

RECLAMATION

Managing Water in the West

A.V. Watkins Dam Safety of Dams Modification Draft Environmental Assessment PRO-EA-07-002

**Weber Basin Project
Box Elder County, Utah
Upper Colorado Region
Provo Area Office**



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

October 2007

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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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Upper Colorado Region
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Chapter 1 - Need for Proposed Action and Background

1.1 Introduction

This document is an environmental assessment (EA) of the proposal to modify A.V. Watkins Dam under the Safety of Dams (SOD) Act of 1978 (Public Law 95-578, as amended). The proposed SOD modifications would correct safety deficiencies of the dam without affecting the purpose or benefits of the dam. Specifically, the embankment and foundation of the dam need to be repaired. The repairs are needed to restore the reservoir to full function and to incorporate state-of-the-art defensive measures of controlling seepage within the foundation and embankment. On November 13, 2006, emergency remedial actions were taken at A.V. Watkins Dam when it was discovered that a foundation seepage erosion failure mode was in progress. There was a high probability of failure of the dam which could have resulted in the uncontrolled release of the reservoir and which could have resulted in loss of life. It is now critical to the Weber Basin Project (Project) that A.V. Watkins Dam be permanently repaired to allow the reservoir to fill to full capacity and restore Project benefits.

The dam is located in Box Elder County, Utah. The Willard Bay State Park is located adjacent to the reservoir created by A.V. Watkins Dam. The park is managed by the Utah Division of Parks and Recreation which maintains several campgrounds, boat docks and ramps, entrance station, and other associated buildings and infrastructure. Modifications to State Park facilities would not be needed.

This EA analyzes the potential impacts of the proposed SOD modifications. If potentially significant impacts to the human environment are identified, a Notice of Intent to prepare a draft environmental impact statement (EIS) would be published in the *Federal Register* and an EIS would be prepared. If no significant impacts are identified, Reclamation would issue a Finding of No Significant Impact (FONSI). The FONSI would include the decision to proceed with a selected alternative.

1.1.1 Safety of Dams (SOD) Program Overview

In keeping with the mission to ensure that Reclamation dams do not present unacceptable risks to people, property, and the environment, Reclamation's Dam Safety Program was officially implemented in 1978. The modifications proposed for A.V. Watkins Dam are authorized by the Reclamation Safety of Dams Act of 1978 (Public Law 95-578) and the Reclamation Safety of Dams Act Amendments of 1984 (Public law 98-404), 2000 (Public Law 106-377), 2001 (Public Law 107-

117), and 2004 (Public Law 108-439). Together, these are referred to as the Safety of Dams Act.

Dams must be operated and maintained in a safe manner. Safe operation is ensured through safety inspections, analyses utilizing current technologies, and designs and corrective actions taken if needed based on current engineering practices.

The primary emphasis of the Safety Evaluation of Existing Dams (SEED) program, a subtask under the SOD program, is to perform site evaluations and to identify potential safety deficiencies of Reclamation and other Interior Bureau's dams. The basic objective is to identify dams which pose an increased threat to the public and to quickly complete the related analyses in order to expedite corrective action decisions and safeguard the public and associated resources.

The SOD program focuses on evaluation of Reclamation dams and implementing actions to resolve safety concerns. Under this program, Reclamation completes studies and identifies and accomplishes needed corrective actions for Reclamation dams. The selected course of action relies on assessments of risks and liabilities with environmental and public involvement issues incorporated into the decision making process.

1.1.2 SOD NEPA Compliance Requirements

As required by Section 5 of the Reclamation Safety of Dams Act, this EA must be completed and submitted to the Congress, along with a technical report and other supporting information, in order to obtain authorization to proceed with the proposed SOD modifications. The information and analyses in the EA, including the description of the proposed SOD modifications and alternatives, represent the best available information at this stage of the SOD process for A.V. Watkins Dam. Further analysis after Congressional approval, but prior to or in the early stages of project initiation, may result in a need to modify the alternative selected for implementation. Project changes that are not specifically analyzed in this environmental assessment will be documented in the administrative record. Major changes, for which additional environmental analysis is appropriate, would be analyzed in a supplement to this EA. This supplement would be made available to the public upon request. If a FONSI is completed, it would be modified if warranted by project changes and would also be made available to the public upon request.

1.2 Background

Willard Reservoir is an off-channel storage facility located twelve miles northwest of Ogden, Utah, in Box Elder County (Appendix 1, Map 1). The extreme southern portion of the project extends into Weber County. Construction of this U-shaped zoned earthfill dam was started in 1958 and completed in 1964. It is primarily founded on lacustrine deposits of sand, silt, and clay. Prior to

construction, a drainage canal was excavated downstream and parallel to the proposed embankment alignment to lower the groundwater table in the vicinity of the dam and facilitate embankment construction. The canal or South Drain as it is referred to, continues to collect local groundwater and transports it under the Willard Intake Canal through a siphon, and discharges it into the Great Salt Lake.

The reservoir is fed by the Willard Canal, which receives water through the Slaterville Diversion Dam located on the Weber River, approximately 8 miles south of the reservoir. Water is returned from Willard Reservoir to Weber River as needed over the same route (Willard Canal), facilitated by two pumping plants. The dam and reservoir are features of the Weber Basin Project (Project) and provides irrigation and municipal and industrial (M&I) water to heavily populated and industrialized lands east of the Great Salt Lake. Project benefits include irrigation, M&I water, fish and wildlife, and flood control. The Weber Basin Water Conservancy District (District) assumed responsibility for repayment of construction costs, delivery of water, and general operation of the Project pursuant to a 1952 repayment contract between Reclamation and the District. Reclamation transferred, by contrast, to the District full responsibility for operating and maintaining the dam on April 10, 1969.

The reservoir has a total water capacity of 215,100 acre-feet (af) at a water surface elevation of 4226 feet above sea level. The active (usable) storage is 198,200 af. The minimum water surface elevation is 4205 feet. The reservoir has a surface area of 10,000 acres. A.V. Watkins Dam is an earthen structure. The dam is 36 feet high at the maximum section, has a crest length of 76,665 feet (slightly more than 14.5 miles), and contains 17,060,000 cubic yards of material. On the north end of the dam, the outlet works and overflow sill spillway are combined into one structure. The combined outlet works/spillway capacity is 1,121 cubic feet per second (cfs) at water surface elevation 4226.85 feet.

Since this is an off-channel reservoir, water is not released directly into any natural drainage. Water can be delivered back into the Willard Canal via Willard Pumping Plants No.1 and No.2.

On November 13, 2006, A.V. Watkins Dam nearly failed as the result of piping and internal erosion of the foundation soils at approximate dam station 639+00 (Appendix 1, Map 2). Piping of the foundation soils was occurring from beneath the dam, and the fine-grained, silty, sand soils were exiting from the dam's downstream toe and from the base of the north slope of the south drain canal.

Efforts to save the dam were successful in stopping the foundation erosion and immediately reduced the overall seepage flows. SOD modifications described in this EA would ensure long term safety of the dam.

1.3 Purpose, Need and Scope of Analysis

The purpose of the Proposed Action (SOD modifications) is to repair safety deficiencies recently discovered in A.V. Watkins Dam in a cost effective and structurally feasible manner, and to meet current safety standards without affecting the purposes of the Weber Basin Project which are: to provide water for M&I and agricultural water use, fish and wildlife, and flood control.

The modifications are needed to correct, for the long term, previously unidentified unsafe conditions at A.V. Watkins Dam to comply with the Safety of Dams Act. Reclamation proposes to repair the dam embankment and toe drain system along the southeast side of the dam with the goal of restoring the reservoir to full operation by the spring of 2010.

If the dam failed near current maximum water surface elevation, loss of life would occur (Reclamation 2007). A current restriction of the reservoir's maximum water surface elevation greatly decreases the probability of failure. Loss of life would primarily be attributed to flood waters crossing Interstate 15. Warning times could be as little as minutes if the breach occurred in the reach of the dam that runs parallel to the interstate, up to many hours after the failure if the breach occurred in areas of the dam further west. This would allow ample time to close the road to traffic.

The scope of analysis in this EA is limited to consideration of whether or not to repair the dam. This EA is being prepared because a seepage erosion failure mode was recently found in the dam's embankment. Construction activities associated with the Proposed Action would be limited to previously disturbed lands within Willard Bay State Park and the dam and reservoir's primary jurisdiction zone.

Investigations of A.V. Watkins Dam conducted under Reclamation's SOD Program, have confirmed certain safety deficiencies that could contribute to catastrophic failure of the dam. In compliance with Reclamation's SOD Program, this EA discloses and discusses recommendations to undertake corrective actions for modifying the dam. These actions would be accomplished for the following reasons:

- Reclamation is required to comply with stipulations stated in the Safety of Dams Act. This act and amendments direct the Secretary of the Interior to preserve the structural integrity of Reclamation dams by developing modifications that the Secretary determines may reasonably be required.
- A.V. Watkins Dam is at risk of failure because of safety deficiencies. Dam failure could result in an uncontrolled release of water from the reservoir which could cause loss of life and property.

- Reclamation has a contractual obligation to continue water deliveries for irrigation and M&I uses. Such deliveries are dependent upon the existence and operation of A.V. Watkins Dam.
- Failure of the dam would eliminate flood protection benefits for surrounding areas.
- Willard Reservoir provides essential fish and wildlife habitats which would be lost in the event of dam failure.
- Failure of A.V. Watkins Dam could cause significant disruption and degradation of fish and wildlife habitats located downstream from the dam. Water quality could be degraded.
- Failure of A.V. Watkins Dam would eliminate the recreational benefits associated with Willard Reservoir and Willard Bay State Park.

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.

- A permit, covering construction associated with the Proposed Action, may be needed from the Army Corps of Engineers (USACOE), to comply with Section 404 of the Clean Water Act, as amended. Construction would occur in and near the berm of the dam. This area is highly disturbed, consisting mostly of typical upland vegetation. Several small (less than 1 acre) wetlands would be permanently impacted by this project. A wetland delineation and consultation with the USACOE would be required on these small wetland areas.
- A General Construction Storm Water Permit as a part of the Utah Pollutant Discharge Elimination System (UPDES) from the State of Utah Division of Water Quality would be required if the area of disturbance equals or exceeds one acre. The contractor would need to implement erosion and sediment controls according to a storm water pollution prevention plan prepared in compliance with the general permit.

Chapter 2 - Proposed Action and Alternatives

2.1 Introduction

The purpose of the Proposed Action is to repair the embankment of A.V. Watkins Dam. This EA analyzes the potential effects to the human environment from the Proposed Action and will serve to guide Reclamation's decision, along with other pertinent information, whether to implement the Proposed Action.

The Proposed Action Alternative is analyzed in this EA, along with a No Action Alternative, to facilitate comparison of potential effects between the two.

2.2 No Action Alternative

Under the No Action Alternative, Reclamation would not repair the dam's embankment. This alternative would require a reservoir water surface elevation restriction to prevent failure of the dam. The maximum water surface would not be allowed to exceed 4214 feet in elevation. It would be allowed to go up to elevation 4217 with 24-hour a day, 7-day a week inspections and monitoring of observation wells and piezometers.

2.3 Proposed Action Alternative

The Proposed Action Alternative is to repair the embankment of A.V. Watkins Dam. An impermeable, fully-penetrating, cement-bentonite or soil-cement cutoff wall would be installed laterally along the dam extending through the erodible sandy soils immediately below the dam into the less permeable lacustrine silt and clay layer at an average depth of 30 feet below the embankment foundation. This cutoff wall would extend horizontally approximately 20,000 feet from near the bend in the east embankment near Interstate 15 (station 733+00) to some distance beyond the inlet channel and marina (station 470+00) (Appendix 1, Map 3). The cutoff wall would be approximately 2-feet wide.

The cutoff wall would be constructed in one of two possible locations: (1) through the embankment aligned with the dam centerline; or (2) parallel to dam centerline at the upstream toe. In the event that the cutoff wall is constructed through the embankment, the top 5 feet of the existing embankment would be removed to provide sufficient room for construction equipment atop the dam,

after which the cutoff wall can be constructed. Upon completion of the cutoff wall, the dam crest would be rebuilt back up to original height.

In the second option, the cutoff wall would be constructed at the upstream toe of the existing embankment. First, a portion of the upstream embankment would be removed and a working platform created. The cutoff wall would then be constructed. Lastly, the upstream embankment would be replaced and a berm built above the cutoff wall to prevent excessive seepage above the cutoff wall through the dam.

This cutoff wall is expected to provide a continuous horizontal and vertical barrier to seepage through the dam and underlying sandy foundation soils. The use of cement-bentonite for the cutoff wall was based upon ease of construction and long term strength.

All land between the upstream toe of the dam and the far side of the south drain, has the potential to be disturbed during this project (see red area, Appendix 1, Map 4). These lands may be used for access roads and ramps, staging equipment, stockpiling of debris and materials, or other construction purposes. Existing roads would be used for construction to the extent possible.

An area 100 to 150 feet upstream of the dam embankment in the reservoir could be used for stockpiling riprap and embankment materials and mixing of the soil-bentonite backfill material. Earth berms and/or silt fencing would be constructed upstream of these stockpiles to preclude the possible contamination of the reservoir.

The highest allowable water surface elevation of the reservoir during construction is dependent upon the location of the cutoff wall. For the first option, where the cutoff wall is constructed through the dam, the reservoir would be restricted to elevation 4214; however, the reservoir could be allowed to rise to a maximum elevation 4217 feet with 24-hour monitoring seven days a week. For the second option, where the cutoff wall is located at the upstream toe of the dam, the water level would be much lower during construction, and the reservoir restriction elevation would also depend upon the location of the western terminus of the cutoff wall. Currently, the western end of the cutoff wall is anticipated to terminate at station 470+00, which would require the reservoir to be drawn down to approximate elevation 4207.

If construction begins in 2008, repair of the dam is estimated to be completed by November, 2009. Filling of the reservoir after the proposed repairs have been made would be rigorously monitored to ensure the new dam section is performing satisfactorily. With satisfactory performance, the reservoir would be allowed to fill in the spring of 2010.

All disturbed lands would be re-contoured and re-vegetated using an approved native seed mix and seeding methods. Success of this effort would be evaluated on the basis of percent vegetative cover of the ground surface and level of plant species diversity.

2.4 Alternatives Considered but Eliminated from Further Analysis

During a SOD Scoping Study (Reclamation 2007), identification of alternatives for the dam's repair were developed. The following alternatives could reduce the risks created by the dam's safety deficiencies as discussed in Section 1.2 above. These alternatives were considered but eliminated from further study because they did not meet the purpose and need of the SOD modifications as outlined in Section 1.2 above, or were determined to be too costly, environmentally unacceptable, or too disruptive to dam operations and project purposes.

2.4.1 Downstream Toe Interceptor Trench / Toe Drain

This option would consist of installing a vertical interceptor trench which includes a toe drain along the downstream toe of the dam. The interceptor trench would extend approximately 12 feet below the existing ground surface with the intent of interrupting any hardpan layers within that depth zone. The downstream wall of the trench would be lined with a flexible geomembrane supported at the ground surface. The geomembrane liner would serve to prevent backward progression of potential piping channels initiated at the South Drain as well as direct seepage flows upward to the toe drain. The remaining space in the interceptor trench would be backfilled with filter sand so as to retain the existing in place sandy foundation material. A perforated pipe enveloped in drainage gravel and filter sand (i.e. toe drain) would form the toe drain portion within the interceptor trench. Seepage collected by the interceptor trench/toe drain would discharge to the South Drain at locations spaced approximately 500 feet apart. Each perforated pipe would be connected to an inspection man-hole structure. The inspection man-holes would in turn be connected to solid wall outlet pipes which flow to the South Drain.

An approximate 5-foot thick soil berm would overlay the entire width of the interceptor trench/toe drain and would lap up onto the downstream face of the dam. The contact between the embankment and berm would consist of a layer of filter sand and serve to divert seepage at the toe of the dam into the interceptor trench/toe drain for collection and removal. The berm thickness was chosen to balance potential reservoir-like water pressures should undetected piping channels exist in the dam or dam foundation that could be closely connected to the reservoir level.

Due to groundwater conditions expected to be present at the toe of the dam, difficulty in unwatering excavations which penetrate the hardpan layer(s) is

anticipated. Consequently it is expected that the trenching effort for the interceptor trench/toe drain would, at least in-part, need to be performed using bio-polymer slurry methods in order to support the trench sidewalls during excavation and backfill.

This alternative does not address the dam's currently damaged embankment.

2.4.2 South Drain Filter System

This option would consist of reconstructing the northern bank slope of the South Drain such that the soil left in place is protected from unfiltered seepage outletting and initiation of backward erosion piping. The existing northern bank slope of the South Drain, would be removed to form a new bank slope inclined at 2 horizontal to 1 vertical. The excavated bank slope would then be filled using layers of filter sand, drainage gravel, riprap bedding, and stone riprap. The filter sand would be placed directly against the excavated bank slope to retain the in place soil particles. The remaining bank slope buildup would consist of layers of drainage gravel, riprap bedding, and riprap in that order. The filter sand, drainage gravel, and riprap layers would each have thicknesses of approximately 3 feet measured normal to the slope. The bedding layer would have a thickness of approximately 1.5 feet measured normal to the slope.

Spoils from the bank slope excavation would be used to construct a horizontal berm of limited thickness between the toe of the dam and the new top of slope for the South Drain. Construction of the South Drain filter will necessitate continual management of water flowing in the South Drain. Methods will need to be devised to unwater portions of the South Drain such that excavation and bank slope reconstruction can be performed in dry conditions. Methods such as cofferdams and bypass pumping and/or bypass piping are anticipated.

This alternative does not address the dam's currently damaged embankment.

2.4.3 Upstream Partially Penetrating Soil-Bentonite Cutoff Wall/Interceptor Trench – Toe Drain/South Drain Filter Alternative

This alternative would involve implementation of both the interceptor trench/toe drain and South Drain filter alternatives, along with construction of a partially penetrating soil-bentonite cutoff wall along the upstream toe of the dam. The interceptor trench/toe drain and South Drain portions of the alternative would be the same as that described for the stand-alone alternatives. Construction of the upstream soil-bentonite (S-B) cutoff wall would involve temporary removal of a portion of the upstream face of the dam, such that an approximate 30-foot wide working platform at the upstream toe was formed. The work platform would be used by the equipment constructing the S-B wall. The S-B wall depths would be on the order of up to 10 feet. Following completion of the S-B wall, the upstream face of the dam would be reconstructed using compacted, low-permeability embankment material (likely different from the material removed from the upstream face of the dam). The contact between the embankment material and S-B wall would be such that a connection resistant to seepage was formed. In this

way, essentially the entire upstream portion of the dam (including much of the underlying sandy foundation soil) would be improved to resist seepage from the reservoir. Construction of the interceptor trench/toe drain and the South Drain filter, would serve as support measures to control seepage which might pass beneath or through the partially penetrating cutoff wall and through the reconstructed upstream dam face.

2.4.4 Fully Penetrating, Sheet Pile Cutoff Wall Alternative

This alternative is essentially the same as the Proposed Action Alternative except driven steel sheet piles would be used to form the continuous horizontal and vertical barrier to control seepage through the dam and underlying sandy foundation soils. Driven sheet piles are expected to have sufficient integrity to disrupt any piping channels which might exist in or beneath the dam. A sheet pile cutoff wall is also expected to exhibit sufficient resistance to potentially high seepage gradients in the event undetected piping channels exist at locations in the dam or dam foundation.

Chapter 3 - Affected Environment and Environmental Effects

3.1 Introduction

This chapter describes the environment potentially affected by the No Action Alternative and the Proposed Action Alternative and the predicted impacts of the alternatives. These impacts are discussed under the following resource issues: recreation; water rights; water resources; water quality; system operations; public safety, access, and transportation; visual resources; socioeconomics; cultural resources; paleontological resources; wetlands and vegetation; wildlife resources; and threatened, endangered, protected 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 Proposed Action Alternative. The environmental effects are summarized in Table 6 at the end of this chapter.

3.2 Affected Environment

3.2.1 Recreation

Recreation functions on and around the reservoir area consist of Willard Bay State Park, the Willard Bay Wildlife Management Area, and the Harold S. Crane Waterfowl Management Area. The park and wildlife area are associated with the Weber Basin Project and are managed by the Utah Department of Natural Resources (Department) through agreement with Reclamation. The waterfowl area is owned and operated by the Department. Located to the north of the reservoir is the Bear River National Migratory Bird Refuge, and to the south is the Ogden Bay Waterfowl Management Area.

The park was recently renovated and offers day-use and camping facilities, boat launch ramps, and group-use areas. Two separate marinas provide boaters with access to Willard Reservoir. The reservoir and surrounding wildlife area support excellent warm water fishing, upland game bird and waterfowl hunting, boating, waterskiing, swimming, camping, and wildlife viewing. The park has averaged 280,366 recreation visits annually for the 10-year period, 1997-2006 (see Section 3.2.8, Table 3). The majority of visitors tend to participate in a combination of activities. Additional information is available in the Willard Reservoir Resource Management Plan, 1990.

3.2.2 Water Rights

The primary storage right for Willard Reservoir is Application to Appropriate No. A27613 (Water Right No. 35-831). This water right allows 250,000 acre-feet of Weber River water to be diverted at the Slaterville Diversion Dam and conveyed and stored in Willard Reservoir. Willard Reservoir can also store water from other sources under Applications to Appropriate Nos. A27612 (Water Right No. 29-882), A34638 (Water Right No. 35-1391), and A34775 (Water Right No. 29-1078). Water Right No. 29-882 allows Willard Reservoir to store 10,000 acre-feet of Willard Creek water. Water Right No. 35-1391 allows Willard Reservoir to store up to 7.5 cfs from underground drains along the Willard Canal. Water Right No. 35-1078 allows Willard Reservoir to store up to 5.0 cfs from two underground drains located near the northern Willard Bay Recreation Area. All these water rights allow the stored water to be used along the northern Wasatch Front for stockwatering, irrigation, municipal, industrial, and wildlife purposes.

In addition to the Willard Reservoir storage rights, there are two applications that exchange this stored water for other water rights in the Weber River System. Exchange Application E129 (Water Right No. 35-1578) allows Willard Reservoir water to be used in the Hooper Canal, in exchange for Hooper Irrigation's water rights being used within the Weber Basin Project. Exchange Application E1122 (Water Right No. 35-6592) allows Willard Reservoir water to be used in the Layton Canal in exchange for Davis and Weber Counties Canal Company's water rights being conveyed through the Gateway Canal and used in the Weber Basin Project.

The storage and exchange water rights listed above are directly tied to stored water in Willard Reservoir. There are other water rights that are indirectly connected to the reservoir. These water rights include a direct flow diversion water right at Slaterville Diversion Dam, multiple wildlife water rights to nearby bird refuges, a recreation water right for Willard Bay State Park, and a water right tied to the Willard Bay pumping facility. These water rights are outlined below.

- Application to Appropriate No. A27617 (Water Right No. 35-835) allows Slaterville Diversion Dam to divert up to 825 cfs of the high flows on the Weber River for Weber Basin Project purposes. Typically, this right is only used when Willard Bay Reservoir has received all the water it can and there is still Weber River water available at the Slaterville Diversion Dam.
- Application to Appropriate No. A30023 (Water Right No. 29-1208) allows up to 15 cfs of the water collected in the AV Watkins' Dam drains to be used at the Harold Crane Waterfowl Management Area.
- Application to Appropriate No. A12516 (Water Right No. 35-128) claims up to 50 cfs of Weber River flows entering the Ogden Bay Wildlife Refuge. This water right is held by the State of Utah, Division of Wildlife

Resources and is indirectly tied to Contract No. 14-06-400-4643 in which Reclamation agreed to guarantee minimum flows into Ogden Bay. If necessary water stored in Willard Reservoir is released into the Weber River to satisfy this agreement.

- Diligence Claim No. D115 (Water Right No. 35-1651) claims up to 6 cfs from the North Hooper Slough. This water right is held by the State of Utah, Division of Wildlife Resources and is also indirectly tied to Contract No. 14-06-400-4643 in which Reclamation agreed to guarantee minimum flows into Ogden Bay.
- Application to Appropriate No. A27645b (Water Right No. 29-1527) claims up to 1 cfs from two wells located in the Willard Bay State Park for irrigation and recreational uses. A Proof of Beneficial Use submitted June 29, 2007, shows the water from these wells is being allowed to flow into Willard Reservoir in exchange for a like amount of water to be pumped from sumps tied directly to the reservoir. These sumps are being impacted by the currently low water levels in the reservoir.
- Application to Appropriate No. A347774 (Water Right No. 29-1072) allows water to be used from an underground well located at the Willard Canal Pumping Plant No. 1, to be used for washing and sanitation needs of this facility.

3.2.3 Water Resources

The Project delivers approximately 220,000 acre-feet of water annually; 60,000 acre-feet for municipal and industrial uses, and 160,000 acre-feet for irrigation. The District operates six large storage reservoirs which store approximately 400,000 acre-feet of the Project's water (See Figure 2).

The Project conserves and utilizes, for multiple purposes, stream flows in the natural drainage basin of the Weber River, including the basin of the Ogden River, its principal tributary. Four reservoirs, Rockport, Echo, Lost Creek, and East Canyon, regulate the flow of the Weber River and its tributaries before it emerges from its mountain watershed along the east shore area of the Great Salt Lake. Two reservoirs, Causey and Pineview, regulate the Ogden River flow and its tributaries before it emerges from the mountains to join the Weber River. Willard Reservoir is an offstream structure and is the lowest reservoir in elevation. During early spring runoff, when irrigation demands are low, water from the Weber River and the Ogden River is diverted to Willard Canal by the Slaterville Diversion Dam. Willard Canal can deliver up to 1,020 cubic feet per second from the Slaterville Diversion Dam to Willard Reservoir. The only live stream flowing into the reservoir is Willow Creek. Willard Canal then carries the water by gravity flow to Willard Reservoir, where it is stored for future use. Willard Pumping Plants No. 1 and 2, located on the Willard Canal, are bypassed during this gravity flow operation.

The peak demands of the irrigation season are met by augmenting normal flows from the Weber and Ogden Rivers, with water stored in Willard Reservoir. Willard Pumping Plant No. 1, pumps water from the Willard Intake Channel located near the dam and delivers water to the Willard Canal. The water flows approximately 8 miles to Willard Pumping Plant No. 2, where it is lifted and continues in the Willard Canal to Slaterville Diversion Dam and the Layton Pumping Plant Intake Channel. The water is then pumped by the Layton Pumping Plant into the Layton Canal which carries it another 9 miles south for distribution into laterals for irrigation of Project lands and M&I uses. During the pumping period, water is prevented from discharging through each pumping plant bypass by radial gates in the bypass canal headworks.

The historical average annual inflow to the Willard Reservoir is 126,200 acre-feet and evaporation is estimated to be 20,000 acre-feet. There are three outlets from Willard Reservoir: the gated overflow to the Great Salt Lake on the north side of the reservoir, the Willard Canal, and the Great Salt Lake Canal outlet near the southwest corner of the reservoir.

Approximately 25,000 acre-feet of Willard Reservoir appropriated water remains unsold. In 1987, approval was obtained to increase M&I sales through exchanges. The exchanges allow the use of higher quality water higher in the river system and make-up water for irrigation is provided from Willard Reservoir.

3.2.4 Water Quality

Willard 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 3B - Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.
- Class 3D - Protected for waterfowl, shore birds and other water-oriented wildlife not included in classes 3A, 3B, or 3C including the necessary aquatic organisms in their food chain.
- Class 4 - Protected for agricultural uses including irrigation of crops and stock watering.

The primary water quality concerns at Willard Reservoir are high levels of phosphorus, turbidity and sediment. Willard Reservoir is a culinary water source.

The quality of water within Willard Reservoir is related to the quantity and quality of the water diverted from the Weber and Ogden Rivers during spring runoff, and secondarily to the increases in total dissolved solids (TDS) caused by reservoir evaporation and leaching from bottom sediments or ground water inflow. Levels of TDS in the reservoir range from 383 to 945 mg/L, and average about 650 mg/L. The reservoir has a high surface area to volume ratio, shallow depth, and high wind action. This allows for high evaporation and keeps the reservoir water thoroughly mixed where temperature and dissolved oxygen are concerned. The water has also been found to be nutrient-rich, or eutrophic. Nitrogen levels are within acceptable state levels, but phosphorous frequently exceeds the maximum contaminant level (MCL) of 0.05 mg/L. Table 1 summarizes key indicators of pollution within the reservoir.

**Table 1
Willard Reservoir Water Quality Summary**

Location	STORET No.	pH		Dissolved Oxygen (mg/L)		TDS (mg/L)		Total Nitrogen (mg/L)		Total Phosphorous (mg/L)	
		Avg	Range	Avg	Range	Avg	Range	Avg	Range	Avg	Range
Willard Canal at res. bound.	492035	8.3	'8.0-8.6	8.5	'7.1-12	360	'162 -796	0.34	'15-.48	0.09	'045-.140
S Harbor Mouth 100 m west	492044	8.4	'7.4-8.8	7.5	'5.1-10.2	563	'224 -792	0.16	'04-.34	0.05	'014-.110
SW Corner 0.5 mi offshore	492045	8.4	'7.5-8.8	7.4	'0.5-9.8	568	'528 -656	0.10	'02-.26	0.05	'010-.135
mid NW dike 100 m offshore	492046	8.5	'7.0-8.9	7.6	55.1-9.7	588	'520 -656	0.07	'02-.16	0.04	'010-.111
N SE dike 100 m offshore	492047	8.4	'7.5-9.0	7.4	'4.8-9.8	582	'506- 658	0.01	'02-.24	0.05	'010-.128
State Standard max contaminant level (MCL)			6.5-9.0		5.5 Min		1200 Max		4.0 Max		0.05 Max

External Phosphorous Loading

The largest source of total phosphorous to the reservoir is from watershed and stream bank erosion. Erosion in the watershed leads directly to sediment release and the external loading of phosphorous and nitrates into the reservoir. Since the reservoir is located at the bottom of a major watershed drainage, it is very likely that the phosphorous is coming in from the outside. This is evidenced by the higher concentration in the canal than in the reservoir itself.

Turbidity and Cadmium

Turbidity has exceeded state standards in 10 of the 27 samples. This is probably caused by the mixing of the water due to wind and the shallow nature of the reservoir. Dissolved cadmium concentration has exceeded the state standards in one of three samples. All other dissolved metal concentrations have been less than the MCL.

Lead Shot

A concern has arisen that gun clubs have affected the quality of the water within the reservoir by adding lead to the water. To estimate the effect of the gun clubs on water quality, the concentration of dissolved lead (STORET data) was analyzed. The maximum concentration was found to be 0.02 mg/L, which is lower than the state standard MCL of 0.05 mg/L. In 1975, the concentration was 0.005 mg/L, and in 1996, the concentration was less than 0.003 mg/L. Using this information, it can be assumed that the gun clubs have not adversely affected the quality of water within Willard Reservoir.

3.2.5 System Operations

Arthur V. Watkins Dam, and Willard Canal and Pumping Plant

Water available to the Weber Basin Project at the Slaterville Diversion Dam consists of both the natural flows of Weber and Ogden Rivers not required for prior rights, and of storage releases from the upstream reservoirs. The natural flows are surplus high flows not regulated by upstream reservoirs, winter flows released through upstream powerplants, return flows, and other river inflows below upstream reservoirs. Water is diverted at the Slaterville Diversion Dam into Willard Canal or the Layton Canal intake channel. Water diverted into the earth-lined Willard Canal during the nonirrigation season is conveyed 8 miles north to Willard Reservoir, where it is stored. When upstream supplies are insufficient to supply water demands below the Slaterville Diversion Dam, water is pumped from the reservoir at Willard Pumping Plant No. 1. By reverse flow through Willard Canal, it is either returned to the Slaterville Diversion Dam through Willard Pumping Plant No. 2, or released at turnouts in the canal. Willard Canal has a capacity of 1,050 cubic feet per second for gravity flow from Slaterville Diversion Dam to the Plain City Canal turnout, a privately owned irrigation system, and 950 cubic feet per second from the turnout to the reservoir. In the reverse direction, the capacity for pumped flows is 500 cubic feet per second from the reservoir to the turnouts and 300 cubic feet per second from the turnouts to Slaterville Diversion Dam.

Twelve miles northwest of Ogden on the shore of the Great Salt Lake, Arthur V. Watkins Dam is an offstream structure with a structural height of 36 feet. The dam is about 14.5 miles long in a rough rectangle, contains about 17 million cubic yards of material, and encloses a reservoir of 215,120 acre-foot capacity at elevation 4226.0. Its outlet works and overflow sill spillway are combined into one structure and located at the north end of the dam. The outlet works/ spillway consists of an approach channel, a box intake at elevation 4205.0, a 7- by 7-foot upstream conduit, a gate structure containing two 84 by 84-inch manually

operated slide gates, and overflow sill at elevation 4226.0, which is located at the top of the gate shaft, a 7- by 9-foot downstream conduit, a stilling basin, and an outlet channel. The combined outlet works/spillway capacity is 1,121 cfs at water surface elevation 4226.85. There is no discharge channel capacity calculated for the dam, since discharges go directly into the Great Salt Lake.

The District operates the dam. The dam falls within the jurisdiction of Reclamation's Provo Area Office. There is no dam tender living on site at the dam; however, District operators visit the dam weekly, year round. The District office is located about 27 miles from the north end of the dam.

3.2.6 Public Safety, Access, and Transportation

The dam and reservoir are accessed from Interstate 15 from the north at exit 360 and from the south at exit 354. Willard North Marina Road (SR-315) and Willard South Marina Road (SR-312), are both two lane paved roads that lead from the entrance to the north and south marina, respectively, directly to the boat docks in each marina. Utah Department of Transportation (UDOT) maintains these two roads and they are in relatively good condition. Other roads outside the park are maintained by Box Elder County and Weber County. Most of the roads in the park are paved and are maintained by the State's Division of Parks and Recreation.

3.2.7 Visual Resources

Visual Quality Objective

The Visual Management System (VMS) developed by the Forest Service, uses distance zones, variety class, and sensitivity level to establish Visual Quality Objectives (VQO's) for various landscape types. Visual Quality Objectives for the areas within the project boundary are shown in the table below and represent existing visual quality in the area.

There are two VQO's at Willard Reservoir, Modification and Maximum Modification, both reflect the developed and modified nature of the landscape throughout the area.

The VQO's are as follows. Modification - development contrast appears dominant within the natural landscape when viewed up to 5 miles away. The time frame for complete rehabilitation to occur should not exceed 5 years beyond project completion. Maximum modification - development contrast appears dominant and out of character when viewed up to 5 miles away, it blends with the landscape when viewed beyond 5 miles. The time frame for complete rehabilitation to occur should not exceed 5 years beyond project completion. Much more information on visual quality exists in the Willard Reservoir Resource Management Plan, 2000. Table 2 below displays the Visual Quality Objectives for Willard Bay.

Table 2
VISUAL QUALITY OBJECTIVES BY AREA

VISUAL QUALITY OBJECTIVES BY AREA	
NORTH RECREATION AREA	
Willow Creek Campground	Modification
Cottonwood Day Use Area	Modification
Eagle Beach Day Use Area	Modification
Wiper Cove Day Use Area	Modification
Pelican Beach Day Use Area	Modification
North Recreation Area Marina (Marina, slips, and boat parking)	Modification
Administration Area	Modification
Wildlife Management Natural Area	Modification
SOUTH RECREATION AREA	
Campground at South Recreation Area	Modification
South Recreation Area	Modification
South Recreation Area	Modification
Dike	Maximum Modification
Wildlife Management Natural Area	Modification

Visual integrity objectives serve as the base to monitor future visual changes associated with land and resource use.

3.2.8 Socioeconomics

A.V. Watkins Dam and Willard Reservoir provide substantial economic benefit to over 520,000 people in the Northern Wasatch Front and high-mountain valleys who rely on M&I water delivered or exchanged by the reservoir. Additionally, over 25,000 acres of irrigated land and 10,000 thousand acres of wildlife and refuge areas rely on deliveries from the reservoir. Total deliveries from the reservoir have averaged 45,000 acre-feet annually for the 6-year period, 2000-2006. Water supply benefits provided by the reservoir are estimated in present worth terms at about \$9.8 million for irrigation, \$68.9 million for M&I, and \$29.8 million for fish and wildlife. Total water supply benefits are \$108.5 million in present worth terms.

The reservoir and surrounding wildlife area support excellent warm water fishing, upland game bird and waterfowl hunting, boating, waterskiing, swimming, camping, and wildlife viewing. The park has averaged 280,366 recreation visits annually for the 10-year period, 1997-2006. As shown below in Table 3, the value of recreation benefits associated with Willard Reservoir is approximately \$284.5 million in present worth terms.

**Table 3
Recreation Visitation and Benefits**

Activity	Recreation Value ¹	Percent Primary Activity	Average Annual Visitation ²	Total Annual Benefits	Present Worth Benefits (50 years, 4.875%)
	<i>2007 dollars</i>			<i>2007 dollars</i>	
Camping	\$37.91	0.07	19,626	\$744,000	\$13,800,000
Fishing	\$54.13	0.18	50,466	\$2,732,000	\$50,900,000
Hunting	\$53.02	0.01	2,804	\$149,000	\$2,800,000
Boating	\$58.62	0.18	50,466	\$2,958,000	\$55,100,000
Swimming	\$32.26	0.12	33,644	\$1,085,000	\$20,200,000
Waterskiing	\$62.20	0.43	120,557	\$7,499,000	\$139,600,000
Wildlife viewing	\$40.67	0.01	2,804	\$114,000	\$2,100,000
Total			280,366	\$15,281,000	\$284,500,000

¹ Recreation values from Loomis (2005), indexed to 2007 dollars.

² Average annual visitation is distributed among the activities based on a 1999 boating survey and information provided by the manager of Willard Bay State Park.

For socioeconomic resource analyses, annual monetary values are converted to present worth values using the Fiscal Year 2007 Federal Discount Rate of 4.875 percent and a 50-year period of analysis.

3.2.9 Cultural Resources

Cultural resources are defined as the expressions of human culture and history in the physical environment, including culturally significant landscapes, historic and prehistoric archaeological sites, Native American Traditional Cultural Properties, sacred places, and artifacts and documents of cultural and historic significance. The National Historic Preservation Act of 1966 (NHPA) stipulates that Reclamation must take into consideration possible effects of an undertaking on historic properties. This stipulation falls within the broad definition of cultural resources reviewed for NEPA compliance and within the Archaeological and Historic Preservation Act of 1974 (AHPA), as these relate to Reclamation undertakings. Historic properties are defined as historic or prehistoric sites, structures, buildings, districts or objects that are listed in or are eligible for listing 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

The prehistory of the northeastern Great Basin has been summarized by Simms and Stuart (1991) in conjunction with salvage excavations of prehistoric archaeological sites and burials eroding out of the marshes on the eastern periphery of the Great Salt Lake. The following temporal outline has been liberally excerpted from that work.

The Late Pleistocene/Early Holocene Period: 11,500 to 9,000 B.P.

Human occupation of the eastern Great Basin began between 11,500 and 10,000 radiocarbon years ago. Cultural affiliation is primarily with the Western

Stemmed Tradition, associated with an early Archaic hunter-gatherer lifeway. Fluted points associated with the hunting of now extinct megafauna have been reported but there is no contextual evidence demonstrating the association of these points with megafaunal kill sites.

The Holocene Period: 9,000 to 1,600 B.P.

This period encompasses a long epic of cultural constancy. It was characterized by a hunter-gatherer lifeway, exploiting the resources of the eastern Great Basin, the availability of which were much like those known in historic times.

Technology was marked by the absence of ceramics and agriculture, and the use of the spear and atlatl, coiled and twined basketry, and milling stones. There has been some discussion in the literature (Madsen 1982, Thomas 1985, Janetski and Madsen 1990) regarding the possibility of a more sedentary lifeway in the marsh areas east of Great Salt Lake than in the more arid areas of the eastern Great Basin. However, direct evidence of sedentary Archaic villages is absent.

The Late Holocene: Transition to Fremont Agriculturalists: 1650 to 650 B.P.

The agricultural period in Utah, including the northeastern Great Basin, is termed the Fremont culture. We will depart somewhat from the Simms and Stuart (1991) account of events, based on evidence that has become available in recent years (Berry and Berry 2003). As Simms and Stuart (1991) note, major Fremont villages in urban areas have been destroyed by modern agricultural activity and the construction of modern infrastructure. We are left with only a fragmentary record of the Fremont presence. Following Berry and Berry (2003), using the tree-ring calibrated radiocarbon record, the Fremont occupation of the northeastern Great Basin spans the period from A.D. 500 to 1300. In this model, the Fremont culture is thought to result from an expansion of Anasazi populations at a Basketmaker II-III level of technology, with significant interaction with indigenous Archaic groups. The A.D. 1300 abandonment is seen as a response to a widespread Southwestern drought that, similarly, led to the abandonment of the Anasazi area. This interpretation is consistent with informant data from the Northern Ute (Smith 1974) and Southern Paiute (Pendergast and Meighan 1959) that the Fremont agriculturalists occupied the same areas as the historically known Numic speakers, but moved south to join the Hopi when maize agriculture failed due to climatic conditions.

The Late Prehistoric: A.D. 1300 to A.D. 1700.

This is perhaps the least studied prehistoric era. It is presumed that Numic speaking Ute, Gosiute, Paiute and Shoshoni made their first appearance in the eastern Great Basin during this time. Subsistence was again based on hunting-and-gathering. Ceramics are rare and unrelated to the wares characteristic of the previous Fremont occupation. The horse was introduced late in the period but the timing is uncertain (Simms and Stuart 1991)

The Historic Period

The first historic reference to the Great Salt Lake region comes from the journal of the Dominguez-Escalante Expedition of 1776. They observed Ute groups living in substantial villages near Spanish Fork in Utah Valley. Later reports indicate that the Shoshoni were the principle inhabitants of the Great Salt Lake region and note occasional visits and raids by the Ute, Crow, Blackfeet, and Flathead Indians.

The late 1840s, marked the initial appearance of the Mormon pioneers and the development of European villages, towns and, eventually, cities. As noted earlier, the agricultural development on which the Mormon economy was based, resulted in the destruction of a significant portion of the prehistoric archaeological record.

3.2.9.2 Cultural Resources Status

Reclamation has reviewed existing information on historic properties and other resources within and adjacent to the APE in compliance with 36 CFR 800.4(a). An abundance of information is available regarding cultural resources in the region surrounding the Willard Reservoir. More than a dozen cultural resource projects have been previously conducted in and near the reservoir since the turn-of-the-century. Many of these projects were carried out during the early 1900s, while another flurry of activity began in the 1960s, in preparation for the inundation of the newly constructed reservoir. Beginning in the mid-1980s, cultural resources work began around the southern portion of the reservoir in response to fluctuating lake levels and increased shoreline erosion. Of the many previous projects, only a few were formal pedestrian inventories, including large-scale surveys undertaken by avocational archaeologists from the Promontory/Tubaduka Chapter of the Utah Statewide Archaeological Society (USAS). In 1990 and 1991, the Office of Public Archaeology at Brigham Young University conducted a pedestrian inventory of 2,180 acres of Bureau of Reclamation lands within the current project area (Baker et al. 1992). This inventory covered all but 250 acres of the current project area located near the South Marina. In addition, 28 Fremont and Late Prehistoric sites located southwest of the reservoir were excavated by Utah State University (Simms, Loveland and Stuart 1991). Bones from 75 individuals were associated with these sites as intentional burials. These remains reside in a vault at the This is the Place Monument awaiting repatriation.

As a result of the many formal and informal inventories of the area, at least 87 cultural resource sites have been documented in and near the project area. The exact number of sites is somewhat sketchy, as records of cultural resources work maintained at the Utah State Historic Preservation Office (SHPO) are not up to date. However, a close approximation of the number of sites can be obtained through more intensive searching of the individual project reports.

The affected environment for cultural resources is identified as the area of potential effect (APE), in compliance with the NHPA. The APE is the geographic area within which federal actions may directly or indirectly cause alterations in

the character or use of historic properties. The APE for this project is the dam embankment and area immediately adjacent to the dam.

Known prehistoric and historic properties located around and within A.V. Watkins Dam and Willard Reservoir are summarized in Table 4 below. These sites were recorded by a local amateur and no recommendations for National Register of Historic Places (NRHP) were given. All sites have been inundated by the reservoir and are likely destroyed or significantly damaged. Since the dam was completed in 1964, it does not meet the age qualification for eligibility to the NHRP.

Table 4
Cultural Resources Located in and Around Willard Reservoir by Site Type, Age, Damage Potential Analysis, and NRHP Eligibility Determination

Site No.	Damage Potential	Age	Site Type	NRHP Eligibility Established at Documentation	Comments
42BO61	Unknown	Prehistoric	Artifact scatter	Unknown	Inundated 1960s
42BO68	Unknown	Prehistoric	Artifact scatter	Unknown	Inundated 1960s
42BO69	Unknown	Prehistoric	Artifact scatter	Unknown	Inundated 1960s
42BO79	Unknown	Prehistoric	Artifact scatter	Unknown	Inundated 1960s
42BO83	Unknown	Prehistoric	Artifact scatter	Unknown	Inundated 1960s
42BO85	Unknown	Prehistoric	Artifact scatter	Unknown	Inundated 1960s
42BO87	Unknown	Prehistoric	Artifact scatter	Unknown	Inundated 1960s
42BO471	Unknown	Pre-A.D. 1300	Artifact scatter	Unknown	Inundated 1980s
42BO472	Unknown	Pre-A.D. 1300	Artifact scatter	Unknown	Inundated 1980s

3.2.10 Paleontological Resources

Sediments in and around Willard Reservoir are classified as Quaternary in age. Reclamation is unaware of any paleontological resources located within the project area.

3.2.11 Wetlands and Vegetation

Wetlands within the area include the reservoir’s perimeter which consists of littoral, wetland, and upland habitats. Weber River provides water to the reservoir through the Willard Canal. The reservoir is an off-channel storage facility and does not release water to any stream or river system below it. Rather, water is released back to the Willard Canal by the use of two pumping plants.

Weeds, particularly Dyers Woad and other noxious or invading weeds, are a problem. In the area between the eastern shore and I-15, weed control and replacement with forage could provide pheasant habitat. There are wetlands in this area that are closed to foot and vehicle traffic.

Soils

The easternmost portion of the project area is located within the Lasil-Fridlo association of somewhat poorly drained and moderately well drained, nearly level and gently sloping loams on broad low lake terraces and lake plains (Chadwick, 1975). The western parts of the project area are located on the Playas-Saltair association, which consists of playas and poorly drained, nearly level silty clay loams on lake beds and broad plains. The soils were formed in highly stratified, calcareous, mixed alluvium derived mainly from limestone, sandstone and quartzite. Some of the soil types in this area are highly saline. Slopes range from 0 to 1 percent.

Habitat/Vegetation Types

There are six general habitat/vegetation types within the area. These types are discussed below.

Farmed Land Habitat Type

This vegetation type is generally underlain with Syracuse or Warm Springs fine sandy loam soil. The water table is between 24 and 40 inches below the surface. Syracuse soils are used for irrigated crops including alfalfa, small grains, sugar beets, tomatoes, and corn for silage as well as range. When abandoned, these areas may revert to disturbed sites dominated by weedy plant species. These sites primarily occur northeast, south and east of the southern boat ramp.

Altered Land Habitat Type - Undeveloped

This habitat type has been altered by humans and is comprised of areas such as large dikes and grassy pasture. These highly disturbed areas are dominated by grasses and weedy species, including Kentucky bluegrass (*Poa pratensis*) (planted and irrigated), as well as cheatgrass (*Bromus tectorum*), Canada thistle (*Cirsium arvense*), and teasel (*Dipsacus sylvestris*).

Altered Land Habitat Type - Developed

This habitat type includes the developed portions of the property such as campgrounds, picnic areas, roads, beaches, and boat ramps. They are unvegetated or planted with non-native species such as Kentucky bluegrass.

Cottonwood/Willow Riparian Habitat

This habitat type comprises about 20 percent of the wetland types within the project area. In some places, trees have been planted for shade and are maintained by sprinklers. These areas are generally lower in elevation than the surrounding upland area and collect runoff during precipitation events, thereby providing the important function of water quality improvement. The overstory is

dominated by narrowleaf cottonwood (*Populus angustifolia*), coyote willow (*Salix exigua*), red-osier dogwood (*Cornus stolonifera*) and tamarisk (*Tamarix sp.*). Dominant vegetation associated with freshwater emergent wetland plant communities, which are found in ditches, along ponds and other waterways, and in isolated low spots, include Joe-pye weed (*Eupatoriadelphus maculatum*), hairy willowherb (*Epilobium ciliatum*), prostrate knotweed (*Polygonum aviculare*), cattails (*Typha spp.*), lady's thumb (*Polygonum persicaria*), common reed (*Phragmites australis*), reed canary-grass (*Phalaris arundinacea*), curly dock (*Rumex crispus*), rushes (*Juncus spp.*), red-osier dogwood (*Cornus stolonifera*), and coyote willow (*Salix exigua*). The largest wetland/riparian area is located within the northern campground. A small riparian area is located within the southern park and is dominated by cottonwoods.

Open Water Habitat

These areas are generally unvegetated or sparsely vegetated with submerged vegetation. They occur within stream banks and inside borrow areas, ponds, and the reservoir area.

Salt Marsh/Mudflat Habitat Type

Salt marshes are interspersed with and landward of the mudflats located along the south and southeast sections of Willard Reservoir. This area is currently managed by the Utah Division of Wildlife Resources, as part of the Harold S. Crane Waterfowl Management Area. There are two other salt marsh sites, one located along the east side of the reservoir and one west of the North Recreation Area boat ramp. Dominant vegetation associated with salt marsh communities include Olney's threesquare (*Scirpus americanus*), hardstem bulrush (*Scirpus acutus*), cattail (*Typha spp.*), lady's thumb (*Polygonum persicaria*), salt grass (*Distichlis spicata*), tamarisk (*Tamarix spp.*), and common reed (*Phragmites australis*). The salt marsh and associated mudflats comprise over 80 percent of the wetlands in the Willard Reservoir boundary. Soils in the mudflats are of the Saltair and Refuge Series, which are poorly drained soils with slow to moderate permeability. Mudflats have little or no vegetation growing on them.

The Bear River National Wildlife Refuge

This refuge is located just north of the reservoir. It is just over 74,000 acres of marsh, open water, uplands, and alkali mudflats. The marshes and open water are managed using a complex system of dikes and water control structures to provide different water depths suitable for a variety of water bird species over the seasons. The refuge provides critical habitat for migrating birds from both the Pacific and Central Flyway of North America.

Most of the uplands are dominated by grasses such as wheat and salt grasses, with iodinebush and greasewood scattered across the landscape. The grasslands are managed with prescribed grazing. The uplands also have scattered knolls that support a wheatgrass, saltbush, and greasewood plant community. These knolls are a unique ecological community in the Bear River delta.

Wetland Jurisdictional Areas

The Cottonwood/Willow Riparian Habitat, Open Water Habitat, and the Salt Marsh/Mudflat Habitat represent potential jurisdictional areas which are regulated by the U.S. Army Corps of Engineers (Corps) under Section 404 of the Clean Water Act of 1977 (CWA). These areas are called Waters of the United States and include lakes, streams, rivers, ponds, playas, mudflats and wetlands. The CWA sets forth a goal of restoring and maintaining existing aquatic resources in the United States. To achieve a goal of no overall net loss of wetland functions and values, the Corps strives to avoid adverse impacts and offset unavoidable adverse impacts to existing aquatic resources through mitigation requirements.

Reservoir Habitat

Much of the reservoir's perimeter consists of upland vegetation, predominately sagebrush, as well as rocky or bare ground. Other sections of the reservoir's shoreline consist of littoral cottonwood and willow habitats. This habitat varies from approximately 50 to several hundred feet in width and length and consists mostly of young willow (*Salix spp*), some Nebraska sedge (*Carex nebrascensis*), and in places an overstory of narrow leaf cottonwood (*Populus angustifolia*). These habitats occur mainly along areas developed for camping and shoreline recreation. These habitats require lake levels that closely approach or inundate these areas periodically to ensure a vigorous and healthy vegetative community.

Exposed reservoir bottom (existing during seasonally low reservoir levels) consists of muddy and rocky substrates depending on the topography of the exposed shoreline.

All proposed construction areas around the reservoir have been previously disturbed by road, reservoir, and recreation (e.g. camp sites) construction and maintenance activities. Riprap has been placed in areas of erosion that threaten state park infrastructure/facilities or the dam embankment itself.

Big sagebrush (*Artemisia tridentata*), Smooth brome (*Bromus inermis*), timothy (*Phleum pratense*), as well as several other introduced and native grass species (mostly wheat grasses), exist above the reservoir's ordinary high water elevation. Canada thistle (*Cirsium arvense*) has invaded the area in small patches.

Upland Habitat

Both nonnative and native species of vegetation are found within the project area in habitats around the reservoir. Upland habitat consists mainly of big sagebrush (*Artemisia tridentata*), and rabbit brush (*Chrysothamnus spp.*). 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*), and curlycup gumweed (*Grindelia squarrosa*). Crested wheatgrass (*Agropyron cristatum*) has been seeded in previously disturbed areas.

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.

Wildlife Management

To mitigate for waterfowl habitat loss associated with the development of Willard Reservoir, Reclamation acquired and developed approximately 1,800 acres of State sovereign land located west of the reservoir. Dikes, and a delivery canal with inlet structures, were constructed to create ponds that could be managed as marshes. Ownership and management responsibility for these lands, known as the Willard Waterfowl Management Area, were transferred to the UDWR in 1963. The name has since been changed to the Harold S. Crane Waterfowl Management Area and the size has been expanded to encompass over 11,000 acres. An agreement is in place with UDWR that retains access and operations rights across these lands as necessary for Reclamation to complete activities associated with the Weber Basin Project (MOA-Contract No. 14-06-400-2871).

In 1973, Reclamation entered into an agreement (MOA-Contract No. 14-06-400-5925) with UDWR to transfer wildlife administration and development responsibilities for lands located to the south of the reservoir. The area is known as the Willard Wildlife Management Area. An updated agreement for management of the area was implemented in 1980 (MOA-Contract No. 0-07-40-L1478) for a 10 year term. In 1987, this agreement was supplemented (MOA - Contract No. 06-07-L1450) to include management of an additional 100 acres adjacent to the south marina. In 1991, a new agreement was drafted but never signed. Because the 1980 MOA for management of the Willard Wildlife Management Area has expired, a new agreement has been drafted and is being negotiated.

The Harold S. Crane Wildlife Management Area now encompasses almost 2,000 acres and is managed primarily for the benefit of upland species, with emphasis placed on the ring-necked pheasant. The area contains a mix of upland and wetland habitats, ranging from agricultural land to mudflats. Management activities that have been implemented by UDWR to improve pheasant habitat include; planting food plots, cooperative farming (Contract No.3-07-40-L1410), supplemental feeding in winter, planting nesting cover, establishment of shrub rows, predator control, and limited irrigation. Although UDWR is responsible for maintaining roads, fences, and habitat, land ownership and mineral rights remain in the name of the United States. Reclamation also reserved access and operations rights as necessary for operation of the Weber Basin Project. Recreational use of the area includes hunting, fishing, dog training, bird watching and trapping. However, illegal dumping, all terrain vehicle use, trespass livestock, trap and skeet shooting and dispute over responsibility for law enforcement are problems associated with the area that need to be resolved.

An area approximately 50 acres in size, exists at the north end of the reservoir within the reservoir area boundary. This parcel of land is within Reclamation's primary jurisdiction zone and was originally utilized for borrow material during reservoir construction. Overgrazing and habitat degradation have occurred in this area as a result of past livestock grazing leases and trespass cattle. Grazing has been discontinued and Reclamation recently constructed a fence and cattle guard to exclude neighboring livestock from the area. The UDWR has expressed interest in assuming management responsibility for this area and a parcel of land situated between the east dike of the reservoir and I-15. The UDWR is concerned that these areas are being overtaken by noxious weeds, especially Dyers Woad (*Isatis tinctoria*) and would like to assume responsibility for weed control and enhance habitat for pheasants and songbirds. Presently, weed control is being done by the county.

In the past, beavers (*Castor canadensis*) have damaged some of the trees within the park. When this occurs, the skills of a local trapper are solicited and the offending animal is removed.

Fish

Willard Reservoir supports a significant fishery resource. It has traditionally provided game fish of desirable quantity and size for both boat and shore anglers. These fish species are able to survive within normal fluctuations of the reservoir's water surface elevation. There is little natural habitat structure within the reservoir for some of the warm water fishery species. Walleye need structure for cover, such as rock.

At maximum capacity the surface area is 10,000 acres, maximum depth is 30 feet and 215,000 acre feet of water is stored. The bottom is flat, fairly uniform and composed primarily of sand and silt.

Willard Reservoir is eutrophic in nature. Very little thermal stratification occurs in the summer due to the occurrence of periodic storms that create surface waves and mixing with bottom sediments. This mixing action results in increased turbidity and reduced light transparency, thus restricting development of emergent or submergent vegetation to the more sheltered areas of the reservoir. Surface ice generally forms by December and disappears by March.

The Utah Department of Wildlife Resources conducted an ecological survey of water quality in the reservoir. Summertime water temperatures were found to vary between 75 and 80 degrees Fahrenheit. Dissolved oxygen content was at or near saturation at all times and the pH was slightly alkaline. Physical and chemical parameters within the reservoir are best suited for maintenance of a warm water fishery.

The Utah Department of Wildlife Resources manages the fishery resource in Willard Reservoir. The UDWR began stocking largemouth bass (*Micropterus*

salmoides), walleye (*Stizostedion vitreum*), channel catfish (*Ictalurus punctatus*), white bass (*Morone chrysops*), and fathead minnow (*Perca flavescens*) in Willard Reservoir in 1965. Black crappie (*Pomoxis nigromaculatus*) were illegally stocked by anglers shortly after the reservoir was completed. Because water for Willard Reservoir is diverted from the Ogden and Weber Rivers and Willard Creek, fish species present in the reservoir somewhat reflects what exists in those streams and what once existed in ponds flooded by the reservoir. Other fish species known to have occurred in the reservoir historically include: brown trout (*Salmo trutta*), black bullhead (*Ictalurus melas*), bluegill (*Lepomis macrochirus*), carp (*Cyprinus carpio*), cutthroat trout (*Salmo clarki*), Delta smelt (*Hypomesus transpacificus*), green sunfish (*Lepomis cyanellus*), mottled sculpin (*Cottus bairdi*), rainbow trout (*Salmo gairdneri*), mosquitofish (*Gambusia affinis*), reidside shiner (*Richardsonius balteatus*), Utah chub (*Gila atraria*), Utah sucker (*Catostomus ardens*), emerald shiner (*Notropis atherinordes*), fathead minnow (*Pimephales promelas*), log perch (*Percina caprodes*), pond smelt (*Hypomesus olidus*), sand shiner (*Notropis stramineus*), and spottail shiner (*Notropis hudsonius*). However, most of these species have been unsuccessful in establishing and maintaining a viable population within the reservoir.

Throughout the history of Willard Reservoir, the sport fishery has experienced up and down cycles. These cycles appear to coincide with introductions of forage fishes which improve fishing temporarily until the forage population is suppressed by predation and the fishery declines. The reservoir has experienced several drawdowns in the past that exposed much of the dike riprap, which provides shoreline cover for both forage species and young-of-the-year gamefish thus making them more vulnerable to predation. Coordination between UDWR and the District, prior to making seasonal reservoir changes could minimize impacts and possibly benefit reservoir fish populations.

In the past, fish attractors (tire reefs, Christmas tree bundles) were placed in the reservoir basin to provide additional cover for small fish and improve angler success. Most of the trees have since decomposed. Tires still remain in the reservoir. Placement of structures within Reclamation reservoirs for the purpose of creating fish habitat has recently become a topic of concern. There is potential for fish habitat structures to interfere with operation and maintenance and present a hazard to boaters.

Shipman (1977) conducted a study of the utilization of natural and artificial spawning habitat by channel catfish in Willard Reservoir. Types of spawning habitat evaluated consisted of dike riprap, milk cans, plastic trash cans, and automobile tires. Utilization of the artificial structures by spawning catfish was low, however, it was concluded that adequate channel catfish spawning habitat is provided by the existing riprap dike that surrounds the reservoir.

Spottail shiners were stocked in 1981, 1982, and 1983 to improve the forage base for walleye and black crappie. In 1982, Delta smelt were also stocked. Only

short term benefits were realized from introduction of the spottail shiner and Delta smelt and their establishment of a self sustaining forage base was unsuccessful (Sommerfeldt 1984).

In 1990, UDWR introduced the gizzard shad (*Dorosoma cepedianum*) into Willard Reservoir in an attempt to provide forage and boost the walleye / channel catfish sport fishery. This introduction was done on an experimental basis due to concerns over possible transfer of gizzard shad into other Utah waters. Current fishing regulations prohibit possession of gizzard shad. Preliminary results of gizzard shad introductions indicate that they are being utilized by predator fishes and growth rates have increased.

In 1993, a hybrid between a white bass and a striped bass better known as wipers or palmetto bass (*Morone chrysops x saxatilis*) were introduced to utilize the additional forage provided by gizzard shad and exploit the under-utilized pelagic habitat within the reservoir. Preliminary results of this introduction, confirms that the wipers are utilizing the abundant forage and are growing at a rapid rate. The establishment of a wiper fishery has been popular with reservoir anglers.

Mammals

Mammals observed on lands within the reservoir area boundary include: cottontail rabbit (*Sylvilagus audubonii*), jackrabbit (*Lepus spp.*) raccoon (*Procyon lotor*), red fox (*Vulpes fulva*), striped skunk (*Mephitis mephitis*), muskrat (*Ondatra zibethicus*), and long-tailed weasel (*Mustela frenata*).

Other mammals common within the area include: yellow-bellied marmot (*Marmota flaviventris*), badger (*Taxidea taxus*), 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*) and muskrat (*Ondatra zibethicus*) use the wetland and riparian habitat around the reservoir. Raccoon (*Procyon lotor*), Uinta ground squirrel (*Spermophilus armatus*), mountain cottontail (*Sylvilagus nuttallii*), and various species of voles (*Microtus spp.*), and bats (*e.g. Myotis spp.*) occupy the area.

Big Game

The flatland and foothills surrounding the reservoir are covered mostly with sagebrush and grassland communities. This area provides big game habitat for both summer and winter use for deer (*Odocoileus hemionus*). Coyote (*Canis latrans*) are present in the area.

Raptors

Raptors, such as the northern harrier (*Circus cyaneus*), and the red-tailed hawk (*Buteo jamaicensis*) are also observed by visitors to the area. In the winter months, bald eagles (*Haliaeetus leucocephalus*), recently de-listed under the

Endangered Species Act (ESA), congregate in trees around the shoreline of the lake near the north recreation area.

Other raptors found in the area are red-tailed hawk (*Buteo jamaicensis*), great horned owl (*Bubo virginianus*), golden eagles (*Aquila chrysaetos*), American kestrel (*Falco sparverius*), barn owl (*Tyto alba*), and turkey vulture (*Cathartes aura*).

Peregrine falcons (*Falco peregrinus*) utilize nesting towers on the nearby shores of the Great Salt Lake.

Water Birds

Numerous waterbirds 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 waterbirds due to the prevalence of emergent vegetation around the reservoir. These areas provide important forage and cover sites for waterfowl and wading birds.

The abundance of birds within the area is due to its proximity to the Pacific flyway and nearby waterfowl management areas. Located to the north of the reservoir is the Bear River Migratory Bird Refuge, to the west is the Harold S. Crane Waterfowl Management Area and the Great Salt Lake, and to the south is the Ogden Bay Waterfowl Management Area (Ogden Bay WMA). The Ogden Bay WMA receives water that is stored in Willard Reservoir. Weber River water is diverted through the Willard Canal, stored in Willard Reservoir, and released to maintain flows in the Ogden Bay WMA. Most of the manageable upland wildlife habitat within the area boundary is located on lands located to the south of the reservoir.

Willard Reservoir and adjacent wetlands, serve as an important migratory stopover habitat 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.

Waterbirds commonly observed include the pied-billed (*Podilymbus podiceps*), eared (*Podiceps caspicus*), and western grebes (*Aechmophorus occidentalis*), gadwall (*Anas strepera*), mallard (*Anas platyrhynchos*), cinnamon teal (*Anas cyanoptera*), northern shoveler (*Spatula clypeata*), lesser scaup (*Aythya 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*).

Snowy plover (*Charadrius alexandrinus*) is a shorebird that nests on the alkaline flats surrounding the Great Salt Lake and has been observed nesting on the western embankment of A.V. Watkins Dam. Nesting usually occurs from mid-March through late summer. Populations of this bird that breed along the Pacific Coast have been listed as threatened under the Endangered Species Act. Populations in Utah have not been listed.

Upland Game Birds

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

Other Birds

Besides waterbirds, the reservoir and associated wetland and upland habitat within the area boundary are utilized by many other types of birds like songbirds. Probably the most common birds at Willard Reservoir are songbirds. Western kingbirds (*Tyrannus verticalis*), several species of sparrows 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*), are common. 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. 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*), wandering garter snake (*Thamnophis elegans*), great basin skink (*Eumeces skiltonianus*), and short-horned lizard (*Phrynosoma douglassii*). Historically, boreal toad (*Bufo boreas*) and Columbia spotted frog (*Rana lutieventris*) may have occurred in the area but have not been documented within the project area.

3.2.13 Threatened, Endangered, Candidate, Protected, 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 Box Elder County. These species are discussed below.

Wildlife Species

The whooping crane (*Grus americanus*) (endangered) migrates through Utah during the spring and fall. There are no resident populations in Utah. Canada Lynx (*Lynx canadensis*) (threatened) occurred historically in the Mountains above the reservoir but do not occur within the project area. The western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) (candidate) may use the area during their breeding season. Mexican spotted owl (*Strix occidentalis lucida*) are not known to occur within the area affected by the proposed project.

The bald eagle (*Haliaeetus leucocephalus*) was recently delisted as a threatened species, however, this species continues to be protected under the Bald Eagle Protection Act. Bald eagles roost in the North Recreation Area during winter attracted by a supply of winter-killed gizzard shad in the reservoir. 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. These areas should be protected from construction activities.

The Fat-whorled Pondsail (*Stagnicola bonnevillensis*) and Ogden Rocky Mountain Snail (*Oreohelix peripherica wasatchensis*) are both listed as candidate species. They are both found in Box Elder County. However, they are not found in areas affected by this project.

The State of Utah maintains a list of sensitive species (species of special concern). These species that may occur within the project area and are managed under conservation agreements include: Bonneville cutthroat trout (*Oncorhynchus clarkii utah*), northern goshawk (*Accipiter gentilis*), and bluehead sucker (*Catostomus discobolus*). Other state sensitive species include American white pelican (*Pelecanus erythrorhynchos*), bobolink (*Dolichonyx oryzivorus*), burrowing owl (*Athene cunicularia*), ferruginous hawk (*Buteo regalis*), grasshopper sparrow (*Ammodramus savannarum*), greater sage-grouse (*Centrocercus urophasianus*), kit fox (*Vulpes macrotis*), Lewis's woodpecker (*Melanerpes lewis*), long-billed curlew (*Numenius americanus*), pygmy rabbit (*Brachylagus idahoensis*), sharp-tailed grouse (*Tympanuchus phasianellus*), short-eared owl (*Asio flammeus*), Townsend's big-eared bat (*Corynorhinus townsendii*), western toad (*Bufo boreas*), Yellowstone cutthroat trout (*Oncorhynchus clarkia boubieri*), and smooth greensnake (*Opheodrys vernalis*).

Plant Species

Ute ladies'-tresses (*Spiranthes diluvialis*) (threatened), have not been found on lands likely to be disturbed during construction within the project area. If found they should be avoided during construction.

3.3 Environmental Effects of Alternatives

Analysis of the effects of both the No Action and the Proposed Action Alternative in this EA include the repair of the dam's embankment and activities associated with this repair (e.g. temporary road improvement or construction). All construction activities would occur on previously disturbed lands.

3.3.1 Recreation

3.3.1.1 No Action Alternative

The No Action Alternative and associated reservoir restriction would result in significant impacts to recreation. Below the reservoir level of 4215 feet, boat launch ramps and docks are closed and the retreating shoreline reveals mud flats, rocks, and debris, severely impacting water related activities. Large boats used for water skiing and fishing would be unable to access the reservoir. Reduced boating, swimming, hunting, camping, and wildlife viewing benefits would remain under this alternative.

3.3.1.2 Proposed Action Alternative

Under the Proposed Action Alternative there would be no long-term impacts to recreation. During construction, the temporarily restricted reservoir level will have minor short-term impacts on recreation.

3.3.2 Water Rights

3.3.2.1 No Action Alternative

The No Action Alternative would have a significant impact on water rights. Proofs of Beneficial Use have not been submitted for Willard Reservoir Storage Water Right Nos. 35-831, 29-882, 35-1391, and 29-1078. If the storage in Willard Reservoir is restricted in the future, these water rights would likely be limited to the lower storage value. Additionally, if the reservoir storage is limited then the exchange based Water Right Nos. 35-1578 and 35-6592 would like wise be based on the reduced storage.

The No Action Alternative would also impact the water right indirectly tied to Willard Reservoir. There would be less water available to deliver under contract to the Ogden Bay Wildlife Refuge and there could be less water in the A.V. Watkins Dam drains to flow into the Harold Crane Water Fowl Management Area. Lastly, the sumps used to collect water for irrigation within the Willard Bay State Park would have to be modified to match the lower water surface elevation.

3.3.2.2 Proposed Action Alternative

Under the Proposed Action Alternative there would be no long term impacts to the water rights associated with Willard Reservoir. The storage water rights in

Willard Reservoir have not been certificated so these water rights would not be subject to forfeiture even if the repairs lasted beyond November 2011.

3.3.3 Water Resources

3.3.3.1 No Action Alternative

In the event of dam failure, the No Action Alternative could leave water customers liable for property damages and exposed to the risk of losing all project benefits. This alternative would result in a reduction of the reservoir's maximum water surface elevation since the dam's embankment is deemed unsafe. The restricted elevation would severely reduce the operational flexibility of the entire Project, impacting all project beneficiaries.

3.3.3.2 Proposed Action Alternative

The Proposed Action Alternative would have no impact on the water resources including water rights. However, it would result in a reduction of the reservoir's maximum water surface elevation during construction activities.

3.3.4 Water Quality

3.3.4.1 No Action Alternative

Since no construction would occur, there would be no construction-related water quality impacts.

3.3.4.2 Proposed Action Alternative

Under the Proposed Action Alternative, best management practices would be employed during construction activities to minimize temporary impacts to water quality in Willard Reservoir. There could be temporary increases in turbidity immediately adjacent to construction activities; however, these would be localized and short term. There would be no long-term impacts upon water quality in the reservoir.

3.3.5 System Operations

3.3.5.1 No Action Alternative

This alternative would alter A.V. Watkins Dam operations in the future by not allowing the use of the reservoir's full Active Storage Capacity. This reduction in the reservoir level would occur since the dam's embankment is deemed unsafe. Finding the embankment unsafe affects if, when, and how much water is stored in the reservoir.

3.3.5.2 Proposed Action Alternative

The Proposed Action Alternative would have no effect on the dam's operations. However, it would result in a reduction of the reservoir's maximum water surface elevation during construction activities.

3.3.6 Public Safety, Access, and Transportation

3.3.6.1 No Action Alternative

The No Action Alternative would have no impact on public transportation. However, to protect the public, the number of water craft allowed to access the reservoir could be limited if the water surface area or depth of the reservoir is sufficiently reduced to warrant such an action by the Utah Division of Parks and Recreation.

3.3.6.2 Proposed Action Alternative

The Proposed Action Alternative would have no impact on public transportation. However, to protect the public during construction activities, the number of water craft allowed to access the reservoir could be limited if the water surface area or depth of the reservoir is sufficiently reduced to warrant such an action by the Utah Division of Parks and Recreation.

3.3.7 Visual Resources

3.3.7.1 No Action Alternative

The Visual Classification will remain as an overall downgrade in the seen area (4217), due to its nine foot height reduction for a healthy reservoir (4226). The Visual Resource suffers when the height of the reservoir is reduced.

3.3.7.2 Proposed Action Alternative

The Proposed Action Alternative puts the water level at the original 4226 elevation; therefore, the Visual Quality is enhanced over the 4217 (No Action) elevation.

3.3.8 Socioeconomics

For socioeconomic resource analyses, annual monetary values are converted to present worth values using the Fiscal Year 2007 Federal Discount Rate of 4.875 percent and a 50-year period of analysis.

3.3.8.1 No Action Alternative

The No Action Alternative and associated reservoir restriction would result in significant socioeconomic impacts. Under this alternative, deliveries would be inadequate to satisfy demand or make the necessary exchanges to upstream reservoirs. The restricted reservoir level would severely reduce the operational flexibility of the entire Project, impacting all project beneficiaries. While this alternative provides adequate public protection and is within Reclamation guidelines for risk, significant economic and environmental impacts would occur. The economic cost of implementing this alternative is estimated at \$163.3 million in present worth terms. This cost includes lost irrigation, M&I, fish and wildlife, and recreation benefits and increased operation and maintenance costs to pump longer each year.

3.3.8.2 Proposed Action Alternative

The Proposed Action Alternative would allow full utilization of the dam and reservoir resulting in no measurable long-term effects and preservation of all project benefits. The economic cost of implementing this alternative is estimated at \$49.2 million in present worth terms. During construction, the temporarily restricted reservoir level will have minor short-term impacts on water supply and recreation. No measurable effect on traffic or the commercial sector would be expected from implementation of this alternative.

3.3.9 Cultural Resources

Effects to cultural resources located within the project area may be caused by a combination of several factors, including topography, slope, soil type, site type, and various mechanical, biochemical, or human impact agents.

3.3.9.1 No Action Alternative

Table 4 in Section 3.2.9.2, lists historic properties which are located within the basin or near the historic shoreline of the reservoir. Under the No Action Alternative, the water levels would be significantly lower than the range of elevations of the past 45 years, including drought years. This condition would increase the visibility of sites and impacts to them.

3.3.9.2 Proposed Action Alternative

Table 5 below, lists only those sites which would possibly be affected by the proposed project. Most of the sites in and near the reservoir have been inundated and likely do not retain integrity. Once construction is completed lake levels would return to normal. Cultural resources would not likely be affected. Site Numbers with possible mitigation measures are delineated below.

**Table 5
Anticipated Effects and Possible Mitigation Measures (2007)**

Site No.	Possible Mitigation Measures (2007)
42BO61	Monitor/Evaluate
42BO68	Monitor/Evaluate
42BO69	Monitor/Evaluate
42BO79	Monitor/Evaluate
42BO83	Monitor/Evaluate
42BO85	Monitor/Evaluate
42BO87	Monitor/Evaluate
42BO471	Monitor/Evaluate
42BO472	Monitor/Evaluate

3.3.10 Paleontological Resources

3.3.10.1 No Action Alternative

There would be no effect to paleontological resources as a result of the No Action Alternative.

3.3.10.2 Proposed Action Alternative

There would be no effect to paleontological resources as a result of implementation of the Proposed Action Alternative.

3.3.11 Wetlands and Vegetation

3.3.11.1 No Action Alternative

The No Action Alternative would have no effect on upland habitats. The permanent reservoir water elevation restriction, associated with this alternative, would eliminate wetland vegetation currently supported by this maximum water elevation. Wetland vegetation would eventually recolonize new areas at the lower maximum water surface elevation.

Through agreements and contracts the reservoir provides water to wetlands and wildlife refuges along the shoreline of the Great Salt Lake. These wetlands and wildlife refuges were developed when the original project was constructed. This alternative would greatly reduce the reservoir's capacity to provide the water needed under these agreements and contracts. Their lower water deliveries would reduce wetland habitats in these important wildlife refuges.

3.3.11.2 Proposed Action Alternative

Approximately 210 acres of upland habitat (consisting mostly of sagebrush, rabbitbrush, grasses) and 11 acres of wetland vegetation (willow, and cottonwood, Sedge, rush spp.) would be directly disturbed by construction activities around the reservoir. The majority of construction would occur on previously disturbed lands. Many weedy patches occur in these areas as well.

Negative effects to native vegetation would be negligible and disturbed areas would return to useful habitat over time. It is possible that reseeding commitments listed in this EA could improve the condition and extent of native vegetation in the project area above current conditions.

After construction, disturbed areas would be recontoured and revegetated with native plants. A process of vegetative succession would then begin. This process would eventually establish a vegetative community favorable to native species.

Water deliveries to the above mentioned wildlife refuges would be decreased especially in the fall for two years during project construction. These areas should naturally rebound once historic water deliveries are possible.

3.3.12 Wildlife Resources

3.3.12.1 No Action Alternative

Species associated with or dependant on wetland habitats currently existing in areas around the reservoir pool would be displaced until a new wetland vegetative community is formed at the new maximum water surface elevation. Reduced wetland habitat within wildlife refuges that rely on project water deliveries would also reduce wildlife species reliant on these habitats.

The riprapped surface of the face of the dam provides feeding and breeding habitat for fish, but when the level of the reservoir is drawn down, this habitat is rapidly exposed and lost. This is particularly problematic in this reservoir with its broad, flat, U-shaped form. The reservoir restriction needed under this alternative would also increase the likelihood of low oxygen levels, excessive temperatures, high turbidity, and detrimental algae blooms which precipitate fish kills. The proposed reservoir restriction would eventually eliminate the reservoir's desirable fishery resources. Carp and bullhead catfish populations would likely increase dramatically.

3.3.12.2 Proposed Action Alternative

Approximately 221 acres of upland/wetland habitat would be temporarily disturbed. Big game would be able to obtain water and any other needs provided by upland, wetland, or lacustrine habitat in the same general areas as they now find it. Big game may be temporarily displaced from small areas during construction activities, but would move back in a short period of time. Due to the relatively small extent of disturbance and in comparison to current, normal human activity in the area, big game would not be measurably affected. Other mammals existing in riparian areas where construction occurs would be temporarily excluded from construction areas. Wildlife dependant on wetlands within the above mentioned wildlife refuges would be temporarily displaced until water deliveries are back to normal after construction of the proposed project.

Eagles use cottonwood trees in the area for roost and observation perches mainly during the winter. Removal of these trees either living or dead should be avoided. Construction activities occurring during the winter (November 1st to March 31st) would be restricted to the hours between 9:00 a.m. and 4:00 p.m. This restriction would ensure that any roosting eagles would not be significantly affected by the project.

Construction activities could disturb other bird species from preferred breeding, nesting, or foraging habitat. These effects would be limited to relatively small areas, and birds would be capable of moving to very similar habitat nearby. Snowy plover breeding populations found along the western embankment of the dam may experience some minor disturbance. Construction activities would not occur on this side of the dam; thus, limiting disturbance of these birds.

Construction associated with this alternative could disturb reptiles and amphibians from preferred habitat. These effects would be limited to a relatively small area and these animals would be capable of moving to very similar habitat nearby.

Fish species existing within the reservoir have experienced stresses associated with the current reservoir water level drawdown. This drawdown was mandated due to the unsafe condition of the dam as described in Section 1.2. The Proposed Action would not increase negative effects to these species beyond what they are experiencing currently. After completion of the Proposed Action, the current reservoir restriction on the reservoir's water elevation would be lifted and the reservoir could once again be filled to its normal maximum water surface elevation. The reservoir's fishery may not return historic population levels, species diversity, and use levels without management intervention. Chemical treatment of the reservoir's water and restocking of desirable fish species will likely be necessary to recover the fishery.

3.3.13 Threatened, Endangered, Candidate, Protected and Sensitive Species

3.3.13.1 No Action Alternative

Under the No Action Alternative cottonwood trees would be lost due to the lowered maximum water surface elevation. Bald eagles (protected under the Bald and Golden Eagle Protection Act) use these trees as roost sites. The remaining dead trees would provide roost sites for some period of time but would eventually be lost also. It is expected that a new population of cottonwood trees would replace the existing stand in time and possibly be adequate for eagle roosting as the dead cottonwood trees are lost. No effects to other threatened, endangered, candidate, or state sensitive species would occur.

3.3.13.2 Proposed Action Alternative

Bald eagles are winter residents of this area and may be displaced by construction activities (noise and habitat disturbance). Removal of cottonwood trees and dead snags should be avoided during construction. This could displace eagles if they are present in the area. 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 very similar roost sites or other habitat elements in the immediate vicinity of the project.

Canada lynx may occur in the mountains above the reservoir but do not occur within the project area. Therefore, no effects would occur to them.

Western yellow-billed cuckoo are not known to occur 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.

Northern goshawk would not likely use habitats within the area of disturbance to any significant degree. Therefore, affects to them would be negligible.

Under the Proposed Action Alternative a No Effect determination is made for all endangered and threatened species.

3.4 Summary of Environmental Effects

Table 6 below describes environmental effects under the No Action Alternative and the Proposed Action Alternative.

**Table 6
Summary of Environmental Effects**

Resource Issue	Alternatives	
	No Action Alternative	Proposed Action Alternative
Recreation	Significant effect	Minimal temporary effects during construction
Water Rights	Significant effect	No long term effect
Water Resources	Significant effect	Minimal temporary effects during construction
Water Quality	No effect	Minimum temporary localized turbidity during construction. No long-term impacts.
System Operations	Significant effect	No effect
Public Safety, Access, and Transportation	No effect	No effect
Visual Resources	Significant effect	No effect
Socioeconomics	Significant effect	Minimal temporary effects during construction
Cultural Resources	Minor effect	No effect likely
Paleontological Resources	No effect	No effect
Wetlands and Vegetation	Areas of wetlands would be permanently effected	Minimal effects during construction. A relatively small area of wetlands would be temporarily impacted.
Wildlife Resources	Significant Effects to fish and wildlife associated with lost habitat	Temporary effects during construction. The fishery may need management intervention after construction
Threatened, Endangered, Protected Species	No effect	No effect

3.5 Cumulative Effects

In addition to project-specific impacts, Reclamation analyzed the potential for significant cumulative impacts to resources affected by the project and by other past, present, and reasonably foreseeable activities within the watershed.

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 impacts 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 reasonably 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.

Based on Reclamation resource specialists' review of the Proposed Action Alternative, Reclamation has determined that this action would not have a significant adverse cumulative effect on any resources.

3.6 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 carries 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 Alternative would have no foreseeable negative impacts on Indian Trust Assets.

3.7 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. 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 would be implemented as an integral part of the Proposed Action.

1. Standard Reclamation Management Practices--Standard Reclamation management practices would be applied during construction activities to minimize environmental effects and would be implemented by Reclamation construction forces or included in construction specifications. Such practices or specifications include sections in the present 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.
2. Additional Analyses--If the Proposed Action were to change significantly from that described in the EA because of additional or new information, or if other construction areas are required outside the areas analyzed in this EA, additional environmental analysis including cultural and paleontological analyses would be undertaken if necessary.
3. Clean Water Act Compliance--If required, before beginning construction activities associated with modification or relocation of recreation facilities, the contractor would obtain from the U.S. Army Corps of Engineers, a 404 Permit, Clean Water Act of 1977 (P.L. 217). The conditions and requirements of the 404 Permit would be strictly adhered to by Reclamation and the District. Also, in compliance with the provisions of the Utah Water Quality Act, Title 19, Chapter 5, Utah Code Annotated 1953, the contractor would be required to get a General Construction Storm Water Permit as part of the Utah Pollutant Discharge Elimination System (UPDES) from the State of Utah Division of Water Quality, if the area of disturbance is or exceeds one acre. The contractor would need to implement erosion and sediment controls according to a storm water pollution prevention plan prepared in compliance with the general permit.
4. Appropriate measures would be taken to ensure that construction related sediments would not enter Willard Reservoir either during or after construction.

5. Cultural Resources--The construction activity will be monitored by the Provo Area Office archaeologist to ensure that historic properties will not be adversely affected.

Any person who knows that he/she has inadvertently discovered possible human remains on Federal land, must provide immediate telephone notification of the discovery to Reclamation's Provo Area Office archaeologist. Work would stop until the proper authorities were able to assess the situation onsite. This action would promptly be followed by written confirmation to the responsible Federal agency official with respect to Federal lands. The Utah State Historic Preservation Office and interested Native American tribal representatives would be promptly notified (see Section 3.2.9.2 for list of tribes contacted). Consultation would begin immediately. This requirement is prescribed under the Native American Graves Protection and Repatriation Act (43 CFR Part 10); 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 would be distributed to the equipment operators and verbal direction and description of possible inadvertent discovery scenarios would be given at a preconstruction meeting by the Provo Area Office archaeologist prior to any ground-disturbing activity.

6. Construction Activities Confined to Previously Disturbed Areas--All construction activities would be confined to previously disturbed areas, to the extent practicable. 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.
7. Public Access--Construction sites would be closed to public access. Temporary fencing, along with signs, would be installed to prevent public access. Reclamation and the District would coordinate with Willard Bay State Park personnel as necessary to ensure public safety.
8. Disturbed Areas--All disturbed areas would be smoothed, shaped, seeded, contoured, and rehabilitated to as near their pre-project construction condition as practicable. After completion of the recreation facility construction and restoration activities, disturbed areas would be seeded at appropriate times with weed-free, native seed mixes. The composition of seed mixes would be coordinated

with wildlife habitat specialists. Weed control on all disturbed areas would be required.

9. Appropriate steps would be taken to prevent the spread of, and to otherwise control undesirable plants and animals within areas affected by construction activities. Equipment used for the project would be inspected for reproductive and vegetative parts, foreign soil, mud or other debris that may cause the spread of weeds, invasive species and other pests, and for removing such material before moving vehicles and equipment onto any Federal land or out of any area on Federal project land where work is performed. Upon the completion of work, decontamination would be performed within the work area before the vehicle and/or equipment are removed from Federal project lands.
10. Environmental Commitment Plan (ECP) and Environmental Commitment Checklist (ECC)--An ECP and an ECC would be prepared and used by the Provo Area Office to ensure compliance with the environmental commitments and the environmental quality protection requirements. A post-construction environmental summary (PCES) would be completed within 1 year after completion of the project to assess the effectiveness of the mitigation measures.

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

This draft EA will be made available for public review and comment. Comments received on the draft EA will be fully and carefully considered in preparing the final EA.

Interested parties may view a copy of the Draft EA on the internet at Reclamation's Provo area Office web site at www.usbr.gov/uc/provo/index.html (look under the section "Current Focus" and click on the EA. They may also obtain a copy by submitting a written request to Mr. W. Russ Findlay, Bureau of Reclamation, Provo Area Office. The address is 302 East 1860 South, Provo, Utah 84606-7317, or e-mail, rfindlay@uc.usbr.gov.

5.3 Native American Consultation

Consultation regarding cultural resources for this Proposed Action has been completed with all interested tribes, including the Ute Tribe of the Uintah and Ouray Reservation near Fort Duchesne, Utah; the Northwest Band Shoshone Nation of Brigham City, Utah; the Paiute Indian Tribe of Utah, Cedar City, Utah; the Skull Valley Goshute Tribe of Salt Lake City, Utah; the Zuni Indian Tribe of Zuni, New Mexico; the Hopi Tribe of Kykotsmovi, Arizona; the Pueblo of Zia of Zia, New Mexico; the Kaibab Band of Paiute Indians of Fredonia, Arizona; the Pueblo of Laguna, Laguna, New Mexico; the Pueblo of Nambe, of Santa Fe, New Mexico, and the Confederated Goshutes of Irapah, Utah.

This consultation is being 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 of historic properties, including those of traditional religious and cultural importance; (3) express 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

Consultation has been initiated with the Utah SHPO to comply with Section 106 of the NHPA for cultural resources.

Chapter 6 - Preparers

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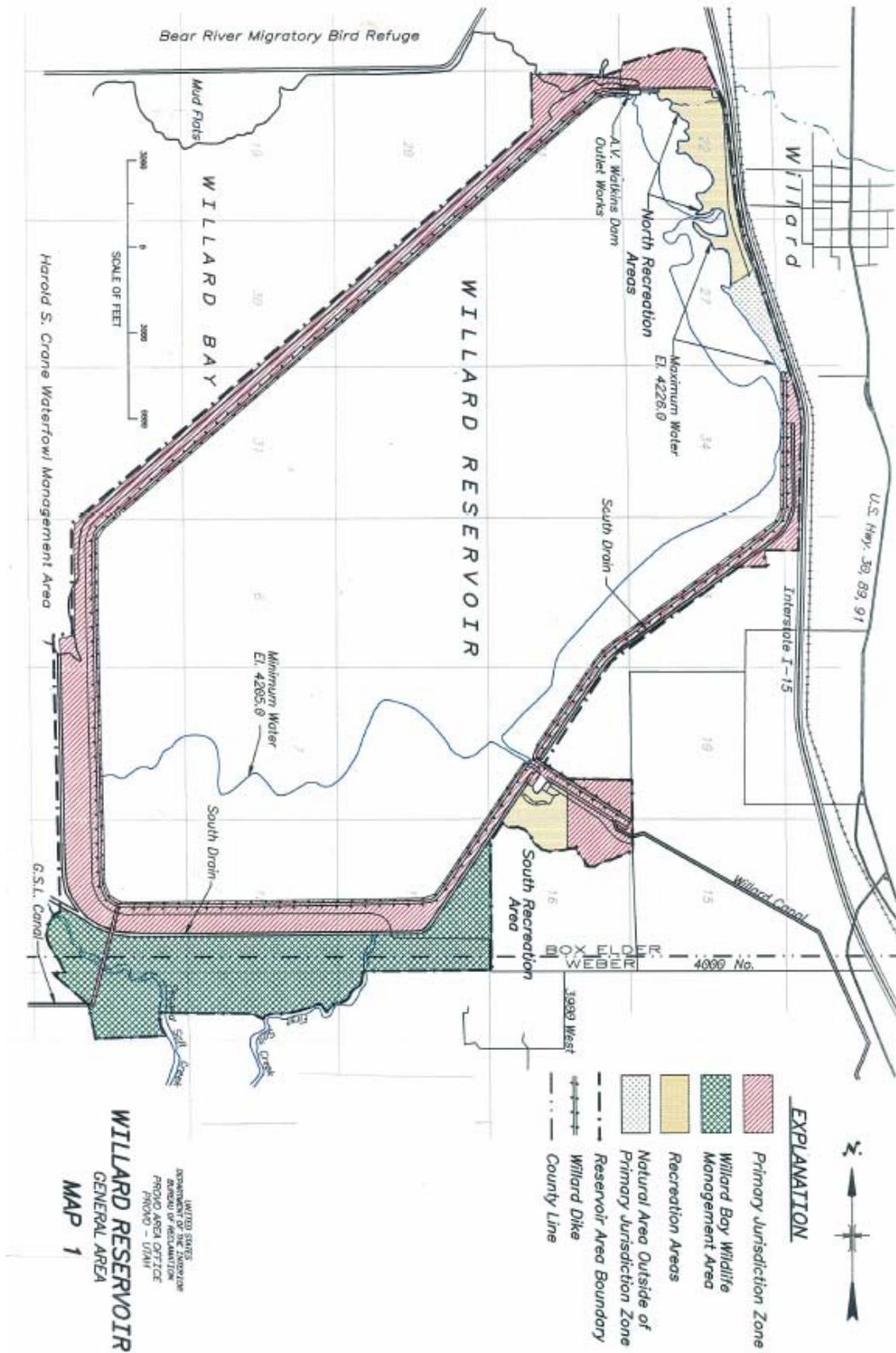
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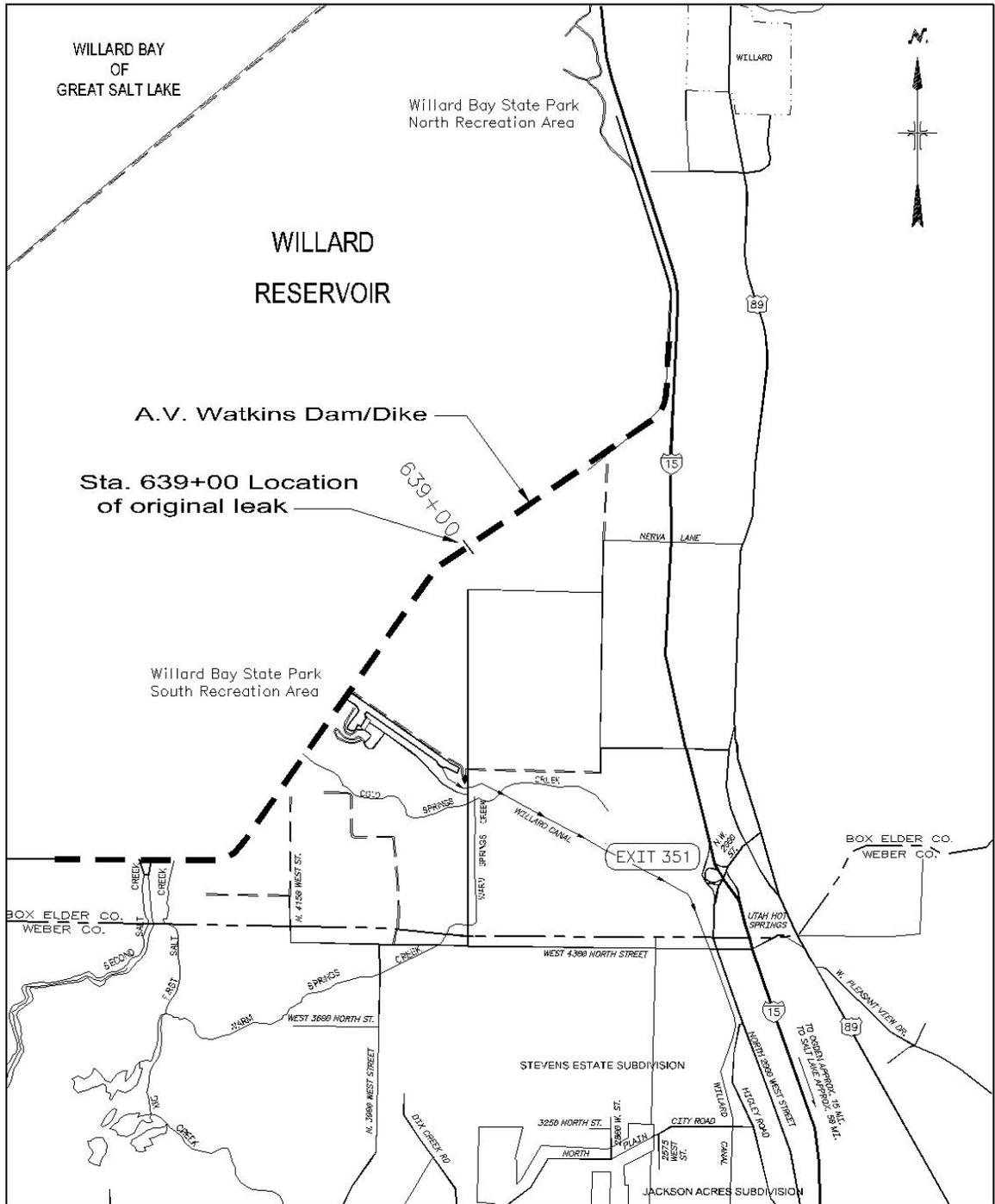
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Appendix 1 - Maps

Map 1

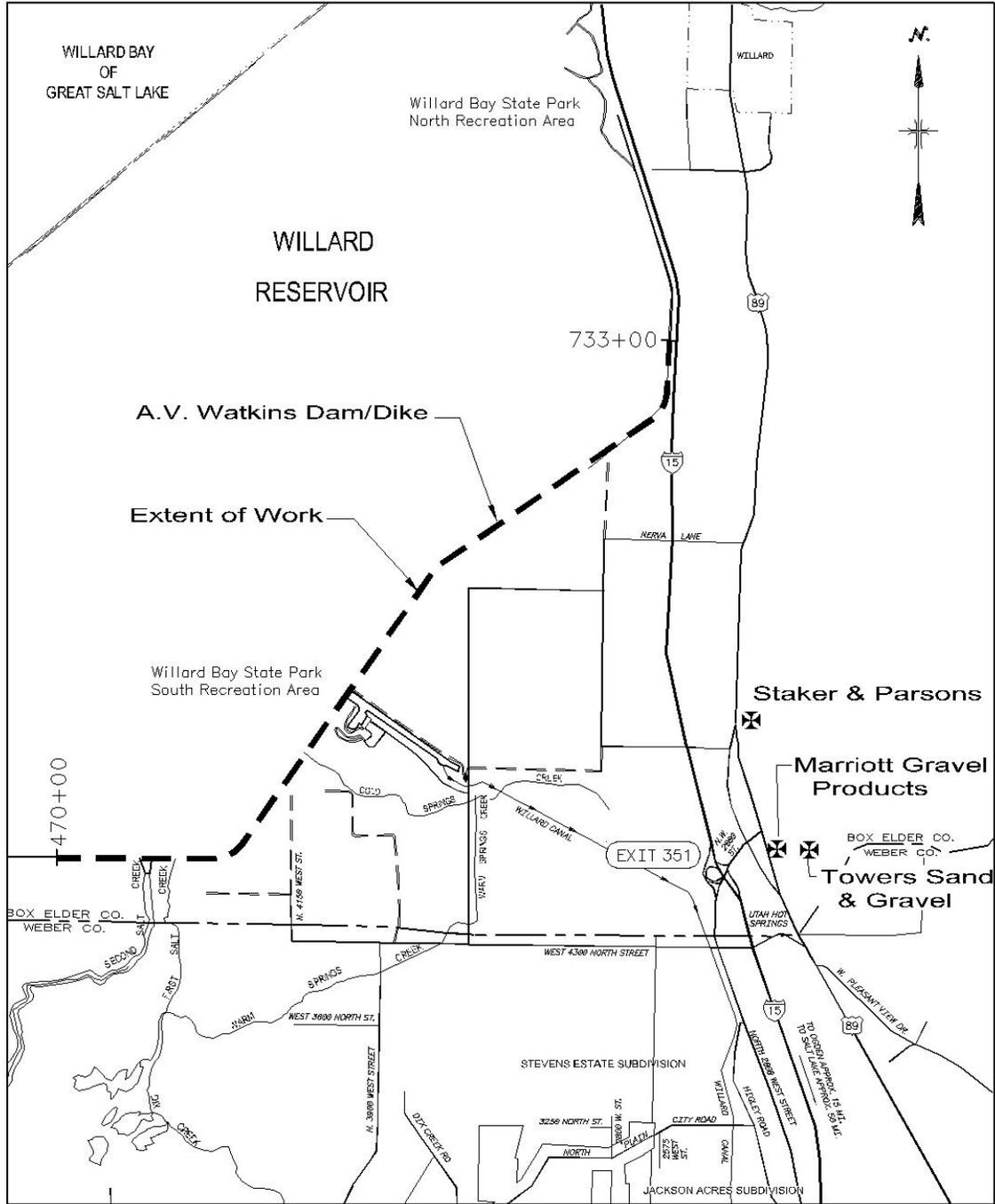


Map 2



**A.V. WATKINS DAM
ORIGINAL LEAK
LOCATION
Map 2**

Map 3



LEGEND

-  Gravel pits
-  Extent of embankment work
-  Paved road
-  Unpaved road

NOT TO SCALE

**A.V. WATKINS DAM
EXTENT OF WORK AND
GRAVEL SOURCES
Map 3**



NOT TO SCALE

LEGEND

 Contractor staging and stockpiling areas

NOTE

Contractor staging and stockpiling area shall be located between 150 ft. upstream of dam and the South Drain/Canal.

**A.V. WATKINS DAM
CONTRACTOR STAGING AND
STOCKPILING AREAS**

Map 4