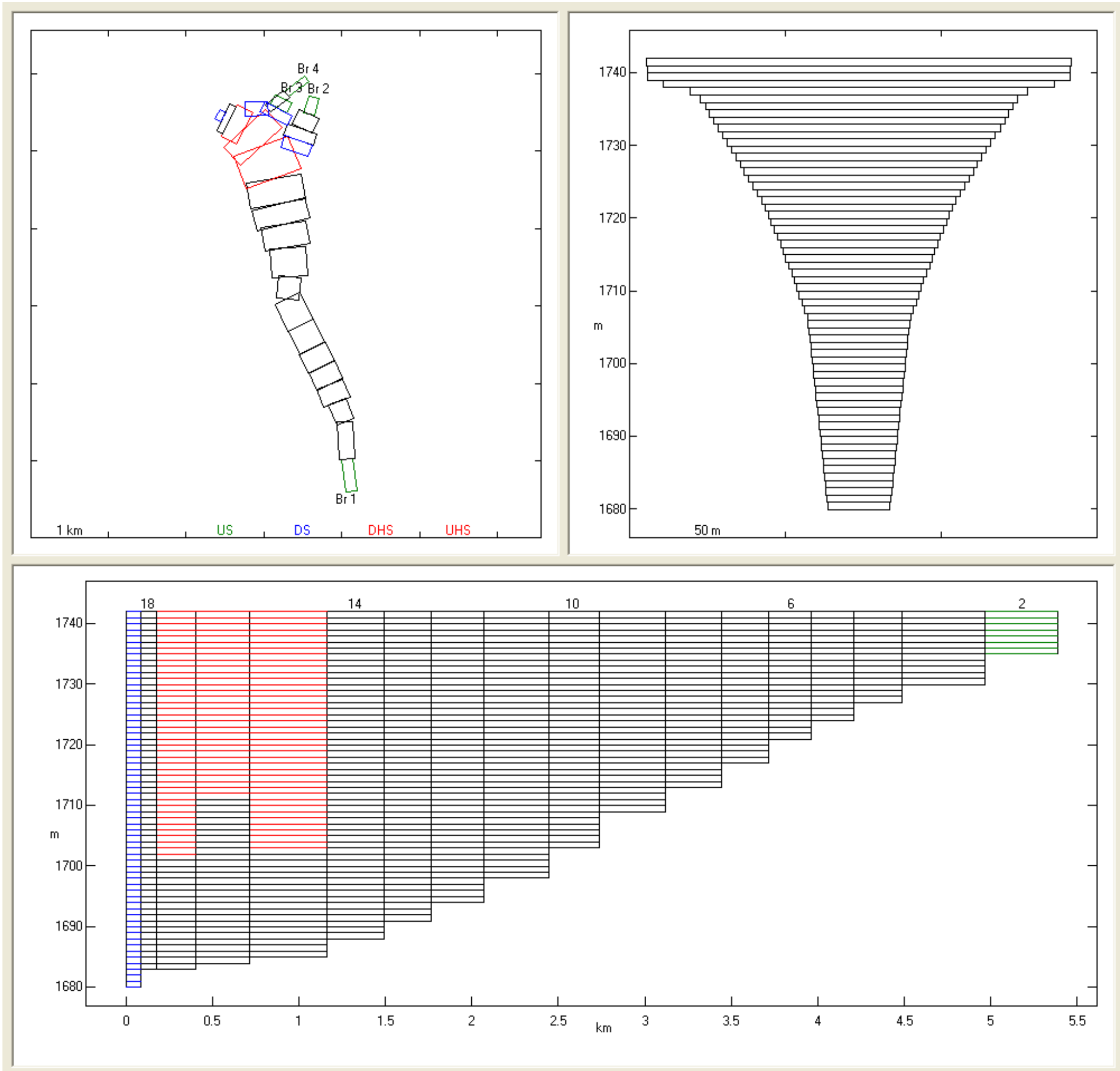

Figure B-1: East Canyon Reservoir W2 Bathymetry (plan, profile, and cross section views)

Modeling Assumptions
The input data used in the model are the best available and are assumed to be accurate representations of meteorology, flow, and water quality parameters. Additional assumptions and the impacts to model accuracy and reliability are described below.

Meteorology
Meteorological data in the immediate vicinity of East Canyon Reservoir is not available during the time period of model simulation. The nearest site with hourly observations is the Salt Lake City International Airport, which is 22 miles southwest of the reservoir and sits at an elevation 1,500 feet below the reservoir. Additionally, the reservoir is an a narrow valley with mountains rising abruptly on all sides of the reservoir to elevations over 8,000 feet, while the airport is near the

north end of the 500 square mile Salt Lake Valley. Additional meteorological data was available beginning in 1999 at Snake Creek near Heber City, Utah, 30 miles south of East Canyon Reservoir. This site is situated in a valley at an elevation near that of East Canyon Reservoir, and the valley size is much more similar to East Canyon than the Salt Lake Valley. However, because East Canyon lacks hourly and even daily weather observations, it is impossible to determine if air and dewpoint temperature, wind speeds and directions, and cloud cover used in the model, are accurate representations of conditions at East Canyon Reservoir.

The dataset used in the W2 model is adjusted based on statistical regressions of Salt Lake City International Airport and Snake Creek meteorological data. Wind directions are then further adjusted to the orientation of the East Canyon Reservoir valley. Additionally, numerous changes were made to the meteorological dataset and tests made to improve model accuracy. After several months, it was concluded that local conditions at East Canyon Reservoir varied enough from conditions at the Salt Lake Airport and Snake Creek, that collecting actual data near the reservoir would be needed to improve the dataset.

Water Balance

Daily inflows to East Canyon Reservoir are calculated by determining the difference between reservoir discharges and changes to reservoir storage. Reservoir discharge and storage changes are determined once a day. This method of calculating reservoir inflow, does not take into account fluctuations in pool elevation or discharge, evaporation, or seepage not captured by discharge measurements. During times of low flows in East Canyon Creek, this method also calculates a negative inflow to the reservoir. The W2 model inflow assumes a minimum flow rate of 5 cfs in East Canyon Creek inflows to the reservoir. The model is then calibrated to reproduce observed water surface elevations. An additional input known as the distributed tributary is created to handle the positive and negative flows needed to match the observed water surface elevations. These flows represent precipitation, ungaged flows, bank storage, and other source/sinks. CE-QUAL-W2 distributes this flow evenly over the water surface in a simulation. Large flows can have water quality impacts. Reasonable assumptions are made for assigning water quality constituent concentrations to these flows.

Dam Discharge

Water is discharged from East Canyon Dam through one of three features, a spillway, the outlet works, and a bypass. The spillway is an uncontrolled crest at elevation 5,705 feet. The outlet works withdraws water from an elevation of 5,535 feet. The bypass is at elevation 5,540.75 feet. Records of outflow from East Canyon Dam capture the total discharge and do not separate flows over or through the individual features. Properly capturing the points (spillway, outlet works, bypass, and seepage) and volume of discharges is an important part of accurately modeling the reservoir hydrodynamics. Guidelines were used to divide the total outflow between the individual features. Discharge over the spillway was based on a rating curve and interpretation of flows before and after spills. Spillway discharge was only calculated when reservoir elevations were greater than 5,705 feet. Discharge from the outlet works was calculated as the difference between spills and total outflow during spill events and as all flow above 32 cfs at other times. Discharge from the bypass typically occurs when total outflow is less than 32 cfs per the dam tender (Carter, 2008).

An additional factor complicating the discharges from the dam is the hydrodynamics, or flow paths through the reservoir. These are unusual and complex due to the existing series of submerged dams and their features. East Canyon Reservoir was first impounded by a small earthen dam constructed in 1896. The earthen dam was modified twice to increase the reservoir size. In 1916, a concrete dam was constructed which formed a 29,200 acre-foot reservoir. The crest of this dam is at elevation 5,660 feet. A channel 45 feet deep was excavated through the earthen dams as part of construction of the concrete dam. In 1966 a second concrete dam was finished downstream of the existing structures. This dam increased reservoir storage to 51,200 acre-feet and raised the water surface elevation to 5,705 feet at full pool. The first concrete dam was left in place to allow for water storage during construction of the newer dam. A 5-foot diameter hole was bored through the first concrete dam at an elevation of 5,567 feet before it was submerged. The concrete dams are separated by 7 feet at the dam abutments and 44 feet at the dam axes. The water in this small pool between the dams enters either through the 5-foot diameter hole at elevation 5,567 feet or over the crest (5,660 feet) of the submerged concrete dam. Water discharged from the outlet works, therefore, has different characteristics (temperature, dissolved oxygen, nutrient concentrations, etc.) than water at similar depths upstream of the existing dams.

The CE-QUAL-W2 model as currently coded is not capable of accurately representing the various structures and their features. To approximate the hydrodynamics of the flow through and over the submerged concrete dam, the internal weir feature of the W2 model is used. Two internal weirs are added to the model simulation just upstream of the last segment in the main branch of East Canyon Reservoir. The lower weir is placed from the bottom of the reservoir up to layer 48. The upper weir spans the depths from layer 46 to layer 19. This leaves an opening at layer 47, which is approximately the same elevation as the hole in the submerged dam. The top of the upper weir at layer 19 is approximately the same elevation as the crest of the submerged dam. See Figure B-2 for an illustration. This configuration forces water to flow over the submerged dam, as well as flow through the hole. However, because CE-QUAL-W2 is laterally averaged, there is not a width associated with the hole. Flow through the hole is not restricted by the size of the opening as it realistically should be. This is compensated for somewhat by restricting the withdrawal of the outlet works to a higher elevation, in an attempt to increase flow over the crest of the upper weir and decrease flow through the opening between the two weirs.

Figure B-2: East Canyon Reservoir W2 model internal weirs

Historic Model Calibration

The East Canyon Reservoir historic model is specifically calibrated so that predicted results for reservoir pool elevation, temperature, and dissolved oxygen match observations taken at the reservoir. Predicted results are compared to observed data from 3 reservoir locations, near the dam, mid-reservoir, and the upper reservoir (Figure B-3). Calibration efforts for nutrient concentrations are considered qualitative at this stage in model development. Calibration to dissolved oxygen observations is used as a general confirmation of the calibration of nutrient cycles and algal dynamics. Calibration data were collected by the DWQ, Reclamation, and WBWCD.

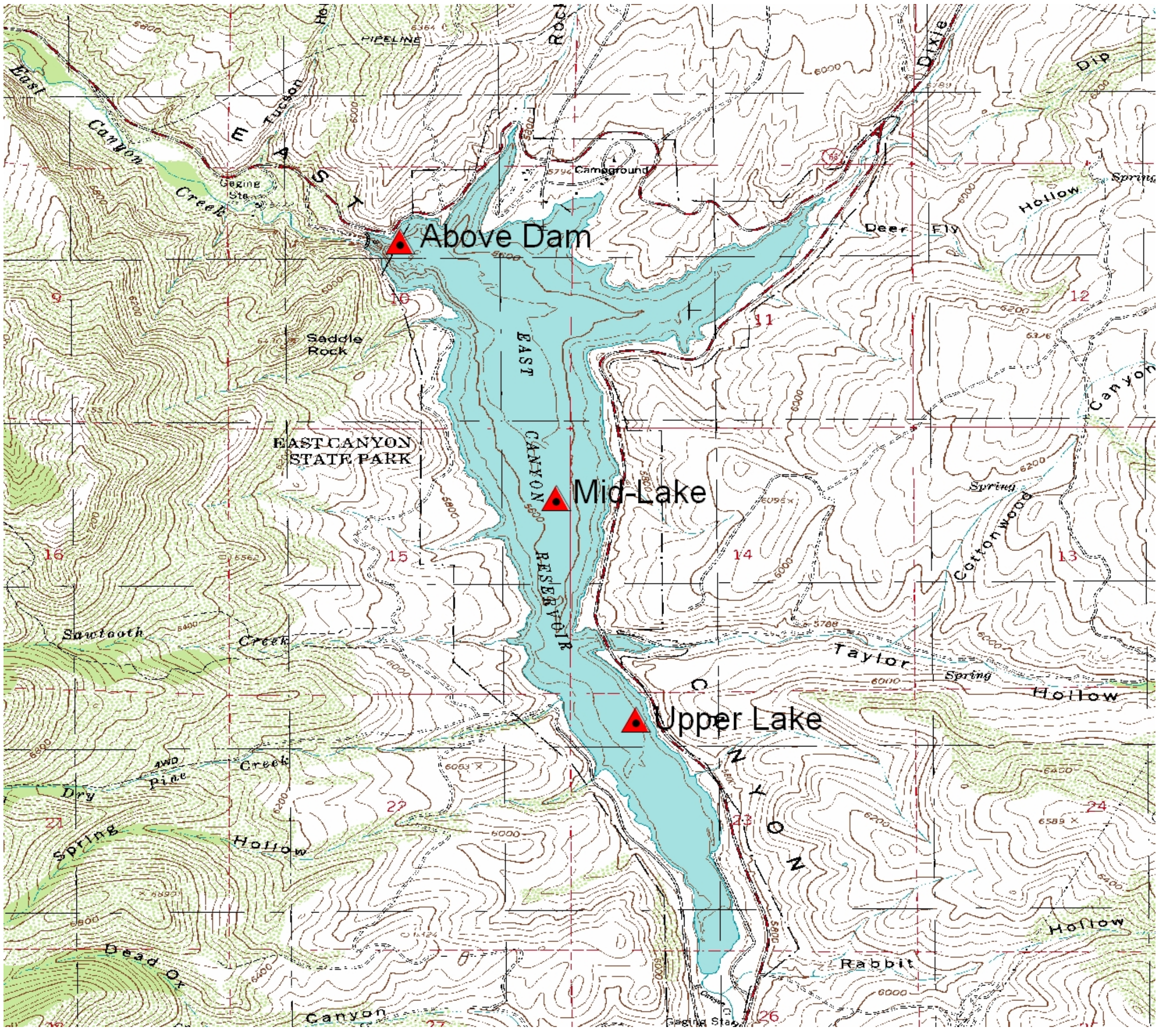

Figure B-3: East Canyon Reservoir, DWQ Monitoring Sites

Water Balance

The water balance calibration is determined by matching predicted model pool elevations to the observed elevations. The reservoir pool elevation is a daily measurement made near the dam. Figure B-4 shows the predicted and observed reservoir pool elevations from the period 1991 to 2007. Over this time period the model AME for reservoir pool elevation is 0.19 feet.

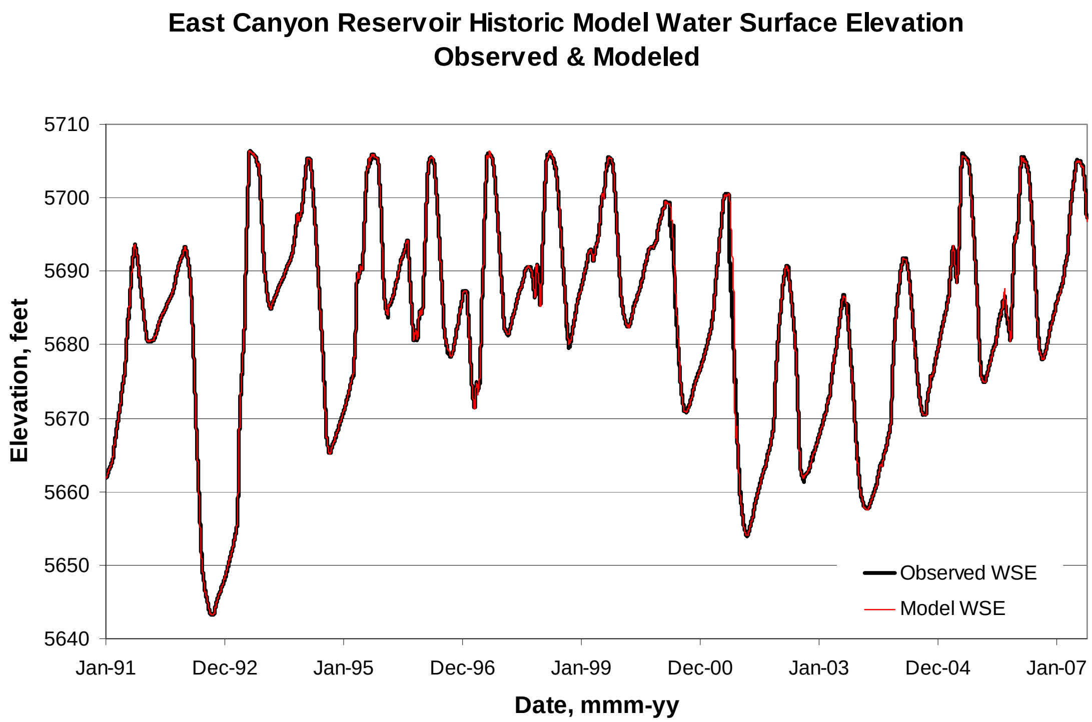

Figure B-4: East Canyon Reservoir historic model pool elevation vs. observed pool elevation, 1991-2007

Temperature

Calibration statistics for temperature profiles are shown for each station in Table B-1. The number of profiles at each station is also reported in the table. The AME of the temperature profiles is 1.46°C.

Table B-1: East Canyon Reservoir historic model temperature calibration statistics

Site	*AME*	*# of Profiles*
Above Dam	1.35	62
Mid Lake	1.55	27
Upper Lake	1.59	37
Average	1.46	126

There are a total of 126 temperature profiles from the three sampling stations in East Canyon Reservoir between 1992 and 2007. Figure B-5 displays model results compared to observed temperature profiles near the dam during 2004.

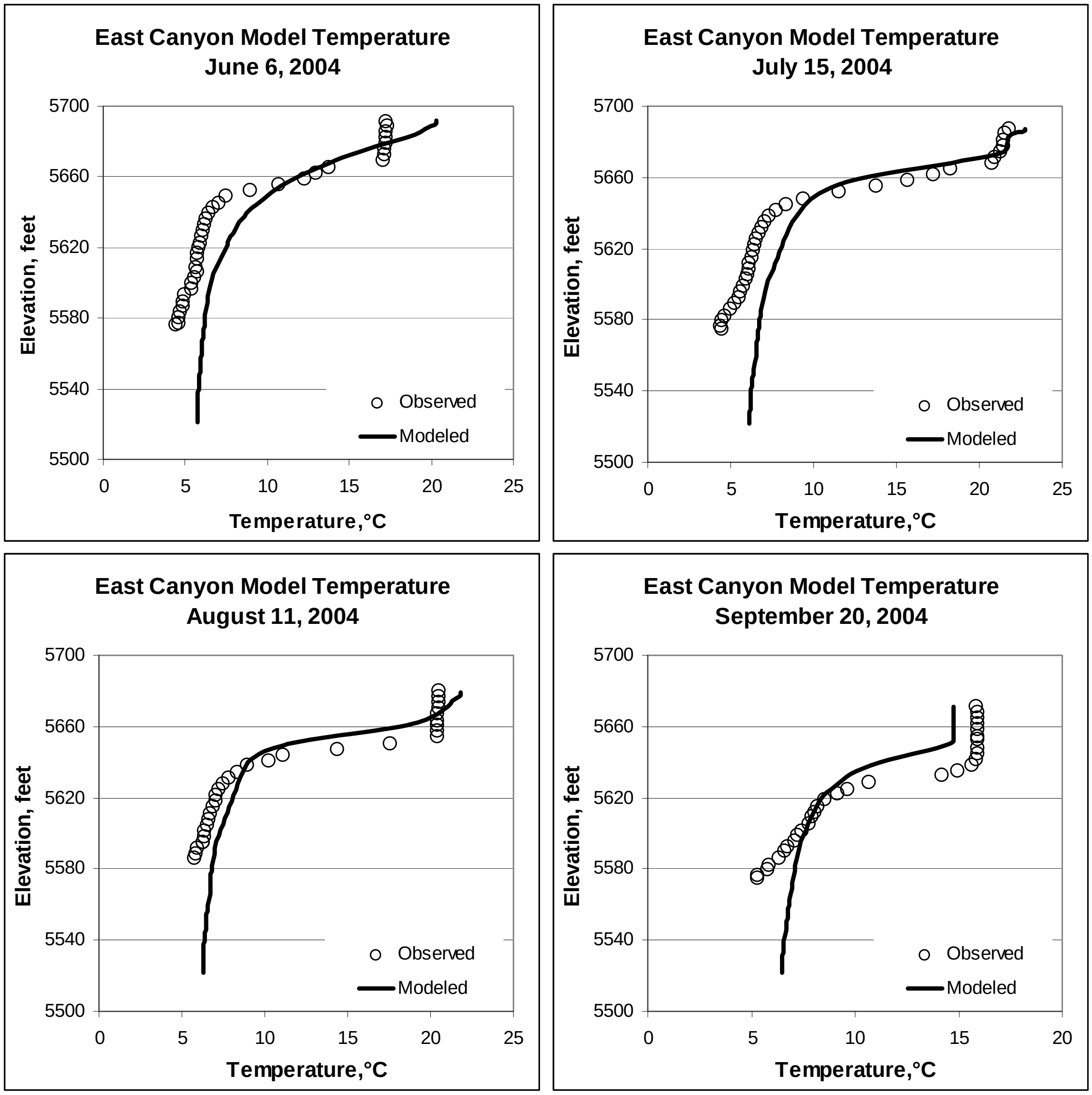

Figure B-5: East Canyon Reservoir historic model temperature profiles, 2004

Dissolved Oxygen

Calibration statistics for dissolved oxygen are shown for each station in Table B-2. The number of profiles at each station is also given in the table. The AME of the dissolved oxygen profiles is 2.07 mg/L.

Table B-2: East Canyon Reservoir historic model DO calibration statistics

Site	*AME*	*# of Profiles*
Above Dam	2.06	62
Mid Lake	2.23	27
Upper Lake	1.96	37
Average	2.07	126

There are a total of 126 dissolved oxygen profiles from the three sampling stations in East Canyon Reservoir between 1992 and 2007. Figure B-6 displays model results compared to each observed dissolved oxygen profile near the dam during 2004.

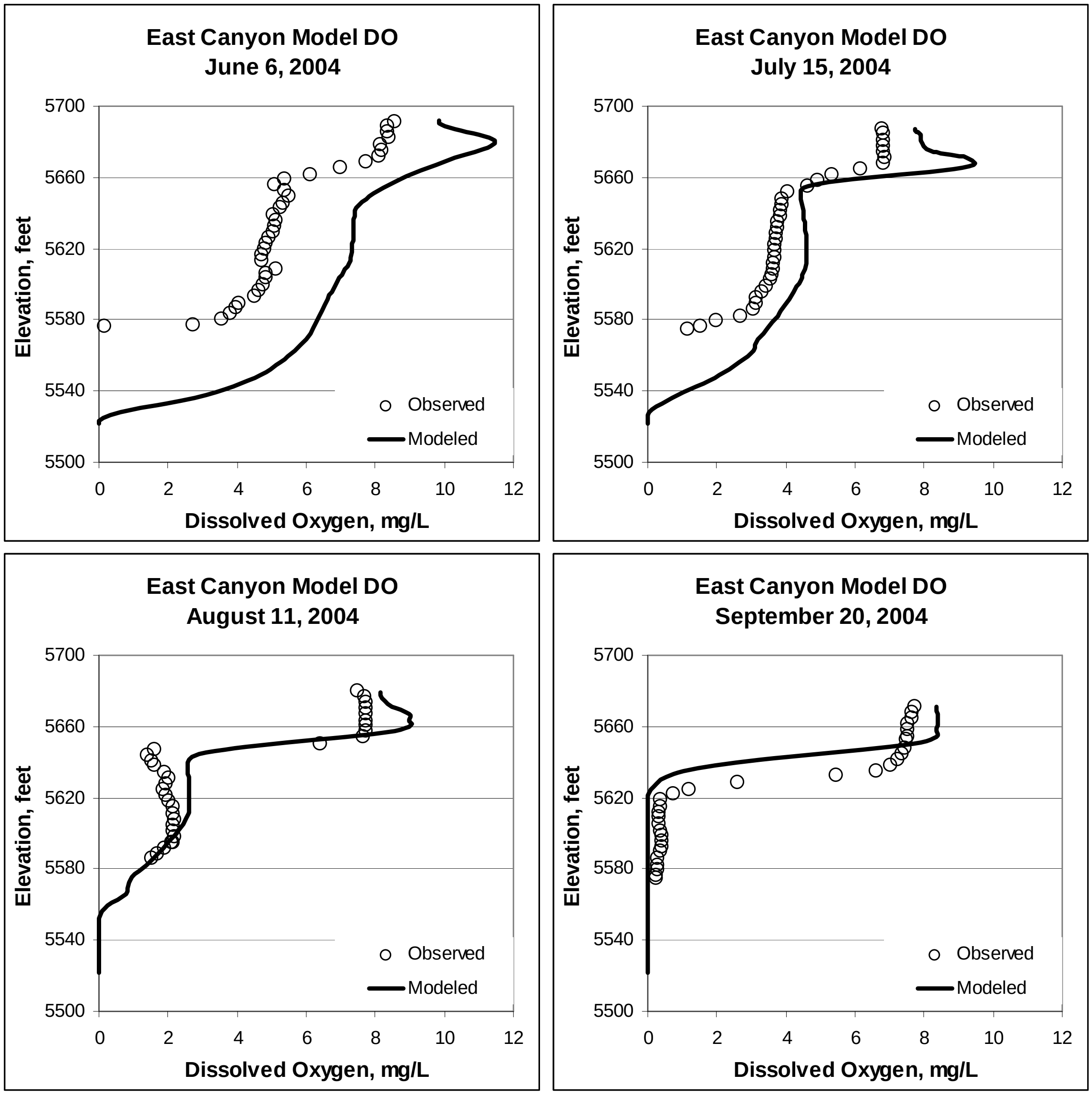

Figure B-6: East Canyon Reservoir historic model DO profiles, 2004

No Action Model

Methods & Assumptions

The East Canyon Reservoir historic model, 1991-2007, was the base model used for the no action alternative evaluation of reservoir water quality. The model was modified to simulate the no action alternative by replacing the historic reservoir operations with the projected no action reservoir operations for 1991-2007. Operations under the no action alternative were determined by evaluating reservoir storage and outflow under full use of project water. The no action alternative water quality model is used as a base model for comparison with the action alternative water quality model.

The no action alternative water quality model simulates projected conditions and the validity of results from or comparisons to this model, are subject to several assumptions. The no action alternative water quality model uses the same kinetic coefficient and parameters settings as the calibrated historic water quality model. The purpose of the calibrated historic model is to provide coefficient and parameters settings which can be used in projected or hypothetical scenarios. The calibration allows for the comparison between the action and no action models.

The no action model simulates 1991-2007 conditions, with the exception of the reservoir operations, i.e. storage and discharge. Other inputs to the model match the historic time period which the no action alternative was based on. Therefore, the meteorology and inflow volumes, temperatures, and water quality constituent concentrations used in the no action model are assumed to be the same as historic values.

Discharges from the dam are separated between the individual features using the same assumptions applied to discharges in the historic model. The no action model is also subject to the assumptions of the water resources analysis which determined the reservoir operations between 1991 and 2007.

Water Balance

Reservoir storage is matched by comparing model pool elevations to no action alternative pool elevations and iterating model simulations until an adequate match is achieved. Figure B-7 displays the model predicted water surface elevations and the no action alternative water surface elevations. The AME of the model for water surface elevations is 0.17 feet.

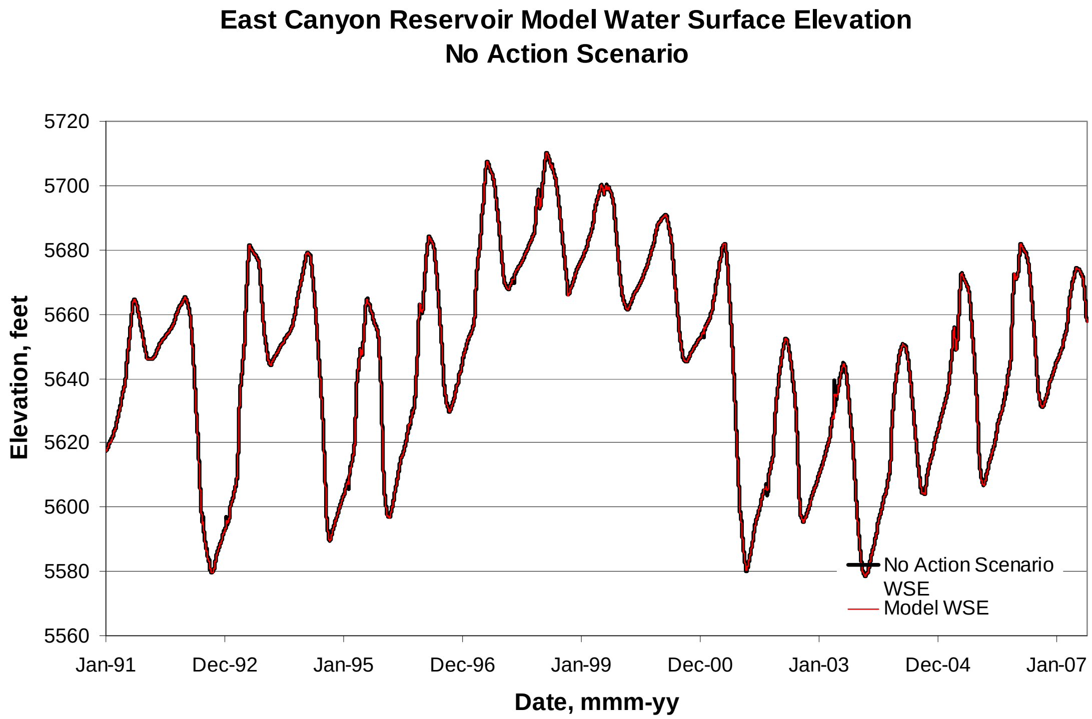

Figure B-7: East Canyon Reservoir No Action Alternative reservoir pool elevations, 1991-2007

Action Model

Methods & Assumptions

The East Canyon Reservoir historic model, 1991-2007, was the base model used for the action alternative evaluation of reservoir water quality. The model was modified to simulate the action alternative by replacing the historic reservoir operations with the projected action reservoir operations for 1991-2007. Operations under the action alternative were determined by evaluating reservoir storage, outflow, and full development of the 12,500 acre-foot diversion from East Canyon Reservoir plus pumping of 2 cfs, which is discharged to East Canyon Creek for instream flow purposes. Results from the action alternative water quality model are compared with the no action alternative for interpretation and conclusions.

The action alternative water quality model simulates projected conditions and the validity of results from or comparisons to this model are subject to several assumptions. The action alternative model uses the same kinetic coefficient and parameters settings as the calibrated historic water quality model. The purpose of the calibrated historic model is to provide coefficient and parameter settings which can be used in projected or hypothetical scenarios. The calibration allows for the comparison between the action and no action models.

The action model simulates 1991-2007 conditions, with the exception of the inflow volumes, inflow phosphorus concentrations, pipeline diversion, and reservoir operations, i.e. storage and discharge. Other inputs to the model match the historic time period which the action alternative was based on. Therefore, the meteorology and inflow temperatures and water quality constituent concentrations other than phosphorus used in the action model are assumed to be the same as historic values.

Inflow volumes include return flows from water use in the East Canyon watershed. Assumptions regarding the volume of return flow and lag time are explained in the hydrology analysis. The majority of the return flows enter East Canyon Creek at the East Canyon Water Reclamation Facility (ECWRF) as treated wastewater. Though the temperature of return flows will likely be different than temperatures in the creek, especially in the winter, an equilibrium temperature is assumed once the inflow enters the reservoir and no adjustments are made to the historical inflow temperatures.

Water quality assumptions of the treated wastewater are based on discussions with Michael Luers, General Manager of the Snyderville Basin Water Reclamation District, and the current UPDES (Utah Pollution Discharge Elimination System) permit. The permit is based on a capacity of 7.2 MGD and regulates the phosphorus concentration of the effluent to an average concentration of 0.1 mg/L total phosphorus. This concentration is added to East Canyon Creek by mass balance. No reductions in phosphorus in the creek as it travels to the reservoir, are assumed for the return flow portion of the inflow volume. In reality, some reduction in phosphorus concentration may occur due to biological uptake in the creek, but the extent is difficult to determine.

Return flows from sources other than the ECWRF such as snowmaking, are assumed to have phosphorus concentrations equal to 0.1 mg/L total phosphorus. This assumption is based on the treatment for phosphorus removal, which will occur at the SWDC treatment facility and reduce total phosphorus concentrations to 0.1 mg/L in water distributed for all municipal and industrial uses, including snowmaking (Campbell, 2009).

Instream flows of up to 2 cfs are assumed to have phosphorus concentrations equal to concentrations in the reservoir. Water provided for instream flows will not be treated for phosphorus removal prior to discharge to East Canyon Creek. The phosphorus concentrations of this water were included as part of the inflow water quality input to the reservoir model.

Return flows anticipated from municipal water use are allocated water quality concentrations based on treatment at the SWDC facility, the current ECWRF effluent concentrations, and the UPDES permit limits. Specifically, total phosphorus in the effluent is limited to a concentration of 0.10 mg/L. The CE-QUAL-W2 model requires inputs of bio-available phosphorus, typically approximated by orthophosphate concentrations. Concurrent samples collected by ECWRF of orthophosphate and total phosphorus taken from the effluent twice per week in 2006 are shown as monthly averages in Table B-3. The year 2006 is used because it reflects the current level of treatment at the ECWRF, as well as the anticipated level of future treatment once the facility reaches full capacity. In these samples, the orthophosphate is much less than the total phosphorus concentration. To be conservative, the model bio-available phosphorus concentration of the return flow is assumed to be 0.03 mg/L or slightly higher than the 2006 effluent average. In reality, the phosphorus concentrations may be lower, which would result in improved water quality in the reservoir.

Table B-3: ECWRF effluent samples - phosphorus concentrations, 2006

Month	*Total Phosphorus*	*Orthophosphate*
JAN	**0.21**	**0.05**
FEB	**0.20**	**0.01**
MAR	**0.09**	**0.04**
APR	**0.45**	**0.03**
MAY	**0.04**	**0.01**
JUN	**0.05**	**0.02**
JUL	**0.05**	**0.02**
AUG	**0.06**	**0.03**
SEP	**0.04**	**0.01**
OCT	**0.03**	**0.01**
NOV	**0.03**	**0.01**
DEC	**0.03**	**0.01**
Average	**0.11**	**0.02**

Discharges from the dam are separated between the individual features, using the same assumptions applied to discharges in the historic model. Diversions to the pipeline are assumed to be taken from model segment 15 at an elevation of 5,565 feet. The action model is also subject to the assumptions of the water resources analysis which determined the reservoir operations between 1991 and 2007.

Impacts to water quality resulting from the action alternative are determined by comparing water quality modeling results of the action alternative model to baseline conditions, which were determined from the results of the no action alternative model. These methods included comparing results for the water quality parameters phytoplankton production, dissolved oxygen distribution, and phosphorus concentration.

Model results are not compared directly to the TMDL target for chlorophyll a, nuisance algae, and blue-green algae dominance. To determine if the action alternative results in an impact relating to algal production, two comparisons were made with the no action alternative. The first compares daily average chlorophyll concentrations between the two alternatives over the duration of the simulation.

The second compares daily average blue-green algal biomass between the two alternatives over the duration of the simulation.

The TMDL targets of dissolved oxygen are used to compare results from the action and no action alternatives. These results are generated by evaluating monthly profiles for the mixed and stratified periods. The three sample locations monitored by the DWQ during monitoring are used in the model to generate the profiles. The mixed periods were determined to be the months of January-April and November-December. The stratified periods were determined to be the months of May-October. During the mixed periods, the monthly profiles which failed to meet the targets were compared between the two alternatives. During the stratified periods, the profiles which failed to meet the targets were compared between the two alternatives.

Daily average concentrations of dissolved phosphorus were compared between the two alternatives. Total phosphorus is not included as it is not an input in the model. Dissolved phosphorus is a component of total phosphorus; therefore, total phosphorus is at least as great as the dissolved component and is typically greater.

Water Balance

Reservoir storage is matched by comparing model pool elevations to action alternative pool elevations and iterating model simulations until an adequate match is achieved. Figure 3-7 displays the model predicted water surface elevations and the action alternative water surface elevations. The AME of the model for water surface elevations is 0.25 feet.

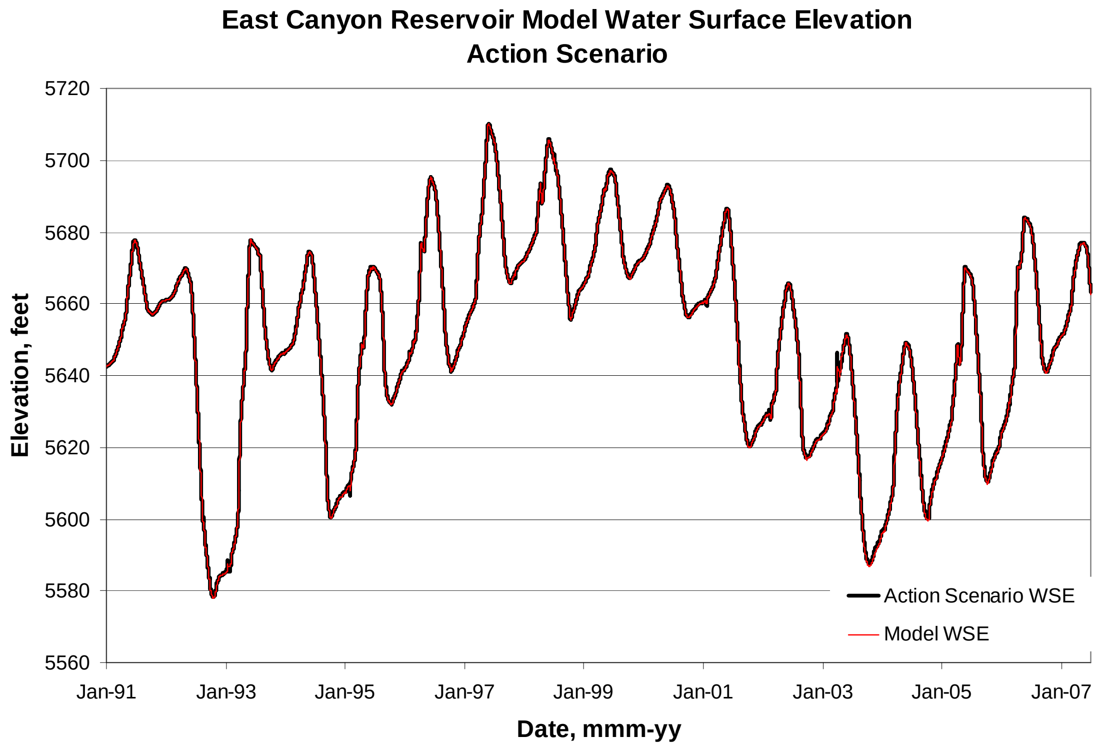

Figure B-8: East Canyon Reservoir action alternative reservoir pool elevations, 1991-2007

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