UTAH DIVISION OF WATER RESOURCES

Volume I of II
Bear River Pipeline Concept Report - Draft

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BEAR RIVER PIPELINE CONCEPT REPORT

Draft

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LIST OF ACRONYMS

AACE	Association for the Advancement of Cost Engineering
BA	biological assessment
BMPs	best management practices
BRCC	Bear River Canal Company
BRMBR	Bear River Migratory Bird Refuge
BRWCD	Bear River Water Conservancy District
CFR	Code of Federal Regulations
CLSM	controlled low-strength material
CUWCD	Central Utah Water Conservancy District
CWA	Clean Water Act
DWRe	Division of Water Resources
EIS	Environmental Impact Statement
ESA	Endangered Species Act
fps	feet per second
GIS	geographic information systems
GPS	Global Positioning System
HP	horsepower
HWS	high water surface
I-15	Interstate 15
IBC	International Building Code
ILS	Intensive Level Survey
IRT	Interagency Review Team
JMM	James M. Montgomery
JVWCD	Jordan Valley Water Conservancy District
LEDPA	least environmentally damaging practicable alternative
M&I	municipal and industrial
MBI	mitigation banking instrument
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NWI	National Wetland Inventory

LIST OF ACRONYMS
(continued)

O&M	operations and maintenance
OHWM	ordinary high water mark
PCCP	Pre-Tensioned Concrete Cylinder Pipe
PGA	peak ground acceleration
PIP	Public Involvement Plan
Project	Bear River Pipeline Project
Refuge	Bear River Migratory Bird Refuge
ROW	right-of-way
SHPO	State Historic Preservation Office
SNWA	Southern Nevada Water Association
SQFT	square foot
Task Force	2005 Water Delivery Financing Task Force Report
TCE	Temporary Construction Easements
TDS	total dissolved solids
TES	threatened and endangered species
THMFP	Trihalomethane Formation Potential
UDOT	Utah Department of Transportation
UPDES	Utah Pollutant Discharge Elimination System
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USBR	US Bureau of Reclamation
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
UGS	Utah Geological Survey
UTA	Utah Transit Authority
UWRL	Utah Water Research Laboratory
WBWCD	Weber Basin Water Conservancy District
Work Group	Bear River Project Work Group
WSE	water surface elevation

1.0 PROJECT INTRODUCTION

1.1 PROJECT BACKGROUND AND PURPOSE

The Division of Water Resources (DWRe) has begun further studies on the Bear River Project (hereinafter referred to as "Project") as part of the implementation of the Bear River Water Development Act.

In 1991 the Utah State Legislature passed the Bear River Development Act (Act). The Act directs the DWRe to develop 220,000 acre-feet of water right applications held by the Board of Water Resources. The Act states:

> "The Division shall develop the surface waters of the Bear River and its tributaries through the planning and construction of reservoirs and associated facilities as authorized and funded by the Legislature; own and operate the facilities constructed; and market the developed waters. The Division is authorized to develop the Honeyville, Barrens, Hyrum Dam, and Avon reservoirs and associated works, including an interconnection from Honeyville Reservoir to Willard Reservoir, and shall proceed with design work, environmental assessments, acquisition of land and rights-of-way, and construction subject to the appropriation of funds for those purposes by the Legislature. The Division may not begin construction of any project until contracts have been made for sale or lease of 70% or more of the developed water and all required permits have been obtained."

The Act allocates the water developed as follows: 50,000 acre-feet each to Jordan Valley and Weber Basin (WBWCD) Water Conservancy districts, 60,000 acre-feet to Bear River Water Conservancy District (BRWCD), and 60,000 acre-feet to Cache County.

The Act defines public purpose uses of the facilities constructed to be recreation, fish and wildlife (required mitigation is not a public purpose), and flood control. These public purpose uses are to be paid by the state, and all other construction costs and all operation costs are to be paid by the water users.

The purpose of the Project is to develop Bear River water and deliver it to Box Elder, Cache, Weber, Davis, and Salt Lake Counties. The overall Project will consist of conveyance facilities and reservoir storage necessary to deliver water from the Bear River to the three participating water agencies and Cache County.

As Weber and Box Elder Counties have grown over the last decade, the need to identify the features of the Bear River Project has intensified. Limited rights-of-way and reservoir sites exist, and many of those rights-of-way are being identified and planned for other utilities and uses. DWRe needs to begin to identify Project features clearly, so that sites and rights-of-way may be preserved for the Bear River Project and project cost, and long-term impacts to the community and the environment may be minimized.

The goals of this study were to identify a proposed alignment corridor for the Bear River Pipeline from its source on the Bear River to the proposed Washakie Reservoir site, and from the Washakie Reservoir to the terminus of the pipeline at the proposed West Haven Water Treatment Plant (WTP) in Weber County. Another goal was to develop a conceptual design for the overall Bear River Project including analyzing additional possible reservoir sites. The study area is shown on Figure 1-1 (Volume II). The alignment of the pipeline from Washakie Reservoir to West Haven WTP covers about fifty miles through Box Elder and Weber Counties. The establishment of the pipeline alignment will allow DWRe to prioritize and implement property acquisition activities. Information generated by the study contained in this Concept Report will also provide DWRe with revised Bear River Pipeline project design criteria, key pipeline project assumptions, and a comprehensive pipeline project scope. The study will also provide for the overall Bear River Project; a pipeline/pumping facilities concept design, a reservoir siting analysis, an updated Project cost estimate, and a clear pipeline project development plan that includes a public involvement plan, an environmental compliance plan, a property acquisition plan, and an overall Project schedule.

2.0 PREVIOUS BEAR RIVER PROJECT STUDIES

Formulation of the Project has been going on for several decades. A significant amount of investigation has been completed in previous studies of the Project. Some of the results from these earlier studies may be out of date. Other studies were intended to be preliminary in nature or to reflect earlier Project method assumptions for operation or construction. The main components of the Project (use of surplus Bear River flow, use of reservoir storage to make supply reliable, diversion above areas of water quality degradation, and delivery to meet both the Wasatch Front and local water needs) have been consistently part of the Project.

This section summarizes many of the earlier studies of the Project, and highlights information most relevant for use in current Bear River Pipeline planning.

2.1 EARLY RESERVOIR STUDIES

Initial studies of Bear River water development were completed by the US Bureau of Reclamation (USBR) in the 1960s. In 1966, USBR published a geologic analysis of potential sites for the Smithfield Dam, with a capacity of 100,000 acre-feet (USBR, 1966, *Bear River Project Feasibility Geologic Report Smithfield Dam and Reservoir Sites*). In 1970, USBR published a summary of Bear River investigations related to potential reservoir storage projects, which included projects from Oneida Narrows, in Idaho, downstream to Honeyville and Corinne (USBR, *Bear River Investigations*, June 1970). A range of reservoir capacities was evaluated, from 10,000 acre-feet up to 435,000 acre-feet.

In the 1970s, the DWRe evaluated a range of potential storage projects in Cache County, which included storage capacities from 12,000 acre-feet up to 75,000 acre-feet, and sites on most of the major Cache Valley tributaries to the Bear River. All of these potential projects had benefit/cost ratios significantly over 1.0.

2.2 ADDITIONAL STUDIES FROM THE 1980s AND EARLY 1990s

A subsequent Cache Valley study, completed by DWRe in 1982, evaluated four different storage sites (Cutler enlargement, Amalga Barrens, Cub River, and Smithfield), at capacities ranging from 25,000 acre-feet up to 172,000 acre-feet (DWRe, *Cache Valley Study*, December 1982). The most economically favorable project in this study was a 102,000 acre-feet offstream municipal and industrial (M&I) project located at the Amalga Barrens site. In 1983, DWRe also completed a multiple reservoir planning analysis that evaluated three combinations of 10 different reservoirs, located from Cache Valley down to West Bay on the Great Salt Lake (DWRe, Summary of Investigations, Lower Bear River Basin, January 1983).

Following this initial round of studies, DWRe completed a series of more focused evaluations aimed at specific aspects of the Bear River water development. In 1984, DWRe completed a study somewhat similar to this Bear River Pipeline Concept Study, regarding water conveyance from the Bear River to Salt Lake County (James M Montgomery [JMM]), *Municipal Pipeline Project from Bear River/Honeyville to Salt Lake County*). This study assessed the feasibility of transporting and treating 50,000 to 100,000 acre-ft per year of Bear River water. The recommended route by which the water was to be transported (via pipeline) begins in Honeyville, just upstream from where the river crosses I-15, and runs parallel to the Union Pacific railroad south to Salt Lake County. Three additional routes were assessed in addition to the railroad pipeline; a route following I-15, a route following the power lines west of I-15, and a route following SR84 and SR89. All were examined based on factors that included capacity, cost, environmental considerations, point of intake and delivery, pipe failure impact, and geologic considerations. Design criteria for an optimal water treatment facility, intake method, pipe diameter, pumping stations, and storage mechanisms were also evaluated. The study concluded the optimal alternative to be the railroad alignment, with a bank type intake, 54-inch to 96-inch diameter pipes (depending on delivery), two pumping stations along the pipeline, intermediate and terminal storage reservoirs, and a conventional process water treatment plant.

Subsequently, the DWRe also began a series of studies of potential environmental effects and water quality issues. In 1986, the Utah Association of Conservation Districts conducted a public involvement program concerning the lower Bear River development project (Utah Association of Conservation Districts 1986, *Public Involvement Program Concerning Water Development in the Lower Bear River Basin*). The objectives of the program were to inform interest groups of the probable future needs for water in the lower Bear River basin, to receive feedback from local officials of the perceived impacts of the alternatives, to analyze issues, concerns, opportunities, and problems identified by concerned parties, to identify key areas where there is consensus or conflict over water development, to identify areas that need further study, and to report the findings to the DWRe. Data collected from an extensive process of interviews, forums, and meetings with local leaders was analyzed at two levels. The first level identified those areas thought to be of most concern to local leaders with respect to water development in the lower Bear River basin. The second level identified areas of concern related to potential reservoir sites in the Project area. The results of the analysis and a final forum discussion were combined to provide recommendations for the DWRe to consider during the next phase of the water development project.

The Utah Water Research Laboratory (UWRL) completed an investigation of Bear River water quality and reservoir eutrophication potential in 1986 (UWRL, 1986, *Water Quality Management Studies for Water Resources Development in the Bear River Basin*). The review of previous water quality studies on the Bear River found issues associated with high fecal indicator bacteria, BOD_5, TDS, and phosphorus concentrations. Both a previous and the cited study indicated that the Cub River was a significant source of pollutants to the Bear River. The eutrophication potential of the proposed reservoirs was modeled using a water temperature model and a longitudinal finite-difference eutrophication simulation model; the Amalga, Honeyville, and Avon reservoir sites were predicted to have the greatest eutrophication potentials. Water treatment costs were also evaluated for the proposed reservoir sites.

In 1988, Palmer-Wilding completed a study to evaluate the feasibility of diverting water by gravity from Cutler Reservoir to Willard Bay (Palmer-Wilding, 1988, *Cutler Diversion to Willard Bay Reservoir*). The objectives of the study included selection of possible canal/ pipeline alignments and estimating the cost of conveying 50,000 to 100,000 acre-feet per year using existing canals to the maximum extent possible. The study examined Hammond East Side and West Side/Corinne Canals, with possible canal or pipeline extensions. The available capacity in the canals was examined. Environmental considerations, including water and fish, wildlife, vegetation, wetlands, air quality, agricultural lands, recreation, and cultural resources were examined. The estimated cost per acre-foot of water delivered ranged from $22 up to $146.

In 1991, the Ecosystems Research Institute completed water quality investigations of the lower Bear River (Ecosystems Research Institute, 1991, *Water Quality Investigations: Lower Bear River and Water Quality Investigations: Hyrum Reservoir*). This report summarizes available environmental data for the lower Bear River basin, as well as documenting existing water quality conditions. Water quality at seven proposed reservoir sites was investigated and modeled. Predictions were made based on modeled algal biomass, orthophosphorus, nitrate and ammonia, total dissolved solids, total suspended solids, water temperature, and dissolved oxygen. The seven sites were Hyrum Reservoir, Avon Reservoir, Mill Creek Reservoir, Smithfield Reservoir, Willard Bay, Barrens Reservoir, and Honeyville Reservoir. Avon was predicted to have the best water quality, while Honeyville was predicted to have the lowest. A water quality management plan for the lower Bear River basin was also developed in this report to address specific areas of concern.

Also in 1991, DWRe completed a study examining the environmental impacts of the pipeline alternative described in the previous JMM, 1984 study (BioWest, Inc., 1991, *Investigation of Environmental Impacts of the Bear River Water Development Storage Unit*). This study also examined five reservoir sites (Mill Creek, Avon, Amalga Barrens, Hyrum, and Honeyville) to determine site feasibility from an environmental perspective. The primary conclusion was that most impacts were expected to be temporary during the construction phase of the project. The focus areas of the report were vegetation, aquatics/fisheries, and wildlife. Each area was examined concerning the existing environment, the environmental consequences of the project, and proposed mitigation measures. Permanent loss of wetland vegetation due to the pipeline right-of-way was determined to be the area of greatest concern concerning vegetation. Stream water quality and fisheries habitat would only be temporarily impacted during construction of the pipeline; and the greatest concern for wildlife was determined to be temporary and permanent loss of riparian and wetland habitat along the proposed right-of-way.

Also in 1991, DWRe completed a re-evaluation of seven potential dam sites for use in preparing a report for the Bear River Task Force Legislative Commission (CH2M Hill, 1991, *The Re-evaluation of Bear River Reservoir Sites*). This study evaluated Honeyville, Washakie, Barrens, Smithfield, Avon, Mill Creek, and Oneida Narrows, with special attention to foundation, feasibility, and cost. The first three were found to have soft, compressible foundations, but with potential for large capacity with a relatively low dam. The others had steep abutments, rock foundations, and relatively small reservoir capacity for a given dam height. Smithfield was found not to meet state dam stability standard, and was not evaluated for cost. Table 2-1 summarizes the results of the DWRe study.

Table 2-1
Summarized Results of 1991 Review of Seven Bear River Dam Sites

Dam Site	Capacity (acre-feet)	Height (feet)	Outlet Capacity (cfs)	Cost (M)	Cost per AF of Storage
Honeyville, Box Elder County, UT (earth-fill)	117,000	90	2,000	$43	$367
Barrens, Cache County, UT (earth-fill)	35,000-100,000	25 - 40	500	$23 - $64.5	$645
Washakie, Box Elder County, UT (earth-fill)	160,000 - 185,000	66 - 71	500	$103.5 - $116.5	$629
Avon, Cache County, UT (earth-fill)	33,000	207	460	$36	$1,090
Mill Creek, Summit County, UT (earth-fill)	27,000	210	460	$19	$702
Oneida Narrows, Franklin County, ID (Roller Compacted Concrete)	103,000	240	2,500	$66.5	$558
Smithfield, Cache County, UT (earth-fill)	80,000	35	2,500	Not evaluated	Not evaluated

2.3 MORE RECENT STUDIES

In 1994, DWRe completed an evaluation of lower Bear River water treatment needs, and started a long-term water-quality monitoring program on the Bear River (Montgomery Watson Americas, Inc., 1994, *Update to the Preliminary Engineering Evaluation of Bear River Water Treatment*). Updating the 1991 report "Preliminary Engineering Evaluation of Bear River Water Treatment", the aim of the report was to consider new Federal Safe Drinking Water regulations and to assess whether or not there was a substantial difference in the water quality of samples upstream and downstream of the Cutler Reservoir. The scope of the report was broken into three tasks: 1) updating the raw water quality data, 2) reviewing existing and anticipated safe drinking water regulations, and 3) developing revised water treatment requirements, cost estimates, and implementation schedule. The results of the raw water quality analysis indicated no significant difference in the levels of TDS or chlorides downstream and upstream of the Cutler Reservoir, indicating no inflow of saline streams to the site. Impacts of the new regulations on treatment recommendations from the 1991 report were assessed and updated, and new recommendations were made in anticipation of future regulations. Total annual costs and the implementation schedule for the overall Bear River Water Treatment Project were also updated.

The results of regular water quality monitoring efforts have been documented in a series of annual and semi-annual reports (MWH; 1996, 1997, 1998, 1999, 2000, 2002, 2005, 2007, 2010; *Bear River Water Quality Monitoring Report*). These reports present the monitoring results at several sampling sites located on the Bear River from downstream of the Idaho border to near the Great Salt Lake, and on the Malad River tributary to the Bear River. The reports also discuss potential water treatment issues and the results of special studies related to Bear River water quality, and make recommendations regarding changes to the monitoring program. Currently, water quality monitoring at four sites on the Bear River and one site on the Malad River is on-going.

A follow-up study to the BioWest, 1991 study served as an environmental evaluation for the proposed construction of the Honeyville Reservoir (BioWest, Inc., 1995, *Honeyville Dam and Reservoir Environmental Evaluation Report*). The 117,000 acre-foot reservoir was to serve two main purposes: as a storage site for water needed in the Bear River Migratory Bird Refuge (Refuge), and an additional water supply for Wasatch Front M&I users only (exclusive of Cache County and Box Elder County). The project would supply 50,000 acre-feet per year for M&I demands at a cost of $239 per acre-foot, and 50,000 acre-feet to the Refuge. The study area was divided into four management areas: 1) the dam and reservoir footprint; 2) the Bear River corridor between the dam and the Bear River Migratory Bird Refuge; 3) the Bear River Migratory Bird Refuge; and 4) the Bear River Bay. Each management area was evaluated based on its existing environmental conditions, water resources, wetland and aquatic habitats, wildlife, fish, and threatened and endangered species. Mitigation methods were also presented for establishing new wetland areas to compensate for those likely to be impacted during construction and operation of the reservoir.

In the mid-1990s, the DWRe also completed specific studies of the Beeton and Barrens reservoir sites. The Beeton Dam site was an alternative for the proposed Honeyville Dam. A 1993 report provided a cost estimate for the Beeton Dam comparable to that of the Honeyville Dam (DWRe, 1993, *Beeton Dam and Reservoir Preliminary Design*). The proposed site was located approximately one mile upstream of the State Highway 102 crossing of the Bear River and estimated to be 50,000 acre-feet. Evaluation of the alternative included hydrology, capacity, slope stability analyses, and possible seismic activity in the area. Geology, subsurface conditions, and liquefaction potential were assumed the same as those of the Honeyville site. A final cost estimate was determined based on the aforementioned evaluations.

The DWRe August 2000 report, *Bear River Development,* summarizes the history of the Bear River Project and planning status for the project at that time. The high runoff years of the 1980s, followed by the low water years of the late 1980s and early 1990s lead the Utah Legislature to pass the Bear River Development Act in 1992 to "plan, construct, own, and operate reservoirs and facilities on the river". The four-part development plan is summarized as follows: 1) enlarge Hyrum Reservoir; 2) connect the Bear River to Willard Bay Reservoir; 3) provide conveyance and treatment to deliver water to the Wasatch Front; and 4) build Honeyville Reservoir. In the 2000 DWRe report, the development plan was changed to: 1) modify the existing operation of Willard Bay by agreement with WBWCD; 2) connect the Bear River with a pipeline to Willard Bay; 3) construct conveyance and treatment to deliver water from Willard Bay to the Wasatch Front; and 4) build a dam in the Bear River Basin.

Alternatives evaluated for water supply benefits in the 2000 DWRe report include Willard Bay separately as well as Willard Bay combined with Honeyville, Barrens, and Beeton reservoirs. The report points out that water shortage could be mitigated using groundwater pumping, improving irrigation efficiency or fallowing of irrigated agricultural lands, and by leasing or purchasing of water rights. The connection from the Bear River in all of the development options is by pipeline from Honeyville or from the near the I-15 crossing, to Willard Bay. The report also notes WBWCD's reluctance to store Bear River water in Willard Bay due to a perception that Willard Bay has much higher water quality. Based on monitoring data, this perception is noted as being inaccurate, and the effects on Willard Bay water quality of storing Bear River water would be small.

The DWRe 2004 plan for the Bear River (DWRe, 2004, *Bear River Basin, Planning for the Future*) describes the current and projected future water use and water supply situation for that time within the Bear River Basin, projecting a need to import Bear River water to the Wasatch Front within the next couple of decades, and to provide additional industrial, commercial and agricultural water supply to Box Elder County and Cache County water users within about the same timeframe. It reports that the Bear River has a remaining, developable supply of about 250,000 acre-feet per year, but that full development of this water will require the construction of reservoir storage. The 2004 plan is cited as:

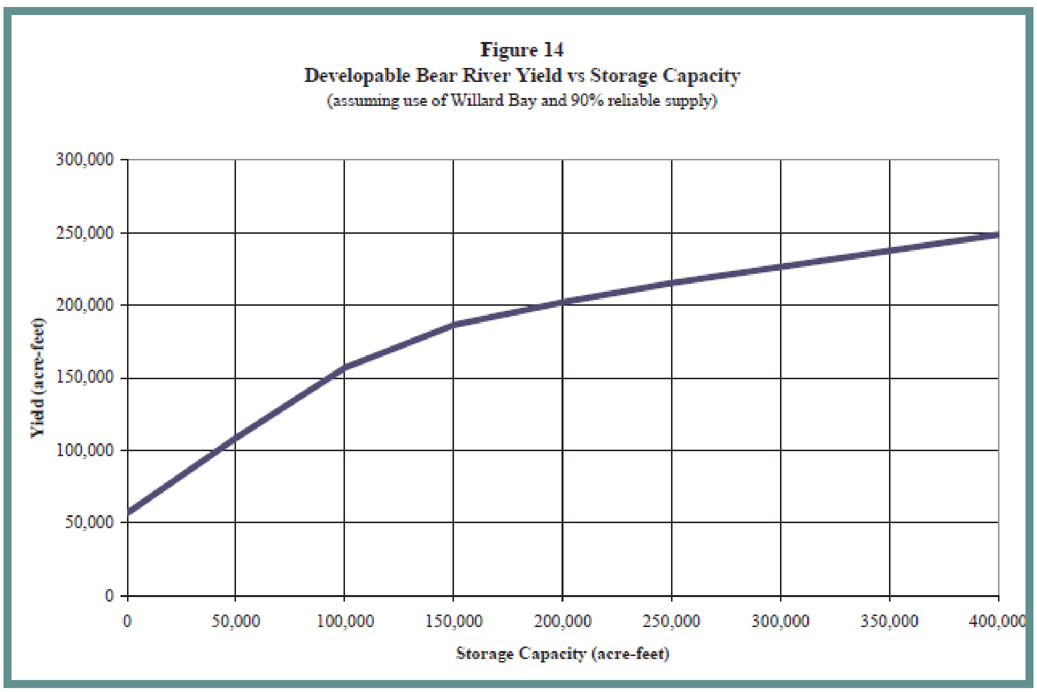
1. Modify the existing operation of Willard Bay by agreement with Weber Basin Water Conservancy District.
2. Connect the Bear River with a pipeline and/or canal to Willard Bay from a point near the I-15 crossing of the Bear River near Elwood in Box Elder County.
3. Construct conveyance and treatment facilities to deliver water from Willard Bay to the Wasatch Front.
4. Build a dam in the Bear River Basin as the demand for additional water continues to increase.

The 2004 Plan also states that the Honeyville and Barrens reservoir sites were rescinded from consideration by the 2002 Legislature, due to "growing concern with the possible environmental and social impacts of those two reservoir sites". A directive by the Legislature to consider the Washakie site was added to the 2004 Plan. Figure 14 from the 2004 Plan (Figure 2-1) shows how the developable water supply from the Bear River is dependent upon the amount of available reservoir storage.

The 2005 Water Delivery Financing Task Force (Task Force) Report: *Financing the Lake Powell Pipeline and Bear River Projects* (September 2005) evaluated the funding needs associated with the Bear River Project. It noted that proceeding with development evaluation studies should begin immediately, as deferring further State, involvement would greatly increase the ultimate cost of the project and compress the planning and engineering of these projects into a few years. The Task Force recommended the State's then current formulation, including modifying the operation of Willard Bay to allow the storage of Bear River, connecting the Bear River with a pipeline and/or canal to Willard Bay from a point near the I-15 crossing of the Bear River near Elwood in Box Elder County, construction of conveyance and treatment facilities to deliver water from Willard Bay to the Wasatch Front (to be done by JVWCD and WBWCD), and building a water storage project in the Bear River Basin. The report also noted that studies on environmental impacts, water quality, and hydrology would be required before federal involvement could be considered. The 2005 report cited an estimated right-of-way cost for the assumed 17-mile long pipeline at $2M, and a pipeline construction cost of $70M.

It is important to note that many of the studies and reports referenced herein include the use of Willard Bay. The Willard Bay Reservoir was constructed by USBR as part of the Weber Basin Project in the 1960s. The current authorized use of Willard Bay is for collection and storage of Weber River and Ogden River water for Weber Basin Project purposes only. Use of Willard Bay for storage of Bear River water would require federal authorization to allow non-project water to be stored in project facilities, and agreement with WBWCD as the project sponsor. Any discussion of the use of Willard Bay in this document is conceptual in nature as no formal discussions between DWRe, USBR, and WBWCD have been initiated. USBR and WBWCD are presently engaged in a Safety of Dams improvement project and a potential minor raise to the dam structure to optimize the storage of Weber and Ogden river water rights. These projects are being constructed solely for the storage of Weber Basin Project water rights from the Weber and Ogden rivers, and are not intended for the storage of Bear River water.

Figure 2-1
Developable Bear River Supply versus Reservoir Storage (from DWRe, 2004)



In 2010, DWRe completed a preliminary design for the Washakie offstream storage site (CH2M Hill, 2010, *Washakie Reservoir Project Preliminary Engineering and Design Report*). The report focuses on the geologic and geotechnical setting of the proposed reservoir, but also includes a description of the major facilities (including the dam and reservoir, Malad River bypass channel, and inflow and outflow piping and pump stations), as well as the hydrology, water quality, and environmental considerations associated with the project. The geotechnical analyses concluded that the embankments would perform adequately during the design seismic event. The hydrologic and water quality review included the assumed used of Willard Bay as a second storage site. The report includes a conceptual cost estimate for the 160,000 acre-foot capacity reservoir, Malad River bypass facilities, and conveyance facilities ranging from $876M to $1,022M.

2.4 SUMMARY OF PREVIOUS STUDIES

After more than four decades of evaluations and studies of potential plans for diverting and using the surplus flow of the Bear River for M&I use, no previous study or report lays out a definitive conceptual plan for water development. Early studies included diversion of water only to the Wasatch Front, examined only a single aspect of the Project, or focused on water quality and/or environmental analysis. More recent planning has included a refined "big-picture" understanding of the phasing of the Project, but without detailed review of facility requirements, institutional restrictions, or updated hydrology. The most recent study of the Washakie site provides a good level of detail, but does not consider the needs of the overall Bear River Project. The Washakie Study also incorporated the use of Willard Bay Reservoir, which may not be possible, given that use of Willard Bay for storage of Bear River water would require Federal authorization to allow non-project water to be stored in project facilities, as mentioned previously.

From the studies described above, the following conclusions may be drawn:

- Bear River water above the Malad River is treatable to meet drinking water quality standards.
- The Bear River Project will require significant storage volume (220,000 to 240,000) to deliver a reliable 220,000 acre-feet per year.
- No clear plan exists for providing the storage required to make the Bear River supply reliable.
- Significant controversy exists regarding the acceptability of developing/using certain reservoirs or sites.
- Potential conveyance routes have been evaluated from the Bear River to Willard Bay (and farther south to Salt Lake City).
- No conveyance facilities have been evaluated to supply BRWCD or Cache County.
- No detailed review has been completed of real estate impacts and no plan has been developed for right-of-way acquisition.
- A complete Project development plan has not been outlined.
- The Willard Bay Reservoir was constructed by USBR as part of the Weber Basin Project in the 1960s. The current authorized use of Willard Bay is for collection and storage of Weber River and Ogden River water for Weber Basin Project purposes only. Use of Willard Bay for storage of Bear River water would require Federal authorization to allow

non-project water to be stored in project facilities, and agreement with WBWCD as the project sponsor. Any discussion of the use of Willard Bay in this document is conceptual in nature as no formal discussions between DWRe, USBR, and WBWCD have been initiated. USBR and WBWCD are presently engaged in a Safety of Dams improvement project and a potential minor raise to the dam structure to optimize the storage of Weber and Ogden river water rights. These projects are being constructed solely for the storage of Weber Basin Project water rights from the Weber and Ogden rivers, and are not intended for the storage of Bear River water.

3.0 PROJECT DESCRIPTION

3.1 PROJECT DESCRIPTION

The Project is designed to utilize surplus Bear River flow that occurs in the winter and during high runoff. The Project water rights are for 220,000 acre-feet. Reservoir storage will be required to make this supply available and reliable. As discussed in Chapter 2, the DWRe has studied reservoir sites all across the basin. Wherever the storage is located within the Bear River basin, it will require storage nearly equal to the required water supply. The Project initially considered storage at the Washakie site of some 160,000 acre-feet and another 70,000-80,000 acre-feet of storage at another reservoir site. Water would be diverted into these reservoirs in the winter and spring months and delivered to the four water agencies during their peak summer demand months. Water would be diverted from the Bear River and stored/pumped to reservoir sites. A pipeline from the reservoir(s) would deliver water through Box Elder and Weber Counties to the proposed WTP in West Haven. From the West Haven WTP south, WBWCD and JVWCD have planned and begun right-of-way acquisition for a project consisting of the water treatment plant, storage reservoirs, and pump stations to deliver the water after treatment to Weber, Davis, and Salt Lake Counties.

3.2 PROJECT APPROACH

The purpose of the Bear River Pipeline Concept Report is twofold: (1) to develop overall Project features that will develop the needed water supply for the stakeholders, and (2) to establish a preferred pipeline alignment corridor from the proposed Washakie Reservoir Site to the proposed West Haven WTP site. The establishment of the pipeline alignment and other project features will allow the State to preserve in advance the ROW required to construct and maintain the future Bear River Project with its water delivery facilities.

To complete the objectives of this pipeline project, the following tasks were performed:

1. **Define Pipeline Project Study Area.** The study area for the pipeline project was defined so that a complete project could be evaluated and established, including project facilities starting from the outlet of Washakie Reservoir; to the Bear River Diversion (intake); to water delivery facilities to Cache County, Box Elder County, WBWCD, and JVWCD.
2. **Establish Pipeline Alignment Options.** The first task of the Pipeline alignment evaluation was to develop a list of all the potential alignment options. Based on established project evaluation criteria, the list of options was narrowed down to a short list of a select few for final evaluation.
3. **Recommend a Final Pipeline Alignment.** The pipeline alignment, which best met the pipeline project evaluation criteria was selected as the final recommended pipeline alignment.
4. **Develop Pipeline Conceptual Design.** The next task was to perform a conceptual level engineering analysis and to evaluate the hydraulics of the pipeline and pump stations for

the final alignment option. This task included identification of other required pipeline project facilities and the development of a concept design for each facility.

5. **Identify Pipeline Critical Environmental Issues.** A detailed environmental analysis was performed on the final alignment option, identifying areas of the pipeline project, which could have environmental impacts.
6. **Identify Pipeline Critical Real Estate Acquisitions.** This task included analysis of the potentially impacted properties due to pipeline project facilities, including ROW acquisition and public ROW preservation. This task also included development of a ranked list of priority acquisition properties for the project.
7. **Develop Storage Alternatives.** This task was to examine all potential storage alternatives within the Bear River Basin that could be used for Project storage.
8. **Develop Project Cost Estimate.** An overall Project facilities cost estimate was developed, based on the conceptual design. The cost estimate includes all the facilities associated with the Bear River Project and associated conveyance and storage facilities.
9. **Project Implementation Plan.** The final task of the project was to develop a comprehensive implementation plan which includes recommended project phasing, an environmental compliance plan, a real estate acquisition schedule, a public involvement plan, and an overall Project implementation schedule with critical project planning and construction milestones.

3.3 PROJECT STUDY AREA

The Bear River Pipeline Project encompasses the area from near the Idaho border along the I-15 corridor down to West Haven City. The process of developing the study area for the Bear River Project included determining the extents of potential project facilities, connecting the proposed Reservoirs with the proposed West Haven WTP, and the extent of all the potential pipeline alignments to be considered for evaluation.

Generally the pipeline alignment study area encompasses the following area, as illustrated in Figure 3-1 (Volume II):

- South Boundary West Haven Water Treatment Plant,
- North Boundary Proposed Washakie Reservoir Outlet,
- East Boundary East bench of the Wasatch Mountains,
- West Boundary Great Salt Lake or West Railroad/I-15 Corridor.

More detailed study area descriptions and maps have been provided in Chapter 6 of this report.

For the analysis of potential reservoir sites we developed the following study area criteria.

3.3.1 Idaho Location

For the purposes of the study of reservoir sites on the Bear River, two limitations were imposed on potential sites related to their location within the Basin. The first is that DWRe does not desire to develop a reservoir in the Basin, which is located in Idaho. Building a reservoir in Idaho for use by Utah water users is seen as very difficult politically and so any reservoir site in Idaho was not considered as part of this Project.

3.3.2 Above Bear Lake

Any site above Bear Lake was also not considered. Bear Lake, while a natural lake, is operated as a storage reservoir in the Basin and any new storage above the lake would be subject to water rights within the Basin. Any storage upstream of Bear Lake would be subject to prior storage rights in Bear Lake.

3.4 AGENCY LIMITATIONS

It is important to note that many of the previous studies and reports referenced herein included the use of Willard Bay. The Willard Bay Reservoir was constructed by USBR in the 1960s as part of the Weber Basin Project. The current authorized use of Willard Bay is for collection and storage of Weber River and Ogden River water for Weber Basin Project purposes only. Use of Willard Bay for storage of Bear River water would require federal authorization to allow non-project water to be stored in project facilities, and agreement with WBWCD as the project sponsor. Any discussion of the use of Willard Bay in this document is conceptual in nature as no formal discussions between DWRe, USBR, and WBWCD have been initiated. USBR and WBWCD are presently engaged in a Safety of Dams improvement project and a potential minor raise to the dam structure to optimize the storage of Weber and Ogden river water rights. These projects are being constructed solely for the storage of Weber Basin Project water rights from the Weber and Ogden rivers, and are not intended for the storage of Bear River water.

As a result of the foregoing, the study area for the Project storage sites was limited to areas downstream of Bear Lake, in Utah, north of Willard Bay, and as far west in Box Elder County as is feasible for the delivery of water to and from the site.

4.0 PIPELINE PROJECT ASSUMPTIONS AND CRITERIA[1]

A number of planning and analysis assumptions are necessary in developing and refining the conceptual alignment scenarios that are one of the primary products of this study. These assumptions helped guide the Bear River Pipeline project team in the following:

- Establishing the overall study area
- Identifying areas of uncertainty and need for additional study
- Determining the pipeline's capacity and potential point(s) of diversion, termination, and delivery
- Determining pumping, valving, and other operational requirements, including facility locations and capacities
- Estimating maximum and minimum ROW widths and other engineering criteria
- Developing and refining initial alignment alternatives and land requirements
- Evaluating alternatives and selecting feasible alignment corridors and land requirements
- Developing a plan and schedule for pipeline project implementation.

Establishing consensus on these assumptions between the DWRe, the BC&A/HDR project team, and the Bear River Project participating agencies allows the Bear River Pipeline project to move forward efficiently, and avoid wasted effort and re-work. Assumptions presented herein consider the following sources of information:

- Project facility formulation and information from previous studies
- Hydrology and water availability information from DWRe modeling studies
- Water quality monitoring data

Each of these is considered in the subsections that follow. After this discussion, each of the important project assumptions is summarized in Section 4.2.

4.1 INFORMATION IMPACTING PROJECT ASSUMPTIONS

As mentioned in Chapters 2 and 3, a significant amount of investigation has already been completed in previous studies of the Bear River Project. Some of this information may be out of date. Other studies have been rendered obsolete by changes in assumptions or political decisions. This subsection combines and discusses information from a variety of sources for the development of consensus with respect to critical assumptions for use in Bear River Pipeline planning.

1 The project assumptions and criteria were developed prior to the analysis of project storage requirements documented in Chapter 10, under the assumption that the primary storage reservoir would be at the Washakie site.

4.1.1 Overall Project Formulation and Previous Studies

Formulation of the Bear River Project is incomplete. Certain information, like the planned annual delivery volumes to each participating agency are specified in the authorizing legislation, and well understood. Other issues, like the points of delivery and the location and volume of reservoir storage required to fully firm up the Bear River supply on an annual and multi-year basis are less clear. For the purposes of this Bear River Pipeline Concept Report, the critical formulation questions include the following:

- Where is water diverted?
- Where is water stored?
- Where is water delivered?
- How much water is available and required to be diverted, stored, or delivered at each location, and at what timing?

Previous studies of the Bear River Project have not clearly identified diversion locations. Based upon water quality monitoring (see Section 4.1.5), it has generally been assumed that water for delivery to WBWCD and JVWCD would be diverted upstream of the confluence with the Malad River and Salt Creek. Diversion locations for BRWCD and Cache County have not previously been identified.

Previous studies of the Bear River Project have considered a number of reservoir storage options including Smithfield, Barrens, Hyrum, Millcreek, and Avon Reservoirs upstream of Cutler Reservoir; and Washakie, Honeyville, Willard Bay[2], and Beeton Reservoirs downstream of Cutler. The Smithfield site was determined to be unfeasible for geotechnical reasons in that it did not meet state dam stability standards (CH2M Hill, 1991) and the Barrens and Honeyville sites were eliminated from further review by the 2002 Legislature (DWRe, 2004). A 2010 study of the Washakie site has determined that a 160,000 acre-foot off-stream reservoir at the site is technically feasible, but expected to be very expensive (CH2M HILL, 2010). Operational studies of the Bear River Project (DWRe, 2010, described below) indicate that an additional 70,000 to 80,000 acre-feet of storage (beyond that provided in Washakie) is needed somewhere in the system in order to allow reliable delivery of the full 220,000 acre-feet of water supply. A feasible site for this additional storage has not yet been identified. Additional information on storage sites is included in Chapter 10.

Previous studies have also not clearly delineated where Bear River Project water would be delivered. WBWCD and JVWCD have long assumed that water would be delivered from the

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[2] The Willard Bay Reservoir was constructed by the US Bureau of Reclamation (USBR) as part of the Weber Basin Project in the 1960s. The current authorized use of Willard Bay is for collection and storage of Weber River and Ogden River water for Weber Basin Project purposes only. Use of Willard Bay for storage of Bear River water would require Federal authorization to allow non-project water to be stored in project facilities, and agreement with WBWCD as the project sponsor. Any discussion of the use of Willard Bay in this document is conceptual in nature as no formal discussions between DWRe, USBR, and WBWCD have been initiated. USBR and WBWCD are presently engaged in a Safety of Dams improvement project and a potential minor raise to the dam structure to optimize the storage of Weber and Ogden river water rights. These projects are being constructed solely for the storage of Weber Basin Project water rights from the Weber and Ogden rivers, and are not intended for the storage of Bear River water.

Bear River Pipeline to the vicinity of a proposed WTP. JVWCD and WBWCD have purchased a site for that WTP in West Haven, and this site is assumed in this study. Neither Cache County nor BRWCD have completed studies to plan for the delivery of their Bear River Project water, although some studies are underway. For this reason, it is difficult to plan for a precise location for delivery of Cache County and BRWCD project water. Subsequent chapters define the delivery of water to BRWCD and Cache County as developed in this study. Discussions with Cache County and BRWCD and preliminary studies of their future water needs (see Volume I Appendix) provide some information to guide the pipeline formulation efforts included herein.

Cache County developable lands are wide spread, although more prevalent on the west side of the Bear River and north of Cutler Reservoir. Local high-quality water supplies tend to be located on the east side of the Bear River and south of Cutler Reservoir. To be most effective in meeting future Cache County water needs, Bear River Project facilities to deliver M&I water should serve the existing areas of high demand, as well as new areas likely to be developed in the future. One way to meet these diverse future water needs is to provide multiple potential water delivery locations. Given that future demand locations are not fully known, good supply planning should remain flexible to provide for delivery near Logan City, from facilities that will be located throughout the county near areas of demand, and directly from the Bear River upstream of, or within, Cutler Reservoir. For preliminary planning purposes, the locations discussed in Chapter 7 are recommended for these facilities.

Box Elder County developable lands within the BRWCD service area are also widespread. Areas of likely future development are more prevalent on the west side of the Bear River. Development trends indicate that areas in the southern portion of the BRWCD service area are more likely to be developed first. To allow for optimum use of Bear River water within the BRWCD service area, it appears that a pipeline located on the west side of the Bear River serving multiple delivery points along its route would be most effective. This is the planning assumption used herein, and displayed on Figure 6-38 (Volume II).

The current understanding and assumptions concerning the formulation of Bear River Project facilities are summarized in Table 4-1. Most of this information is based on the recently completed Washakie Reservoir Study, recent DWRe modeling runs, and formulation completed within this project.

4.1.2 Project Facilities

Figure 4-1 shows an overall schematic of the Bear River Pipeline project (project). Proposed project facilities include the Washakie Reservoir near the Utah/Idaho border, a diversion from the Bear River to the reservoir, and a pipeline from Washakie and from a diversion on the Bear River below Cutler Dam to the vicinity of the proposed West Haven WTP site. Deliveries to Cache County will be made from a combination of stream withdrawls and one or more direct diversions from the Bear River upstream of Cutler Reservoir (or from tributary streams), with exchange from water stored in Washakie Reservoir during some months and released to the BRCC. Diversions to BRWCD will be made along the pipeline through their service area. WBWCD and JVWCD will receive delivered water at the proposed West Haven WTP.

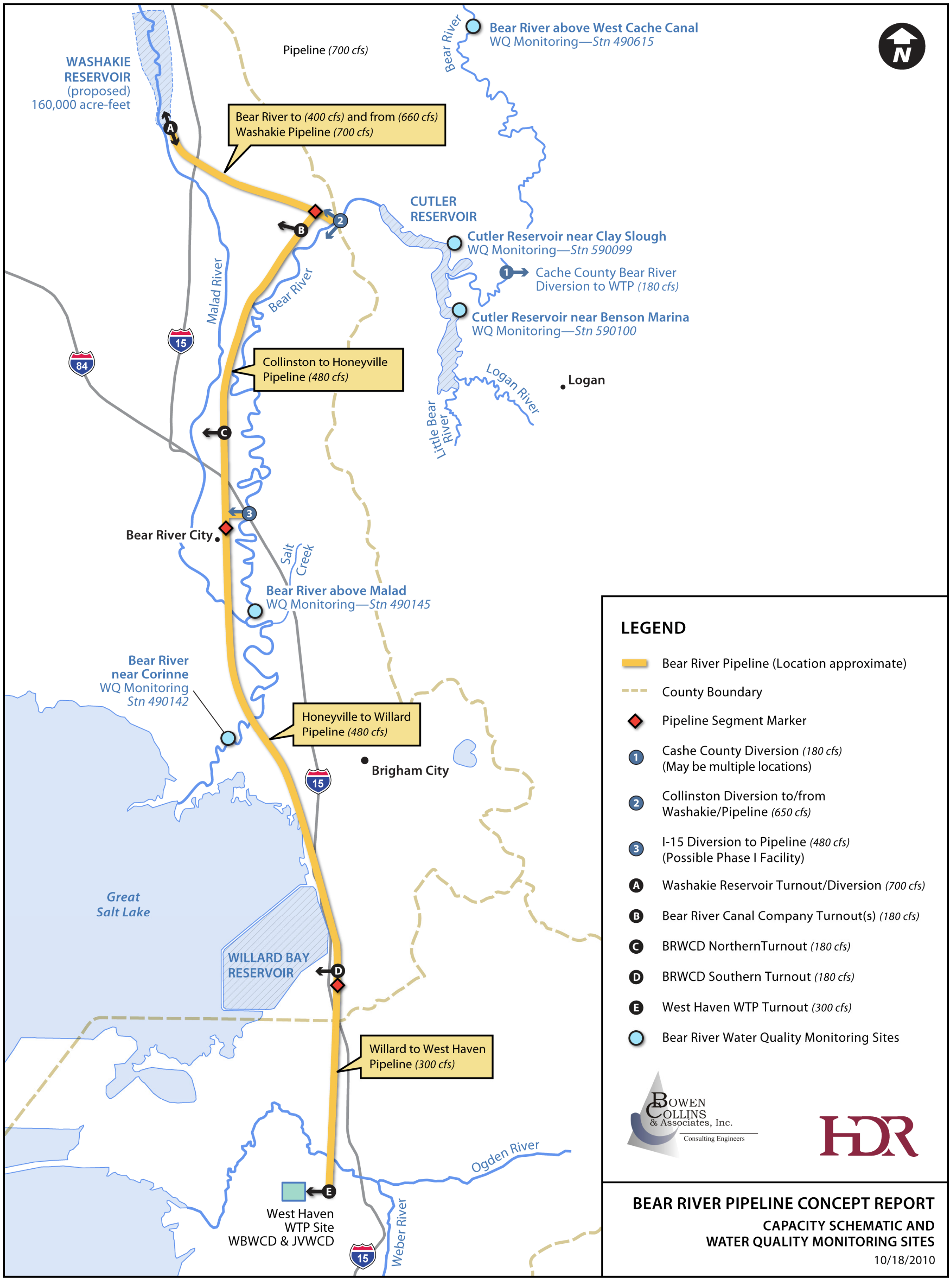
Table 4-1
Current Bear River Project Formulation Assumptions

Project Element	Location	Capacity
Combined Delivery	Cache County, BRWCD, WBWCD, JVWCD	220,000 acre-feet/year; 660 cfs peak monthly delivery
Upstream Storage Reservoir	Off-stream, near Washakie	160,000 acre-feet
River Diversion to Upstream Storage	New diversion between Cutler Dam and Collinston	400 cfs [3]
Delivery from Upstream Storage	Back to Bear River at or near diversion site, to the Westside Canal (for exchange to Cache County), and/or into Bear River Pipeline	660 cfs (to meet peak monthly demand for 220,000 acre-feet/year)
Delivery to Cache County	By a combination of river diversion(s) with exchange from Washakie releases, plus potentially by direct delivery from Washakie	180 cfs (to meet peak monthly demand for 60,000 acre-feet/year of supply)
Delivery to BRWCD	Directly from the river, from Bear River Pipeline at multiple locations, or from smaller Project pipelines.	180 cfs (to meet peak monthly demand for 60,000 acre-feet/year of supply)
Downstream (or Upstream) Storage Reservoir	Unknown	Unknown (approximately 80,000 acre-feet needed)
River Diversion to Downstream (or Upstream) Storage	Unknown	Unknown (likely 300 to 400 cfs, although on-stream storage is significantly more efficient)
Delivery from Downstream Storage	To Bear River Pipeline	300 to 480 cfs (to meet peak monthly demand for 160,000 acre-feet/year to BRWCD, JVWCD, & WBWCD)
Delivery to WBWCD	To West Haven WTP site from Bear River Pipeline	150 cfs (to meet peak monthly demand for 50,000 acre-feet/year of supply)
Delivery to JVWCD	To West Haven WTP site from Bear River Pipeline	150 cfs (to meet peak monthly demand for 50,000 acre-feet/year of supply)

Notes: Capacities based on peak monthly flow of 18 percent of total supply available, which is based on peak month usage of existing supplies of JVWCD/WBWCD.

[3] The Washakie Study recommended a 700 cfs diversion to storage. Updated and more detailed simulation runs conducted as part of this study show that 400 cfs is adequate.

Figure 4-1
Bear River Pipeline Schematic and Water Quality Monitoring Sites



4.1.3 Hydrology and Water Availability[4]

Bear River water availability often does not match the Bear River Project participants' projected pattern of water needs. Available water in the Bear River system occurs in the winter and springtime months while peak demand from the water users will be during the summer and early fall. This is shown on Figure 4-2. Based on historical hydrology, during many months, and particularly during the high demand months of the summer, there is frequently no water available to be diverted directly from the Bear River under the State's water rights. In certain very dry years, there is no divertible water outside of the months of November through April. Because of this variable supply availability, reservoir storage is required to "firm-up" the water supply to meet the participants' year-round projected demand patterns.

Utah DWRe has developed a daily time step computer model of the Bear River water supply called BEARSIM. The BEARSIM model includes long-term, historical records of estimated water availability and streamflow data for the lower Bear River, time series of daily diversions for each major Bear River diversion canal and for the Bear River Migratory Bird Refuge (Refuge), and projected participating member water demands. The model incorporates existing and assumed storage reservoirs, and conveyance and delivery facilities and operational priorities. DWRe has used the BEARSIM model to simulate the long-term operation of the Bear River Project under many different reservoir storage and water delivery assumptions. Results from these simulation runs provide important input for use in establishing the capacity of the Bear River Pipeline and its appurtenant facilities.

Among the many important pieces of information provided by these simulation runs is the conclusion that the Bear River Project cannot develop the full 220,000 acre-feet of reliable water supply without approximately 250,000 acre-feet of storage capacity. This is approximately 80,000 to 90,000 acre-feet more than is incorporated into the planning for the Washakie site, or the overall Bear River Project. This significant deficiency in Project formulation affects the planning of the Bear River Pipeline, since capacities, operations, and even diversion locations could change as additional water storage facilities are brought into the Bear River Project. The current Project planning and formulation (without additional storage) results in an average shortage of about 22,000 acre-feet and a maximum year shortage of about 98,000 acre-feet. The annual shortages in the deliverable supply from the Bear River Project (as currently formulated) are summarized in Figure 4-3.

The following three model simulation scenario summaries incorporate additional/sufficient storage assumptions to develop the full 220,000 acre-feet of authorized water supply of the project, with maximum annual shortages of less than 10 to 15 percent. At this time, they are the most appropriate concepts for use in sizing and planning of the Bear River Pipeline proposed alignment and appurtenant facilities.

4 Additional information and analysis on this subject is included in Chapter 10.

Figure 4-2
Bear River Project Demand and Water Availability

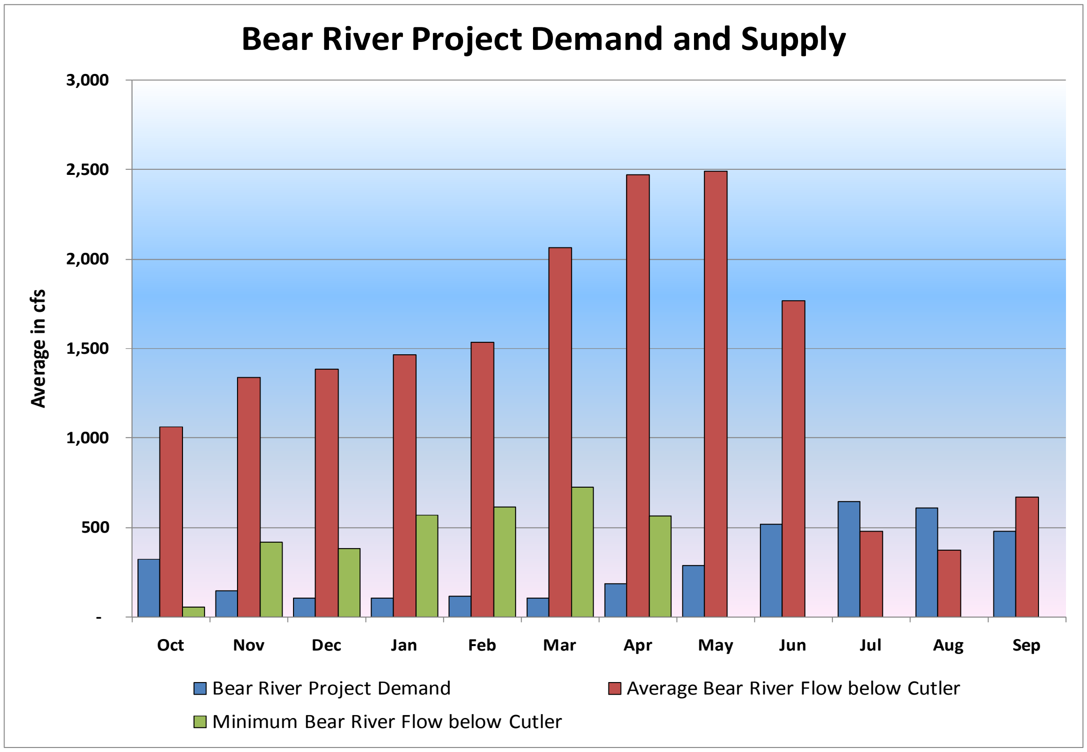
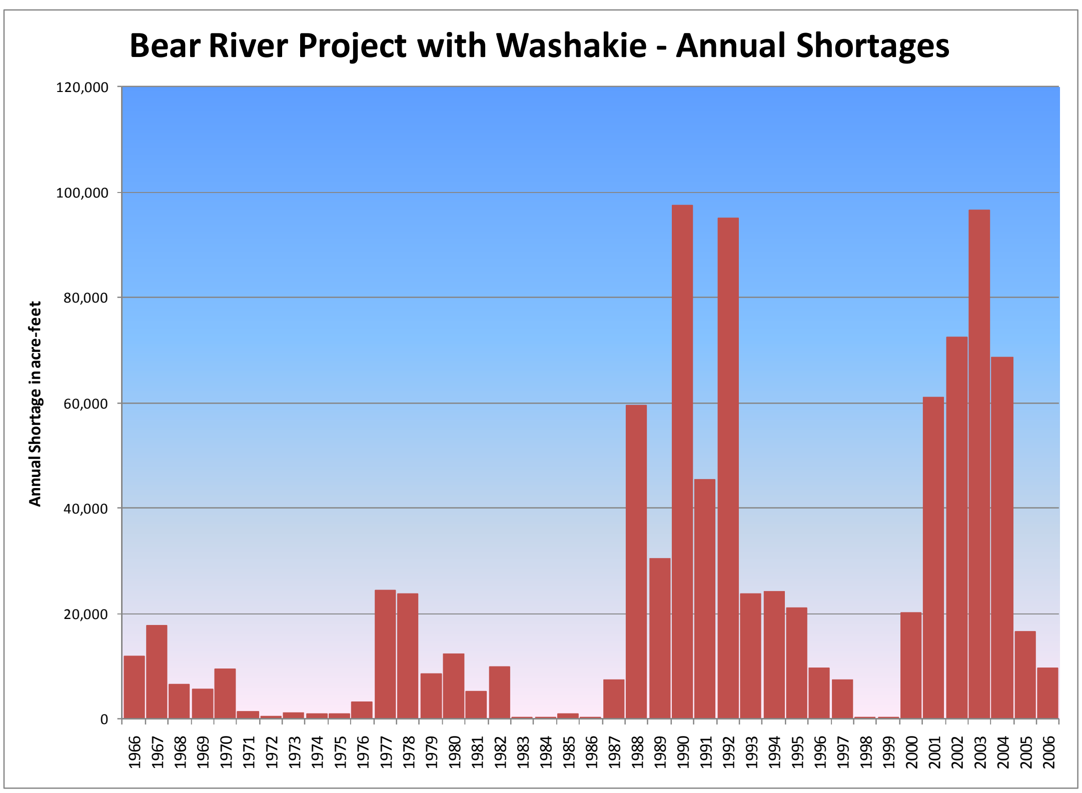


Figure 4-3
Bear River Project Annual Shortages



Scenario #1 – Additional Downstream Reservoir Scenario. Scenario #1 assumes the construction of a 160,000 acre-foot off-stream storage reservoir at the Washakie site. It also assumes the construction of an additional 95,000 acre-feet (of usable capacity, 100,000 acre-feet of total capacity) in an on-stream or off-stream storage reservoir located downstream of Washakie. It is assumed Washakie Reservoir is filled by pumping water from below Washakie Dam, through a 400 cfs capacity pipeline. During certain periods, water is also diverted directly into the Bear River Pipeline for delivery south to BRWCD, JVWCD, and WBWCD at a flow of up to 480 cfs. This simultaneous filling of the reservoir and delivery from the river to meet demands will require careful planning and hydraulic analysis of the diversion and pumping facilities, as described in Chapter 7. Water is released from storage in Washakie at a maximum rate of 660 cfs, back through the pipeline to the Bear River and/or the Bear River Canal Company (BRCC) canals, or to the Bear River Pipeline for delivery to project participants, or both. Water may also be simultaneously released from Washakie Reservoir for delivery to the Bear River Pipeline, and pumped out of the Bear River into the Bear River Pipeline. This also complicates the hydraulic analysis of the pumping facilities at Washakie and at the Bear River diversion site.

A portion of the Bear River Project water supply for Cache County is developed by delivering water from Washakie to satisfy BRCC demands in exchange for Cache County diverting water owned by BRCC upstream of Cutler Dam. The location and capacity of Cache County's required diversion(s) from the Bear River and/or its tributaries have been investigated preliminarily in this study. This study assumes that water is diverted directly from the Bear River just upstream of or within Cutler Reservoir, but this direct diversion could equally well be made from one or more of the tributaries to the Bear River within Cache County through a water rights transfer. Because of the hydropower facilities at Cutler Dam, it is likely that power interference charges may be assessed on the upstream Cache County diversions that occur outside of the irrigation season.

The assumed 100,000 acre-foot reservoir downstream of Washakie would fill using surplus flows of the Bear River and be drawn upon to make deliveries to BRWCD, JVWCD, and WBWCD as needed. The hydrology model of the operation of the system shows that the assumed downstream reservoir releases an average of 53,000 acre-feet per year of the Bear River Project water supply, at a maximum rate of 300 cfs. The full reservoir capacity is utilized to meet project demands in nine of the 41 years simulated.

Results from the current, most relevant BEARSIM model simulation of this scenario are summarized in Tables 4-2 and 4-3. The Washakie Reservoir fill rate is compared with the average reservoir release rate in Figure 4-4.

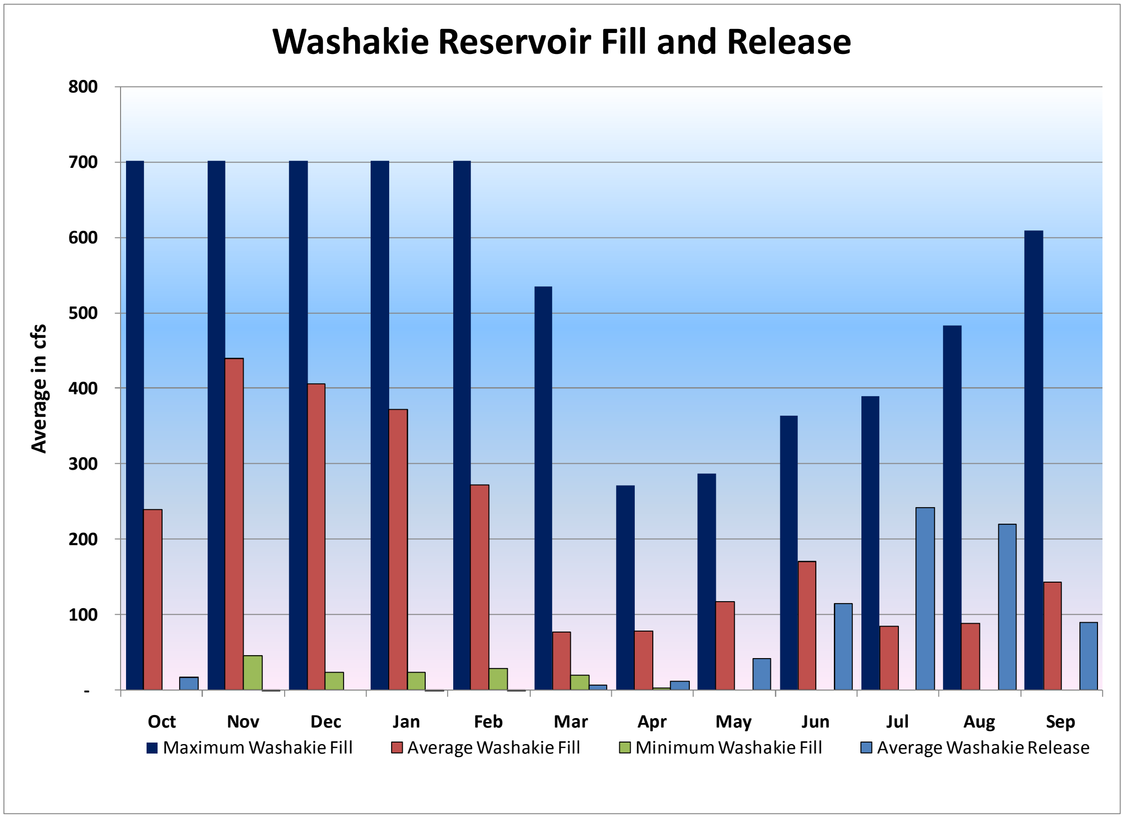
Table 4-2
Capacity Requirements from DWRe
Modeling Scenario #1 (Additional Downstream Reservoir Scenario)

Project Element	Average Annual Flow (acre-ft/cfs)	Maximum Flow (cfs)	Maximum Annual Shortage (acre-ft)
Bear River Project total delivery	220,000 / 303	660	22,000
Diversion to fill Washakie Reservoir	116,000/160	400	N/A
Washakie Reservoir delivery to Bear River Pipeline	99,000 / 137	660	N/A
Direct Diversion from Bear River to Bear River Pipeline	121,000 / 166	480	N/A
Total Diversion from Bear River to Pipeline and Washakie Reservoir	220,000 / 303	650	N/A
Diversion to fill downstream reservoir	60,000 / 80	300	N/A
Downstream reservoir release / delivery	50,000 / 75	300	N/A
Delivery to Cache County (from new diversion, at times by exchange with BRCC)	60,000 / 83	180	6,000
Delivery to BRWCD (from Bear River Pipeline Northern Segment or released from Washakie Reservoir)	60,000 / 83	180	6,000
Delivery to WBWCD (from Bear River Pipeline and from downstream reservoir)	50,000 / 69	150	5,000
Delivery to JVWCD (from Bear River Pipeline and from downstream reservoir)	50,000 / 69	150	5,000
Additional supply to be developed from additional storage	60,000 / 80	450	N/A

Table 4-3
Simulation Results for Scenario #1
Washakie Plus 100,000 acre-feet Downstream On-stream Reservoir (all values in acre-feet)

Month	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Annual
Diversions to Cache County by Exchange from Washakie Releases													
Maximum	5,400	124	58	-	-	-	1,211	4,800	8,400	10,800	10,200	7,800	46,101
Average	1,107	10	1	-	-	-	91	1,032	3,299	8,112	7,572	4,355	25,578
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	-
Direct Diversions to Cache County from Bear River													
Maximum	5,400	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	60,000
Average	2,925	2,357	1,797	1,798	1,798	1,557	2,638	3,325	4,606	2,446	2,406	2,655	30,309
Minimum	-	2,276	1,743	1,800	1,800	1,800	1,790	-	-	-	-	-	13,899
Total Diversions to Cache County													
Maximum	5,400	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	60,000
Average	4,032	2,366	1,798	1,798	1,798	1,557	2,728	4,356	7,906	10,557	9,979	7,010	55,887
Minimum	505	2,000	1,739	1,742	1,738	290	800	257	4,059	8,643	7,859	3,919	47,384
Direct Diversion from Bear River to BRWCD													
Maximum	5,400	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	60,000
Average	3,032	2,385	1,798	1,799	1,800	1,577	2,666	3,331	4,532	2,303	2,442	2,686	30,350
Minimum	-	2,179	1,742	1,748	1,793	290	100	-	-	-	-	-	8,268
Release from Washakie to BRWCD													
Maximum	5,400	221	58	52	7	1,510	2,900	4,800	8,400	10,800	10,200	7,800	51,732
Average	2,283	15	2	1	0	223	334	1,469	3,868	8,497	7,758	5,114	29,565
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined Diversion to BRWCD													
Maximum	5,400	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	60,000
Average	5,315	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	59,915
Minimum	1,916	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	56,516
Direct Diversion from Bear River to WBWCD and JVWCD													
Maximum	9,000	4,000	3,000	3,000	3,000	3,000	5,000	8,000	14,000	18,000	17,000	13,000	99,976
Average	4,429	3,938	2,995	2,996	2,997	2,565	4,268	5,417	7,189	3,089	2,760	3,842	46,485
Minimum	-	3,333	2,903	2,903	2,897	431	15	-	-	-	-	-	13,317
Release from Washakie to WBWCD & JVWCD													
Maximum	9,000	667	97	97	103	2,569	4,985	8,000	14,000	18,000	17,000	13,000	82,076
Average	3,396	56	5	4	3	435	732	2,583	6,811	14,568	13,320	8,056	49,967
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	24
Combined Diversion to WBWCD and JVWCD													
Maximum	9,000	4,000	3,000	3,000	3,000	3,000	5,000	8,000	14,000	18,000	17,000	13,000	100,000
Average	8,371	4,000	3,000	3,000	3,000	3,000	5,000	8,000	14,000	18,000	17,000	12,798	99,170
Minimum	-	4,000	3,000	3,000	3,000	3,000	5,000	8,000	14,000	18,000	17,000	6,473	90,840
Washakie Reservoir Contents													
Maximum	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Average	106,033	120,867	135,756	147,653	155,186	157,577	158,497	156,428	148,416	128,579	114,350	105,061	136,200
Minimum	24,691	43,581	67,553	89,488	111,395	124,036	140,145	132,281	119,524	89,760	54,659	29,020	91,432
Combined Diversion from Bear River to Collinston Diversion													
Maximum	38,995	30,202	29,395	29,395	27,808	24,967	31,465	27,536	24,994	32,621	31,830	38,765	224,924
Average	13,781	21,190	19,686	16,693	12,330	6,850	8,988	10,769	13,526	6,351	10,394	9,658	150,215
Minimum	-	6,347	4,800	4,800	4,697	1,685	115	-	-	-	4,077	-	74,056
Downstream Reservoir Contents													
Maximum	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Average	49,193	60,466	71,197	81,396	87,827	92,862	93,476	91,049	84,384	67,732	53,063	45,891	73,211
Minimum	3,966	4,885	10,956	20,199	26,252	36,628	33,381	28,664	13,736	4,711	4,291	4,062	21,037

Figure 4-4
Washakie Reservoir Fill and Release Rates



Scenario #2 – Additional Upstream Reservoir Scenario. Scenario #2 also assumes the construction of a 160,000 acre-foot off-stream storage reservoir at the Washakie site. Rather than assuming the construction of 100,000 acre-feet of additional downstream storage (as in Scenario #1), it assumes that the Bear River Project would construct an upstream reservoir of approximately 105,000 acre-feet The firm supply generated by the assumed reservoir would have an inflow and outflow capacity of approximately 250 cfs. Full evaluation of the possible impacts to water users and the environment of the assumed upstream storage would be required.

A potential upstream storage would store surplus flows in the winter and spring (non-irrigation season) and release water to meet Bear River Project demand when all of the water flowing down the Bear River was being allocated to prior water rights. The DWRe's current operations modeling of the upstream storage shows that the upstream reservoir yields an average of 67,000 acre-feet per year. The reservoir is drawn down in about 25 out of 41 years.

In this scenario, Washakie Reservoir is operated in the same manner as described under Scenario 1, although specific inflows and outflows would be different. Also, with an upstream reservoir, Bear River Project water supply for Cache County would not need to be developed as frequently by exchanging Washakie releases with BRCC water. The upstream reservoir would be operated to firm-up a portion of the supplies to all four Project water users.

Results from the current, most relevant BEARSIM model simulation of this scenario are summarized in Tables 4-4 and 4-5. There are slightly higher water supply shortages under this scenario, indicating that the volume of storage assumed in the upstream reservoir may be somewhat smaller than would actually be required for a firm yield of 220,000 acre-feet.

Table 4-4
Capacity Requirements from DWRe Modeling Scenario #2
(Additional Upstream Storage Scenario)

Project Element	Average Annual Flow (acre-ft/cfs)	Maximum Flow (cfs)	Maximum Annual Shortage (acre-ft)
Bear River Project total delivery	220,000 / 303	660	28,000
Diversion to Washakie Reservoir	116,000/160	400	N/A
Washakie Reservoir delivery to Bear River Pipeline	99,000 / 137	500	N/A
Diversion from Bear River to Bear River Pipeline	61,000 / 106	480	N/A
Total diversion from Bear River to Pipeline and Washakie Reservoir	220,000 / 303	650	N/A
Delivery to Cache County (from new diversion and by exchange with BRCC supply)	60,000 / 83	180	6,000
Delivery to BRWCD (from Bear River Pipeline Northern Segment or released from Washakie Reservoir)	60,000 / 83	180	6,000
Delivery to WBWCD (from Bear River Pipeline)	50,000 / 69	150	5,000
Delivery to JVWCD (from Bear River Pipeline)	50,000 / 69	150	5,000

Table 4-5
Simulation Results for Scenario #2
Washakie Plus 105,000 acre-feet Upstream On-stream Reservoir (all values in acre-feet)

Month	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Annual
Diversions to Cache County by Exchange from Washakie Releases													
Maximum	34	31	-	-	-	55	189	155	309	395	-	255	547
Average	1	1	-	-	-	4	14	19	43	49	-	6	136
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	-
Direct Diversions to Cache County from Bear River													
Maximum	5,400	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	60,000
Average	4,425	2,399	1,800	1,800	1,800	1,796	2,986	4,781	8,357	10,751	10,200	7,398	58,493
Minimum	-	2,369	1,800	1,800	1,800	1,745	2,811	4,645	8,091	10,405	10,200	2,973	51,465
Total Diversions to Cache County													
Maximum	5,400	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	60,000
Average	4,426	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,404	58,630
Minimum	-	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	2,973	51,465
Direct Diversion from Bear River to BRWCD													
Maximum	5,400	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	60,000
Average	2,848	2,370	1,798	1,797	1,799	1,576	2,626	3,242	4,451	2,031	6,461	2,563	33,563
Minimum	-	2,151	1,758	1,741	1,790	290	62	-	-	-	-	-	8,656
Release from Washakie to BRWCD													
Maximum	5,400	249	42	59	10	1,510	2,939	4,800	8,400	10,800	10,200	7,800	47,513
Average	2,205	30	2	3	1	224	374	1,558	3,949	8,769	3,739	5,037	25,891
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined Diversion to BRWCD													
Maximum	5,400	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	60,000
Average	5,053	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,600	59,454
Minimum	-	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	3,256	54,600
Direct Diversion from Bear River to WBWCD and JVWCD													
Maximum	9,000	4,000	3,000	3,000	3,000	3,000	5,000	8,000	14,000	18,000	17,000	13,000	100,000
Average	6,261	3,993	3,000	3,000	3,000	3,000	5,000	8,000	14,000	17,807	15,786	10,309	93,156
Minimum	-	3,704	3,000	3,000	3,000	3,000	5,000	8,000	14,000	13,567	-	-	56,567
Release from Washakie to WBWCD & JVWCD													
Maximum	9,000	296	-	-	-	-	-	-	-	4,433	16,482	13,000	30,537
Average	2,130	7	-	-	-	-	-	-	-	193	1,181	1,945	5,456
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined Diversion to WBWCD and JVWCD													
Maximum	9,000	4,000	3,000	3,000	3,000	3,000	5,000	8,000	14,000	18,000	17,000	13,000	100,000
Average	8,391	4,000	3,000	3,000	3,000	3,000	5,000	8,000	14,000	18,000	16,967	12,254	98,612
Minimum	-	4,000	3,000	3,000	3,000	3,000	5,000	8,000	14,000	18,000	16,152	-	86,152
Washakie Reservoir Contents													
Maximum	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Average	112,077	122,024	133,225	141,340	147,299	148,987	150,874	150,130	145,579	133,230	125,340	115,989	135,508
Minimum	23,874	30,896	45,934	58,123	73,289	83,677	93,430	87,375	77,458	63,441	32,588	24,347	64,038
Combined Diversion from Bear River to Collinston Diversion													
Maximum	34,152	30,202	29,395	29,395	27,808	20,589	29,187	37,395	37,731	32,621	37,275	28,481	266,254
Average	12,099	16,349	16,001	12,915	10,759	6,580	10,585	13,594	20,404	20,276	23,146	13,590	176,299
Minimum	-	6,400	4,800	4,800	4,800	3,397	5,062	8,000	14,000	13,567	5,100	-	132,695
Upstream Reservoir Contents													
Maximum	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000
Average	45,999	60,054	73,549	84,761	93,868	99,797	100,765	97,551	87,734	65,156	45,358	39,196	74,482
Minimum	4,800	14,573	30,721	46,726	59,235	68,251	63,106	49,997	27,098	4,979	4,896	4,844	33,467

Scenario #3 –New Upstream and Downstream Reservoir Scenario. Scenario #3 does not assume the construction of an off-stream storage reservoir at the Washakie site. Instead, it assumes that the Bear River Project would construct an upstream reservoir of approximately 85,000 acre-feet, and a downstream reservoir on the Bear River with a capacity of 117,000 acre-feet. The firm supply generated by the assumed reservoirs would result in a maximum supply shortage of about 12 percent. Full evaluation of the possible impacts to water users and the environment of the assumed upstream and downstream storage reservoirs would be required.

A potential upstream storage system would store surplus flows in the winter and spring (non-irrigation season) and release water to meet Bear River Project demand when all of the water flowing down the Bear River was being allocated to prior water rights. The DWRe's current operations modeling of the upstream storage shows that the upstream reservoir yields an average of 37,000 acre-feet per year, and the downstream reservoir yields an average of 74,000 acre-feet per year. The upstream reservoir is drawn down in about 5 out of 41 years, and has an average content of 73,000 acre-feet. The downstream reservoir is drawn down completely in 16 out of 41 years and has an average content of 73,000 acre-feet.

With an upstream reservoir Bear River Project water supply for Cache County would not need to be developed as frequently by exchanging with Bear River Canal Company water. Instead, the upstream reservoir would be operated to firm-up a portion of the supplies to all four project water users.

The downstream reservoir would be operated to firm up deliveries to the other three water agencies (BRWCD, JVWCD, and WBWCD). This scenario would likely require a different configuration of the Bear River Pipeline, perhaps with two separate pipelines, one leading to BRWCD, and one leading to the West Haven WTP site. The total of the two pipeline capacities would be 480 cfs, 180 cfs to BRWCD, and 300 cfs to JVWCD and WBWCD.

Results from the current, most relevant BEARSIM model simulation of this scenario are summarized in Tables 4-6 and 4-7. The slightly higher water supply shortages under this scenario (compared with Scenario #1), indicate that the volume of storage assumed in the upstream reservoir may be somewhat smaller than would actually be required for a firm yield of 220,000 acre-feet.

4.1.4 Hydrology and Water Availability Conclusions

The conclusion from the modeling runs completed for this project is that for the Project to deliver the full water supply of 220,000 acre-feet to the water users, storage must either be planned in addition to Washakie, or other water rights or supplies or with multiple reservoirs (not Washakie) must be acquired. Washakie alone cannot develop the full water supply needed for the Project and storage facilities.

A fourth scenario, using just Washakie Reservoir without additional storage was also investigated. This scenario did not meet the DWRe's reliability standard of delivering the planned water supply with no annual shortage greater than 10 percent or 15 percent of the average. The three previously described scenarios for developing 220,000 acre-feet per year of reliable water supply from the Bear River and the Washakie Only scenario are summarized in Table 4-8.

Table 4-6
Capacity Requirements from DWRe Modeling (BEARSIM)
Scenario #3
(New Upstream and Downstream Storage Scenario)

Project Element	Average Annual Flow (acre-ft/cfs)	Maximum Flow (cfs)	Maximum Annual Shortage (acre-ft)
Bear River Project total delivery	220,000 / 303	660	26,000
Diversion from Bear River to Bear River Pipeline	110,000 / 220	480	N/A
Delivery to Cache County (from new diversion and by exchange with BRCC supply)	60,000 / 83	180	6,000
Delivery to BRWCD (from Bear River Pipeline Northern Segment or released from downstream reservoir)	60,000 / 83	180	6,000
Delivery to WBWCD (from Bear River Pipeline)	50,000 / 69	150	5,000
Delivery to JVWCD (from Bear River Pipeline)	50,000 / 69	150	5,000

Table 4-7
Simulation Results for Scenario #3
New 85,000 acre-feet Upstream On-stream Reservoir plus New 117,000 acre-feet Downstream On-stream Reservoir (all values in acre-feet)

Month	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Annual
Diversions to Cache County by Exchange from Washakie Releases													
Maximum	5,400	672	61	58	62	1,510	2,900	4,800	8,400	10,800	10,200	7,800	59,945
Average	2,307	57	3	2	2	243	362	1,475	3,794	8,354	7,794	4,936	32,974
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	0
Direct Diversions to Cache County from Bear River													
Maximum	5,400	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	60,000
Average	2,779	2,341	1,796	1,797	1,798	1,545	2,617	3,314	4,537	2,332	2,332	2,565	26,106
Minimum	-	1,728	1,739	1,742	1,738	290	100	-	-	-	-	-	-
Total Diversions to Cache County													
Maximum	5,400	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	60,000
Average	5,086	2,398	1,799	1,799	1,799	1,788	2,979	4,790	8,331	10,686	10,126	7,500	59,081
Minimum	-	2,334	1,746	1,768	1,778	1,669	2,761	4,618	7,733	9,915	8,766	977	53,177
Direct Diversion from Bear River to BRWCD													
Maximum	5,400	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	60,000
Average	4,193	2,376	1,798	1,797	1,800	1,576	2,656	3,288	4,518	2,394	7,100	3,735	37,231
Minimum	-	2,151	1,758	1,741	1,793	290	62	-	-	-	5,100	178	21,635
Release from Downstream Reservoir to BRWCD													
Maximum	4,183	249	42	59	7	1,510	2,939	4,800	8,400	10,800	5,100	7,622	38,365
Average	906	24	2	3	0	224	344	1,512	3,882	8,406	3,100	3,799	22,201
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined Diversion to BRWCD													
Maximum	5,400	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,800	60,000
Average	5,098	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	7,534	59,432
Minimum	-	2,400	1,800	1,800	1,800	1,800	3,000	4,800	8,400	10,800	10,200	780	52,980
Direct Diversion from Bear River to WBWCD and JVWCD													
Maximum	9,000	4,000	3,000	3,000	3,000	3,000	5,000	8,000	14,000	18,000	17,000	13,000	99,958
Average	5,777	3,696	2,888	2,973	2,988	2,467	4,180	5,300	7,109	2,912	3,104	4,460	47,854
Minimum	-	2,349	1,340	2,658	2,727	122	-	-	-	-	-	-	23,153
Release from Downstream to WBWCD & JVWCD													
Maximum	9,000	1,651	1,660	342	273	2,878	5,000	8,000	14,000	18,000	17,000	13,000	76,847
Average	2,707	304	112	27	12	533	820	2,700	6,891	15,088	13,896	8,096	51,186
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	42
Combined Diversion to WBWCD and JVWCD													
Maximum	9,000	4,000	3,000	3,000	3,000	3,000	5,000	8,000	14,000	18,000	17,000	13,000	100,000
Average	8,484	4,000	3,000	3,000	3,000	3,000	5,000	8,000	14,000	18,000	17,000	12,556	99,040
Minimum	-	4,000	3,000	3,000	3,000	3,000	5,000	8,000	14,000	18,000	17,000	1,300	88,300
Upstream Reservoir Contents													
Maximum	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000
Average	55,404	65,375	73,357	79,266	82,596	84,481	84,563	83,387	79,702	71,469	63,104	57,440	73,345
Minimum	4,909	19,255	33,625	47,404	59,913	74,866	80,172	74,932	66,071	40,739	8,065	4,954	48,418
Combined Diversion from Bear River to Bear River Pipeline													
Maximum	14,400	6,400	4,800	4,800	4,800	4,800	8,000	12,800	22,400	28,800	27,200	20,800	160,000
Average	13,582	6,400	4,800	4,800	4,800	4,800	8,000	12,800	22,400	28,800	27,200	20,090	158,472
Minimum	-	6,400	4,800	4,800	4,800	4,800	8,000	12,800	22,400	28,800	27,200	2,080	141,280
Downstream Reservoir Contents													
Maximum	117,000	117,000	117,000	117,000	117,000	117,000	117,000	117,000	117,000	117,000	117,000	117,000	117,000
Average	50,287	66,185	83,031	97,771	107,497	111,861	111,869	108,212	97,836	72,287	54,140	44,824	83,817
Minimum	8,154	10,000	12,159	25,891	61,324	63,770	57,818	48,965	25,289	9,532	8,773	8,341	35,679

Table 4-8
Summary of Simulation Results for Bear River Water Development Scenarios
(all values in acre-feet)

#	Name	Storage 1	Storage 2	Average Annual Shortage	Maximum Annual Shortage
1	Washakie with Downstream (onstream)	160,000 (Washakie)	100,000 (near Beeton)	4,900	22,000
2	Washakie with Upstream (onstream)	160,000 (Washakie)	105,000 (near Oneida)	3,300	28,000
3	Without Washakie (two new onstream)	85,000 (near Oneida)	117,000 (near Beeton)	2,000	26,000
4	Just Washakie	160,000 (Washakie)		22,000	98,000

4.1.5 Water Quality

The quality of the water along the lower Bear River varies significantly by location and by flow. Of particular concern are high total dissolved solids (TDS) and hardness levels in the downstream reaches of the river, both of which tend to be higher during periods of low flow. These water quality differences may strongly influence the selection of a preferred diversion location (and thus the alignment for the Bear River Pipeline), as well as the water treatment processes required to use the water for M&I supply. Recognizing this fact, DWRe has been monitoring the Bear River for more than a decade. Five water-quality sampling locations are shown on Figure 4-1. Sampling schedule and protocols are generally summarized in Table 4-9.

Water Quality Monitoring Program and Results. Monitoring has generally focused on the acceptability and treatability of the lower Bear River as a drinking water supply, and the documentation of baseline conditions for environmental impact analysis and water conveyance and treatment facility planning. Within this focus, eight parameters have emerged as being of primary concern. These parameters are TDS, turbidity, hardness, iron, manganese, mercury, algae, Giardia and Cryptosporidium, and Trihalomethane Formation Potential (THMFP). Concerns and qualitative monitoring results are summarized in Table 4-10. This table also provides guidance concerning the possible choice of a diversion location.

One of the primary purposes of DWRe water quality monitoring has been to characterize the variation in Bear River water quality by potential diversion location. Based upon findings, this monitoring has evolved over time to focus on five primary monitoring sites that help distinguish four general diversion locations: Bear River upstream of Cache Valley, within Cutler Reservoir (both upstream and downstream of the Bear River), Bear River above the Malad River and Salt Creek, and the Bear River near Corinne. These general locations cover the range of potential Bear River Pipeline diversion locations[5].

[5] For the purposes of this study, water quality immediately downstream of Cutler Dam is assumed to be most like that of monitoring site 590099-Cutler Reservoir near Clay Slough.

Table 4-9
Typical Frequency and Protocol of Bear River Sampling

Bi-weekly Samples	Monthly Samples	Quarterly Samples
Chemistry Group – All Sites	Chemistry Group – All Sites	Chemistry Group – All Sites
Bacteriology Group – All Sites	Bacteriology Group – All Sites	Bacteriology Group – All Sites
	Total Organic Carbon – 4 Sites, Not 590100, 490272, 490146	Total Organic Carbon – 4 Sites, Not 590100, 490272, 490146
	Heterotrophic Plate Count – 4 Sites, Not 590100, 490272, 490146	Heterotrophic Plate Count – 4 Sites, Not 590100, 490272, 490146
		Algae Counts & Chlorophyll A – 4 Sites, Not 590100, 490272, 490146
	Metals (Silica and Selenium) – 4 Sites, Not 590100, 490272, 490146	Metals Group (Arsenic, Barium, Iron, Manganese, Fluoride, Strontium, Silica and Selenium) – 4 Sites, Not 590100, 490272, 490146
		THMFP and Bromide – Only 590099, 490145
		Giardia & Cryptosporidium – Only 590099, 490145

Table 4-10
Bear River Monitoring Parameters and Findings

Parameter of Concern	Basis of Concern	Findings and Conclusions
TDS (Total Dissolved Solids)	JVWCD & WBWCD have established target range of 250 mg/L to 375 mg/L Reducing TDS levels requires expensive treatment and disposal of solids and brine.	Average TDS below Malad confluence far exceeds District standards. TDS above Malad and within and below Cutler frequently exceeds District standards.
Turbidity	Turbidity interferes with disinfection and is regulated under the Surface Water Rule to <0.3 NTU for 95% of the time, with a maximum. instantaneous limit of 1 NTU. Turbidity is lowered in the treatment process, but highly turbid waters requires large filtration systems and disposal of a large volume of removed solids.	Median turbidity levels in the lower Bear River are around 40 NTU, regardless of sampling location.
Hardness	High hardness causes scale build-up on pipes and appliances, which ultimately causes reduction in pipe capacities and the permanent cementing of valves. Consumers will notice higher soap and detergent use, occasional water color, and long-term damage to water heaters and lawn irrigation equipment. Softening requires disposal of a large volume of solids.	Hardness levels are relatively constant across the potential diversion sites. High levels of calcium hardness will require softening. High hardness levels need to be reduced prior to TDS removal.
Iron	Iron is a secondary standard in the State of Utah and is regulated to 0.30 mg/L based on water color, staining of dishes and laundry, and taste considerations.	Iron levels from 0.4 to 2.0 mg/L are relatively constant across sites. Iron removal will be required in the treatment process prior to TDS removal.
Manganese	Manganese is regulated in the State of Utah to the secondary standard of 50 µg/L based on water color, staining of dishes and laundry, and taste considerations. Many studies have shown that effective, consistent removal of aesthetic issues requires treatment down to 30 µg/L.	Manganese levels from 8 to 150 µg/L are relatively constant across sites. Removal will be required in the treatment process prior to TDS removal.
Algae	Algae is a concern due to taste and odor, as well as exerting a strong negative influence on TDS removal, turbidity removal, and THMFP. Algae growth in storage reservoirs may be a problem.	Diversion location and monitoring results less important than reservoir storage. May require special treatment for taste and odor.
THMFP (Trihalomethane Formation Potential)	THMs are formed by the disinfection of various organic compounds, including algae, Consumption of high THM water increases the chronic risk of cancer, reproductive system problems, and liver/kidney/ nervous system problems. There are several regulated THMs, with the crucial often being the MCL for all THMs combined of 80 µg/L and the 5-haloacetic acids (HAA5) of 60 µg/L both on a long-term annual average.	Levels above Malad range from 130 to 500 µg/L for THMFP. No THMFP sampling below Malad and no HAA5 sampling was conducted above or below Malad.
Giardia and Cryptosporidium	Dangerous intestinal pathogens. Federal and state drinking water standards require that a minimum of 99.9% be filtered out during treatment.	Above the Malad, Giardia counts range from zero to 3. Crypto-sporidium counts range from zero to 0.3. No sampling below Malad.

TDS Variation across Potential Diversion Sites. With regard to water treatment cost and suitability as a water supply source, one of the driving parameters is TDS. TDS in the lower Bear River increases as the river flows from north to south. Some of the sources of this TDS loading are the numerous mineral springs throughout the watershed, and particularly along the river. The flow from these mineral springs tends to be fairly constant throughout the year. Most mineral spring inflows are quite small. However, as the flow of the Bear River from upstream drops during the summer, the impact of these inflows dramatically increases. Downstream of Honeyville, there are two main tributaries that have large impacts on the quality (and particularly the TDS) of the Bear River. These are the Malad River and Salt Creek.

Malad River Water Quality Concerns. The Malad River has a typical flow of around 20 cfs, and drains a watershed of about 4,000 square miles. As a result of mineral springs and agricultural return flows, it has high TDS levels. During the summer months, quite a bit of agricultural irrigation return water flows into the Malad. Table 4-11 summarizes Malad River TDS levels. Note that winter flows have a fairly constant 2,000 mg/L concentration along the reach from near Nucor Steel to the confluence with the Bear River. During the summer, and farther downstream, snowmelt flows and irrigation return flows from Bear River water dilute the more saline Malad River water from around 4,500 mg/L to just under 1,000 mg/L. In addition, due to the numerous communities with non-disinfected lagoon systems discharging into the Malad, very high E-coli counts (exceeding 10,000 per 100 mL) have been measured.

Table 4-11
Malad River TDS Variation by Location

Malad River Site ID-Description	February 6, 2006 TDS (mg/L)	August 21, 2006 TDS (mg/L)
490291 (by Nucor Steel)	1,904	4,472
490272 (East of Garland, UT)	2,024	2,976
490146 (South of Bear River City)	1,992	968

Salt Creek Water Quality Concerns. Salt Creek originates on the western flank of the Wellsville Mountains near the location of Crystal Hot Springs Resort. The effluent from this resort, and flow from numerous other springs in the immediate area combine to form a fairly constant flow into the Bear River of about 17 cfs. TDS levels are in the 25,000 to 35,000 mg/L range. This is similar to or higher than the salinity of seawater. When Salt Creek reaches the Bear River, it has a large impact on the TDS levels downstream, particularly during low flow periods. Combined with the nearby inflow from the Malad River, this increases TDS in the Bear River from the confluence point all the way to the Great Salt Lake.

Table 4-12 shows the combined effect of Malad River and Salt Creek on the Bear River near Corinne. During higher winter flow, the dissolved solids load is diluted, with the TDS level increasing about 150 to 250 mg/L. In August, the small flow in the Bear River is insufficient to dilute the high dissolved solids load, and TDS is increased by 500 to 1,500 mg/L, or more.

Table 4-12
Typical Effect of Malad River and Salt Creek Inflow on Lower Bear River TDS

Site ID and Description	February 6, 2006 TDS (mg/L)	August 21, 2006 TDS (mg/L)	Long-term Average (mg/L)
590100 (Cutler near Benson Marina)	302	310	325
590099 (Cutler near Clay Slough)	492	438	432
490145-Bear River above Malad	448	636	500
490142-Bear River near Corinne	544	2,184	905

Comparative Summary of Water Quality Concerns. The five general diversion locations (Bear River upstream of Cache Valley, Cutler Reservoir above the Bear, Collinston diversion site, I-15 diversion site, and near Corinne) show significant variation in TDS as well as other water quality parameters. Critical differences are highlighted in Table 4-13, which shows the average and maximum monitored level at the five primary sampling locations, for seven of the eight primary constituents of concern[6]. The following sections highlight the differences at the three potential Bear River Pipeline diversion locations. In considering water quality at the potential diversion sites, it is apparent that both the diversion location and the time of year when the diversions occur are critical.

<u>Within Cutler Reservoir or Downstream of Cutler Dam (Collinston diversion site).</u> Water quality immediately downstream of Cutler Dam would be most like that of sampling site 590099-Cutler Reservoir near Clay Slough. Average TDS level is 432 mg/L, with a maximum observed level of 582 mg/L. During the period of November through May, this diversion site would produce a supply with TDS in the 400-500 mg/L range. If this water was stored, released back into the Bear River, and re-diverted upstream of the Malad-Salt Creek inflows, this would add some TDS, but most likely less than 100 mg/L, producing a raw water with a TDS in the 500-600 mg/L range. Modeling would be required to produce numbers that are more accurate.

Turbidity at this location averages 32 NTU, with a maximum monitored level of 146 NTU. Hardness varies from the low 200s to nearly 400 mg/L. Reduction of 150 to 300 mg/L of hardness by the use of lime softening in the treatment process would leave water with a TDS concentration averaging below 300 mg/L.

<u>Above Malad River (I-15 diversion site).</u> Water diverted above the confluence of the Malad River would be very similar to water diverted just below Cutler Dam, although TDS, turbidity, and hardness would all be about 10 to 20 percent higher, with higher variability. During very low river flows, TDS may be twice as high as the average level. This observed variation may be reduced somewhat by dilution with water released from Washakie Reservoir. Iron and manganese concentrations appear to be significantly higher at the above the Malad location,

[6] Sampling for THMFP is insufficient to draw conclusions about the relative advantages of one diversion site versus another.

compared to the quality of the water monitored in Cutler Reservoir. This may be due to the higher suspended sediment load of flowing river water, compared to the more settled reservoir water. Giardia and cryptosporidium counts above the Malad also appear to be significantly higher than in Cutler Reservoir. Hardness levels are 30 percent or more above those observed within Cutler Reservoir, presumably due to contributions from agricultural return flow. Reduction of 200 to 400 mg/L of hardness by lime softening would produce water with an average TDS around 300 mg/L.

Near Corinne. Downstream of the Malad River, TDS levels are typically much higher than at the upstream locations. During low summer flows, Bear River water typically exceeds 2,500 mg/L. This water would require removal of about 90 percent of the dissolved solids to approach the WBWCD and JVWCD goals for drinking water. This can only be accomplished by reverse osmosis, or a similar desalination technique. Softening to remove hardness would be required prior to desalination to avoid membrane fouling. For water diverted at this location during the November to May period, only about 60% salt removal would be required to achieve a TDS near 300 mg/L. In this period, treatment by lime softening to remove 250 to 300 mg/L might be sufficient to meet JVWCD and WBWCD TDS goals. The levels of water quality parameters other than TDS appear similar to levels found at the site above the Malad or in Cutler Reservoir.

Table 4-13
Bear River Water Quality Difference by Diversion Location

Parameter of Concern	Potential Diversion Location	Average Level	Maximum Level	Critical Conditions
TDS (mg/L) State of Utah standard 500 mg/L, JVWCD/WBWCD standard 250 mg/L	Upstream Cache Valley	420	590	Area of Concern
	Cutler Reservoir	325	536	Area of Concern
	Collinston Diversion	432	582	Area of Concern
	Above Malad River	500	1,146	Area of Concern
	Near Corinne	905	3,600	High concern
Turbidity (NTU) Treated water standard <0.3 NTU, 95% of time	Upstream Cache Valley	8.2	61	Area of Concern
	Cutler Reservoir	35	172	Area of Concern
	Collinston Diversion	32	146	Area of Concern
	Above Malad River	38	210	Area of Concern
	Near Corinne	45	134	Area of Concern
Hardness (mg/L)	Upstream Cache Valley	304	381	Area of Concern
	Cutler Reservoir	253	391	Area of Concern
	Collinston Diversion	216	363	Area of Concern
	Above Malad River	280	659	Area of Concern
	Near Corinne	305	435	Area of Concern
Iron (mg/L) State of Utah standard 0.3 mg/L	Upstream Cache Valley	0.27	1.1	Possible Concern
	Cutler Reservoir	No data	No data	Possible Concern
	Collinston Diversion	0.60	1.2	Area of Concern
	Above Malad River	1.1	3.5	Area of Concern
	Near Corinne	1.0	2.3	Area of Concern
Manganese (μg/L) State of Utah standard 30 μg/L	Upstream Cache Valley	30	71	Area of Concern
	Cutler Reservoir	No data	No data	Area of Concern
	Collinston Diversion	50	86	Area of Concern
	Above Malad River	71	170	Area of Concern
	Near Corinne	66	66	Area of Concern
THMFP (μg/L, Chloroform) MCL 80 μg/L	Upstream Cache Valley	No data	No data	Possible Concern
	Cutler Reservoir	No data	No data	Possible Concern
	Collinston Diversion	200	380	Area of Concern
	Above Malad River	264	617	Area of Concern
	Near Corinne	No data	No data	Area of Concern
Giardia and Cryptosporidium (#/L) 99.9% filtration	Upstream Cache Valley	No data	No data	Possible Concern
	Cutler Reservoir	No data	No data	Possible Concern
	Collinston Diversion	0.11 / 0.24	0.4 / 0.6	Possible Concern
	Above Malad River	0.9 / 0.13	3.9 / 0.3	Possible Concern
	Near Corinne	No data	No data	Possible Concern

4.2 SUMMARY OF PROJECT ASSUMPTIONS

The Bear River Pipeline Concept Study uses the following assumptions in developing, estimating and refining potential pipeline diversion locations and alignments.

4.2.1 Study Area

The study area for the Bear River Pipeline Concept Study is as shown on Figure 3-1 (Volume II).

4.2.2 Points of Diversion, Termination, and Delivery

The Bear River Pipeline may withdraw or divert water from the Bear River below Cutler Dam, from the Bear River near Collinston, and/or from the Bear River near the I-15 crossing.

The Bear River Pipeline will terminate at the location of the proposed West Haven WTP. Other potential points of delivery from the Bear River Pipeline include the following:

- To BRCC Canals (Westside or Corinne Canals)
- To BRWCD (Northern) near Honeyville
- To BRWCD (Southern) near Willard

4.2.3 Pipeline Capacities and Diversion, Delivery, Pumping, and Other Facility Requirements

The Bear River Pipeline is shown schematically on Figure 4-1, including preliminary capacities for each reach. Figure 4-1 also shows potential diversion and turnout locations and estimated capacity requirements. The Collinston diversion would have a capacity of approximately 880 cfs to meet Washakie Reservoir fill requirements simultaneously with pipeline delivery requirements. The Bear River Pipeline below Washakie may carry up to 660 cfs for a portion of its length, to supply the maximum monthly delivery associated with 220,000 acre-feet of annual supply. This maximum capacity is only required for pipe segments that carry exchange water to allow upstream diversion of Cache County's supply, as well as each of the other participating agencies' water. It is assumed that exchange water is to be delivered into the Westside Canal where the Bear River Pipeline crosses it. Downstream of this exchange delivery point, the Bear River Pipeline may carry up to 480 cfs to supply the maximum monthly delivery associated with BRWCD, WBWCD, and JVWCD supplies. This capacity is only required for pipe segments upstream of BRWCD point(s) of delivery. Downstream of BRWCD point(s) of delivery, the Bear River Pipeline may carry up to 300 cfs for delivery to WBWCD and JVWCD.

4.2.4 Water Quality

The water users require a minimum water quality to allow for affordable treatment of the water for culinary purposes. For the alternative evaluation of diversion locations from the Bear River, locations below the confluence of the Bear River and Salt Creek/Malad River should not be considered due to the deteriorating water quality in the river below those confluences.

4.3 PREVIOUS WATER DEMAND STUDIES

4.3.1 JVWCD Water Demand Studies

The JVWCD *Demand, Supply and Major Conveyance Study* was completed in 2005 by BC&A. The study identified the need for Bear River Project water between 2030 and 2040, depending on progression of secondary water development in JVWCD service area. A subsequent report entitled *Salt Lake County Demand and Supply Study* looked at water demand and supply for Salt Lake County as a whole (BC&A, 2007). This study included additional county sources that may or may not be available to JVWCD and projected the Salt Lake County need for Bear River Project water to be around 2040 or later. For planning purposes, 2035 is assumed to be the year when Bear River Project water will be needed in JVWCD service area.

4.3.2 WBWCD Water Demand Studies

A WBWCD *Supply and Demand Study* was completed in November 2008 by BC&A. This study was updated in January 2010 by BC&A. These studies identified the need for additional water between 2035 and 2040 in WBWCD service area. The studies were based heavily on assumptions that existing agricultural water sources would be converted to M&I sources. Most existing agricultural sources are not owned by WBWCD and conversion to other uses is largely outside of WBWCD control. Due to the uncertainty associated with converting water sources, 2035 will be used for planning purposes as the year when Bear River Project water will be needed in WBWCD service area.

4.3.3 Box Elder County Water Demand Study

A *Box Elder County Ultimate Development Water Demand Study* was completed in June 2010 by BC&A and is included in Volume I Appendix of this report. This study provided estimates of the build-out water demands in Box Elder County, and within the BRWCD service area. The study estimated an ultimate water demand within BRWCD service area of 417,200 acre-ft/year. An estimated timeframe for the development and resulting water demand was not part of the study. A study is underway to estimate the timeframe when Bear River Project water will be needed in Box Elder County and BRWCD service area.

4.3.4 Cache County Water Demand Study

A *Cache County Ultimate Development Water Demand Study* was completed in July 2010 by BC&A and is included in Volume I Appendix of this report. This study provided an estimate of the build-out water demand in Cache County. The study estimated an ultimate water demand within Cache County of 423,000 acre-ft/year. An estimated timeframe for the development and resulting water demand was not part of the study. A study is underway to estimate the timeframe when Bear River Project water will be needed in Cache County.

4.3.5 Summary of Project Water Needs for Major Participants

Based on the JVWCD and WBWCD water demand studies, Project water is expected to be needed by 2035. BRWCD and Cache County have not yet completed their studies to the point of determining timing, but BRWCD, because of a lack of water supplies in Box Elder County will most likely require water from the Project before 2035.

5.0 AGENCY/STAKEHOLDER COORDINATION

5.1 BEAR RIVER PROJECT WORK GROUP

In developing assumptions and criteria for potential alignments of the Bear River Pipeline, input was solicited from a core group of project participants. The Bear River Project Work Group (Work Group) Participants included those entities that will receive water through the Bear River Development Act in the future:

- Bear River Water Conservancy District (BRWCD)
- Jordan Valley Water Conservancy District (JVWCD)
- Weber Basin Water Conservancy District (WBWCD)
- Cache County

5.2 POTENTIALLY AFFECTED PUBLIC AGENCIES

Input was also solicited from potentially affected public agencies that included the elected officials representing the cities/towns and counties that could be impacted by the alignment of the Bear River Pipeline:

- Cache County Commission
- Weber County Commission
- Box Elder County Commission
- Mayors and Public Works Directors
- See Volume I Appendix – Stakeholders and Affected Agencies Contact List, for a complete list of potentially affected public agencies and stakeholders.

Additionally, a general press release was issued at the beginning of the study (June 2009) to announce the project to the general public.

5.3 COORDINATION SUMMARY

Monthly progress meetings were held with the BC&A/HDR project team, DWRe staff, and the Bear River Work Group (Volume I Appendix Part 6 Stakeholder List and Meeting Notes). In addition, DWRe and the project team met with the Cache, Box Elder, and Weber County Boards of Supervisors, and with the mayors of potentially impacted communities in Box Elder County. Also, in May 2009 BRWCD sent out a separate letter to mayors, county commissioners, and other stakeholders in Box Elder County announcing the project.

The purpose of these initial communications and meetings with agencies and stakeholders was to provide advance notice concerning the study and to ask about their project concerns and their unique issues, specifically environmental and planned land uses within the study area. Participating in these meetings helped the project team gain an understanding of what issues and decision making criteria are most important to the potentially impacted communities. Table 5.1 lists these meetings and the general outcomes.

Table 5-1
Stakeholder Meetings

Date	City/Town/Agency	Participants	Outcome
May 26, 2009	Cache County Council	DWRe, Project Team,	Project announcement and exchange of information
May 26, 2009	BRWCD Board	DWRe, Project Team,	Second meeting held 05/26/10
July 16, 2009	Watershed	DWRe	Project announcement and exchange of information
Aug. 19, 2009	Mayors from Box Elder County	DWRe, Project Team,	Exchange of information
Aug. 25, 2009	Weber County Commissioners	DWRe, Project Team	Individual meetings
Sept. 24, 2009	Bear River Canal Company	DWRe, Project Team	Exchange of information
Sept. 24, 2009, Various meetings 2013-2013	Bear River Bird Refuge	DWRe, Project Team	Exchange of information
Various meetings2011-2013	Utah Department of Transportation	DWRe, Project Team	Discussion of rights of way, common interests
Various meetings 2102-2013	Utah Division of Wildlife Resources	DWRe, Project Team	Exchange of information
Oct. 5, 2009	Weber County Council	DWRe, Project Team,	Exchange of information

Once a recommended alignment is identified it will be essential to meet with potentially affected agencies and stakeholders to generate discussion about combining corridors with utilities, transportation facilities, and planned trails.

Moving forward the BC&A/HDR project team will work closely with the DWRe to create a Public Involvement Plan that will engage the public in a manner approved by the DWRe and coordinated with stakeholders and affected agencies. The draft Public Involvement Plan Document has been included in Volume I Appendix Part 4 of this report.

6.0 PIPELINE ROUTE SELECTION

6.1 INTRODUCTION

The use of a clear process to select an optimum pipeline alignment between two points is not new. A number of previous route selection studies have been conducted for large transmission pipelines similar to the Bear River Pipeline[1,2]. While there are some differences between the ways the studies are conducted, the same basic issues are always addressed. These issues include cost, availability of land, and public concerns and desires in the communities through which the pipelines are proposed.

This chapter describes the pipeline route selection process that was conducted to establish the recommended corridor for the Bear River Pipeline. A glossary of terms is provided below to define the specific terms that are used throughout the discussion of the route selection process

6.1.1 Glossary of Terms

GLOSSARY OF TERMS	
ACTUAL LENGTH	The physical length of a pipeline measured along the centerline of the pipe alignment.
ALIGNMENT	The actual pipeline location, or proposed centerline, as established by a survey[2].
CORRIDOR	A wide strip (in miles) of land that could accommodate a pipeline. A corridor runs the entire pipeline length from the beginning point to the termination point[2].
EQUIVALENT LENGTH	The theoretical length of a pipeline required to normalize length with respect to a given variable, such as cost. In this study, equivalent length is used to normalize cost of construction in differing site conditions. For example, if the cost of a pipeline in a congested ROW were 10 times the cost of a pipeline in an open field, then the equivalent length of the congested ROW would be 10 times the length of pipe in the open field.
FATAL FLAW	An alternative or concept that is eliminated from further consideration because of a fundamental problem or issue that violates the basic objectives of the project (i.e. it would be cost prohibitive to construct a 10-ft diameter pipeline within a 50 feet wide restricted right-of-way).

1 "A Versatile Route Selection Process", Phillip K. Ryan, CH2M Hill, presented at the 2001 ASCE Pipelines Conference.

2 "Pipeline Route Selection for Rural and Cross-Country Pipelines:, ASCE Manuals and Reports on Engineering Practice No. 46, 1998.

GLOSSARY OF TERMS (continued)

FAULT ZONE	A fault is a fracture of the earth's crust along which the opposite sides have been relatively displaced. A fault zone is a region that is adjacent to or immediately surrounding a known fault.
GIS	Acronym for Geographic Information System. GIS computer software technology is used to merge graphic information with a database. For this study, GIS was used to manage the large amount of mapping data associated with the pipeline route selection process (roads, wetland areas, surface conditions, etc).
LONG LIST	A list of top rated (by cost) alignment options identified for the project prior to the detailed engineering evaluation.
REACH	A major division of the pipeline that is based upon changes in diameter, flow rate, political boundary, or any other logical reason.
ROUTE	A narrow strip (in 100's of feet) of land that could accommodate a pipeline. A route is a specific pipeline section within a corridor length or a sub-set of a corridor[2].
SEGMENT	A section of pipeline with common physical features (i.e. within a road, crossing, open area, etc). Segments may be as short as a railroad crossing or as long as a stretch of pipeline along a canal. The final alignment will be made up of numerous segments.
SHORT LIST	A list of alignment options capable of meeting the primary objectives of the project, which have been narrowed down from a larger group of potential options.
STAKEHOLDER	Any entity that will be affected by the project. Stakeholders may include state agencies, cities, counties, general public, neighborhood associations, clubs, committees, etc. (See Chapter 5 for specific stakeholder information for this project.)
STUDY AREA	The established limits of the pipeline route selection process. The study area is defined by physical features of the project area.

6.1.2 Route Selection Process Summary

The construction of a large diameter transmission pipeline through developed, undeveloped, and environmentally sensitive areas will create many challenges. There will be many engineering obstacles, environmental issues, construction issues, and general public concerns related to the construction of a pipeline of this size and length. The fundamental objective of the route selection process was to provide a rational basis that could be used to establish the final alignment corridor. The process must be justifiable to all stakeholders that may be impacted by the proposed pipeline, both during construction and into the future of its operation.

A route selection process was established for the Bear River Pipeline based upon the following fundamental concepts:

1. A study area must be defined to encompass the entire region through which the pipeline may be located. No reasonable area should be eliminated based upon preconceived ideas.
2. All possible alignments for the pipeline must be considered before eliminating alignment options.
3. A justifiable method must be used to provide a basis for eliminating options from further consideration. This method must establish a logical process for moving from a large number of potential options to the final recommended corridor.

The route selection process was organized into three levels of analysis, starting with all possible options and narrowing them down to a recommended final pipeline corridor. Figure 6-1 (Volume II) illustrates the entire route selection process in the form of a flow chart. The three levels of analysis with their associated descriptions are summarized in Table 6-1.

Table 6-1
Pipeline Route Selection Process

Level	Description	Remarks
1	Pipeline Segment Analysis	Included the definition of a study area to contain all possible pipeline routes from the proposed Washakie Reservoir to the future West Haven Water Treatment Plant (including supply pipeline from the existing Cutler Reservoir to Washakie). All streets and corridors in the study area were considered as possible options. Each segment was evaluated based upon its estimated degree of construction difficulty. The result of this analysis was the establishment of the long list of pipeline corridor options. The least cost "long list" alignments were evaluated and adjusted to create a viable short list of alignment options. Other options were added to the short list to provide variability in the short list.
2	Short List Analysis	Included a conceptual level hydraulic analysis, real estate analysis, environmental evaluation for each option. A non-cost analysis of issues affecting project stakeholders was also performed. All the analyses were combined into a final ranking of the short list options. The result of this analysis was the selection of the highest overall ranked option as the recommended final alignment. Coordination with project stakeholders allowed input on the recommended final alignment selection.
3	Final Alignment Analysis (see Figure 6-1, in Volume II)	Included the conceptual level engineering evaluation and hydraulic sizing of the pipeline, real estate evaluation, environmental evaluation, and project cost estimation. Optional pipeline routes within the recommended final alignment corridor were developed to form a recommended final alignment corridor.

6.1.3 GIS as a Route Selection Tool

In general, GIS technology can be thought of as a way to attach information to graphics. A GIS figure may contain the same lines and symbols as a simple CAD drawing, but GIS allows data to be referenced to each graphical entity. This data is stored in a database, allowing the GIS user to sort and analyze this information in an infinite number of ways. GIS technology is ideally suited for a pipeline route selection study because of the extremely large amount of data that must be managed for a project of this size.

In GIS, each graphical feature is related to information contained in tables in a database. For example, a line representing a water pipe can have a table linked to it describing pipe size, material, and installation date. The collection of GIS data for the Bear River Pipeline route selection process involved a large amount of digital mapping of physical, political, and topological features. Examples of the type of data that was collected in GIS format include:

- Physical features such as roads, utilities, and canals.
- Political and demographic features such as city boundaries and land ownership parcels.
- Topologic or elevation data.
- Other data such as digital aerial photographs and seismic zones.

GIS was used as an engineering tool in this process by allowing the combination of various features in order to evaluate how one feature interacts with the others. For example, the GIS zoning map was utilized to assign estimated unit land costs to each pipeline segment that would require a right-of-way (ROW) acquisition.

Additional features of the GIS software were used to analyze of the entire network of possible segments and quickly determine the optimum route between two points based upon a combination of cost and length (equivalent length). After each of the alignment options were established, the GIS software was used to compare the length and associated costs of each route to allow a logical ranking of the options, and ultimately narrow the study down to one recommended final alignment.

6.1.4 GIS Data Collection

The GIS data used for the analysis of pipeline alignments and to create background layers for figures, were acquired from a variety of sources. The State of Utah, various counties and cities and private entities use GIS components to catalogue items that they own or maintain such as utility alignments or property boundaries. The GIS data used for this project that were supplied by these entities were obtained by downloading information from databases found on the internet or directly contacting the specific governing agencies. A general list of the types of data collected from various agencies is as follows:

- State of Utah – Municipality boundaries, roads and highways, rivers, canals, railroads, wetlands, historical sites, water body boundaries, fault lines, digital elevation models, aerial photography
- Box Elder and Weber Counties – Parcels, zoning and land use boundaries
- Tremonton, Brigham City – Water, sewer, power, gas and other utility alignments, and road ROWs
- Questar Gas, Rocky Mountain Power, Chevron Pipelines, and other private corporations – Major pipeline or transmission line alignments
- U.S. Fish and Wildlife Service – Bear River Migratory Bird Refuge boundary

A detailed list of GIS data acquired with information regarding source, data type, date obtained, description, and other notes can be found in the Appendix.

6.2 LEVEL I: PIPELINE SEGMENT COST ANALYSIS

The first level of the pipeline route selection process involved the establishment of a study area and the analysis of all reasonable pipeline segments within this area. The pipeline segment analysis included the following tasks:

1. Define the boundaries of the project study area.
2. Identify all reasonable pipeline segments within this area.
3. Rate the segments with respect to cost, difficulty of construction, utility congestion, wetland mitigation, and other factors that would impact a decision to locate the pipeline within each segment.
4. Develop a long list of pipeline route options from this network of segments.

The following sections describe each of the tasks involved in the first level of the pipeline route selection process, ending with the establishment of a long list of pipeline route options.

6.2.1 Project Study Area

The first task in the pipeline route selection process was to define a study area that would establish the geographic boundaries of the project. The study area was defined as follows:

South Boundary	West Haven Water Treatment Plant,
North Boundary	Proposed Washakie Reservoir Outlet,
East Boundary	East bench of the Wasatch Mountains,
West Boundary	Great Salt Lake or West Railroad/I-15 Corridor.

Figure 3-1 (Volume II) provides an illustration of the study area boundaries that were established for the project and the route selection process. Figures 6-2A and 6-2B (Volume II) provide a more detailed map of the study area boundaries. The study area covers about 324 square miles. The straight-line distance from Washakie Reservoir to West Haven WTP is 48 miles. Within Box Elder County the land is mostly undeveloped agricultural land, with the only major cities being Brigham City and Tremonton. The study area land in Weber County is more developed, but still mostly rural.

Significant physical features that exist within this area include:

1. **Wasatch Mountain Range** to the east of the study area. The west boundary of the mountain range is formed by the Wasatch Fault.
2. **Bear River Valley** extends from the outlet of Cutler Reservoir to the Bear River Migratory Bird Refuge, then into the Great Salt Lake.
3. **Malad River** flows from the north to the south into the Bear River just south of Bear River City.

4. **Salt Creek** is a minor drainage flowing from Crystal Springs near Honeyville into the Bear River, just south of Bear River City.
5. **West Side Canal** is a major canal originating from Cutler Reservoir and flowing east to west in the vicinity of Fielding, then south near Garland.
6. **Corinne Canal** is a distributary canal from the West Side Canal, flowing south towards Bear River City.
7. **Bear River Migratory Bird Refuge** is at the delta of the Bear River and the Great Salt Lake. Extends from I-15 just north of Willard Bay and west to the Great Salt Lake.
8. **Willard Bay** receives water from the Willard Canal in Weber County. The reservoir system is owned by the USBR and operated recreational facilities by WBWCD.
9. **Willard Canal** receives water from the Weber River at the Slaterville Diversion, near West Haven in Weber County. The canal system is operated by the USBR.
10. **Weber River** flows from east to west into the Great Salt Lake in Weber County.

The municipalities (with their approximate 2009 population) within the Box Elder County portion of the study area include:

1. Plymouth	330
2. Fielding City	440
3. Tremonton	6,200
4. Garland	1,980
5. Elwood	720
6. Deweyville	310
7. Honeyville City	1,270
8. Bear River City	800
9. Corinne City	650
10. Brigham City	17,150
11. Perry City	2,920
12. Willard City	1,650

The municipalities (with their approximate 2009 population) within the Weber County portion of the study area include:

1. Pleasant View	6,050
2. Plain City	4,160
3. Farr West City	4,260
4. Marriott-Slaterville City	1,420

5. Harrisville 4,780
6. North Ogden City 16,330
7. Ogden City 78,520
8. West Haven 5,240

The elevation gradient of the study area, illustrated in Figure 6-3 (Volume II) ranges from 5,000 feet near the east bench of the mountains down to 4,200 feet at the average water surface elevation (WSE) of the Great Salt Lake. The proposed high water surface (HWS) elevation of Washakie Reservoir is approximately 4,406 feet, while the approximate elevation of the West Haven WTP is 4,258 feet, a difference of 260 feet. The existing Cutler Reservoir HWS elevation is 4,407 feet, and has minimal fluctuations.

6.2.2 Identify Potential Pipeline Segments

Pipeline segments considered reasonable for the future Bear River Pipeline alignment were identified within the study area described above. In general, segments included all possible pipeline alignments, both public and private, that were free of significant development. Pipeline segments that were identified for the project included public streets, open public and private ROW, railroad corridors, canals, and future road corridors. The pipeline segments were identified and input into the GIS database. Figure 6-4 (Volume II) illustrates the entire GIS network of pipeline segments used in the cost analysis portion of the route selection process.

The segments were divided to reflect lengths of pipe with similar features to allow each of the segments to be rated properly. Segments were divided each time a change occurred in surface condition or pipeline construction method. For example, a jack and bore tunnel beneath a railroad was considered separate from the adjacent street segment to reflect the differing costs associated with each construction method. A total of 2,055 segments were created for the Bear River Pipeline route selection process. These pipeline segments included more than 840 miles of streets and open ROWs through the study area.

6.2.3 Field Investigation

A field investigation was conducted to collect additional information for each of the 2,055 segments. The objective of the field investigation was to identify the physical features that may influence decisions to locate the pipeline within each segment. Information gathered for each segment included the following:

1. **Street Rating and ROW Width:** A rating of the general surface type and size of street along the segment. Seven rating factors were established, including:
   a. Open Field or Farm Road
   b. Collector Street – 35 mph
   c. Arterial – Rural Area

   d. Arterial – Residential Zone
   e. Arterial – Commercial Zone.

2. **Utility Factor:** A subjective field rating of the general congestion of utilities that were observed within the segment. Three rating factors were established including:
   a. None
   b. Average
   c. Excessive.
3. **Special Conditions:** A rating factor to identify the segment as a type of crossing. The categories included:
   a. Embankment Crossing or Steep Slope
   b. Small Canal or Ditch Crossing Open Cut
   c. Large Canal Crossing Open Cut
   d. Large Canal Crossing Tunneled
   e. River Crossing Open Cut
   f. River Crossing Tunneled
   g. Railroad or Freeway Crossing Tunneled
   h. Above Ground Buried Pipe
   i. Other.
4. **Photo Documentation:** A photo was taken of each of the pipeline segments for reference and documentation of existing conditions.

Additional information documented for each segment included general observations, potential public and private disruptions, high ground water, and environmentally sensitive areas. The collection of field data was aided by GIS coverages of physical features, parcel data, and recent aerial photographs. The field investigation work covered most corridors in the study area, as illustrated in Figure 6-5 (Volume II).

6.2.4 Identify Fatal Flaws

Fatal flaws were identified to eliminate segments that were located in areas determined to be unacceptable for the Bear River Pipeline alignment. The project team identified fatal flaws following review of the physical features of the study area. A summary of the fatal flaws that were established for the project is provided below:

Narrow ROW. It is estimated that the Bear River Pipeline size will be between 8 feet and 11 feet in diameter. A pipeline of this size requires special construction methods and large equipment that requires adequate ROW space for construction activities. Figure 6-6 (Volume II) includes a drawing of the conceptual pipeline cross section for an 11 feet diameter steel pipeline under average open terrain construction conditions. The width required for standard large diameter pipeline construction was determined to be 100 feet. It is possible to construct a large diameter pipeline within a smaller width, but it significantly affects the pipeline construction methods, type of equipment used, length of time to construct, and cost.

It is understood that the Bear River Pipeline could encounter less than ideal construction width conditions, conditions within which it would be impossible to construct a pipeline without tunneling. Based on field experience and input from pipeline experts, the minimum ROW width for large diameter pipeline construction was determined to be no less than 60 feet. Figures 6-7 and 6-8 (Volume II) include concept drawings of the 70-feet and 60-feet wide ROW pipeline construction cross sections, respectively. It was also determined that ROW widths equal to or less than 60 feet could be constructed by tunneling, but segments longer than a few hundred feet become cost prohibitive.

The segments that were eliminated for narrow ROW were those less than 60 feet (physically limited by existing development) and longer than a few hundred feet. Shorter narrow segments were kept, but assigned a tunneling cost factor.

Wasatch Fault. Multiple crossings of the Wasatch Fault Zone were established as a fatal flaw. All segments that had multiple crossings of the fault or that were east of the fault were eliminated from further consideration.

Figure 6-9 A & B (Volume II) identifies the segments, shown in yellow and red, which were eliminated from further evaluation because of either of the two fatal flaws listed above.

6.2.5 Develop Range of Construction Cost Factors

Cost information was used for comparison purposes rather than for budgetary numbers in this first level of the route selection process. The objective of this analysis was to provide a method to rank various pipeline routes relative to cost. A more detailed cost estimate for the Bear River Pipeline was completed later in the conceptual design.

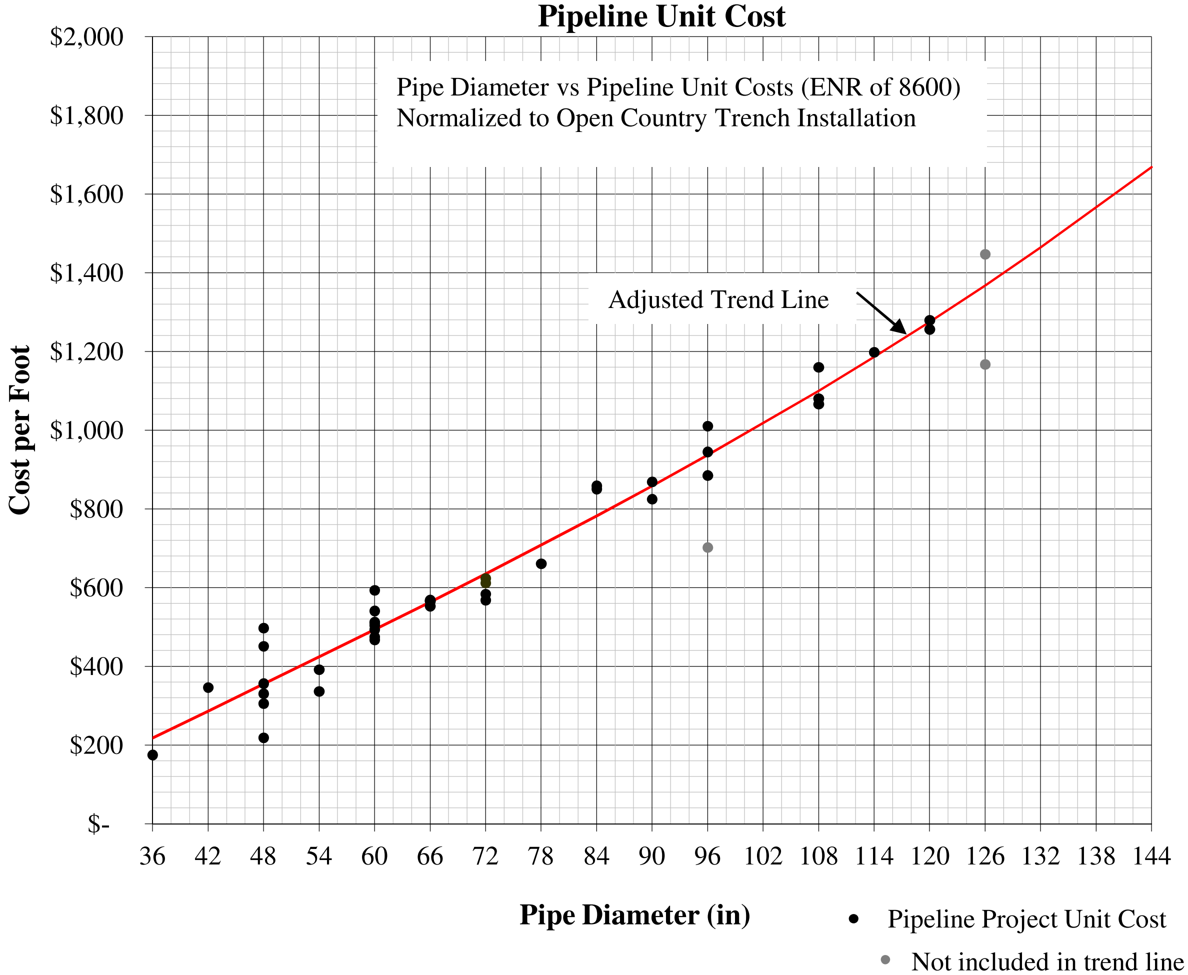
Average Pipeline Cost. Cost factors were developed for the various pipeline installation conditions that were observed during the field investigation. The cost factors were based upon an average pipe installation condition which established the factor of 1.0. The unit cost associated with this average condition was estimated using recent bid tabulations from large diameter pipeline projects, verified with detailed construction cost estimates.

Figure 6-6 (Volume II) shows the typical trench section which illustrates the average pipeline construction assumptions for this project, with the following additional surface and subsurface condition assumptions:

1. 132-inch (11-ft) pipe size, material, trenching, and construction conditions as shown.
2. No underground utilities.
3. No groundwater conditions.
4. No hard surface restoration.
5. No easement or ROW acquisition required.

Figure 6-10 provides a graphical summary of large steel pipeline costs normalized for the average pipeline installation condition, as described above. A technical memorandum was developed to summarize the details of how the average pipeline cost was estimated from past projects, for various large pipe diameters (included in the Appendix as Pipeline Cost Technical Memorandum). Figure 6-10 was developed as part of the technical memorandum on cost.

Figure 6-10
Pipeline Unit Cost



Construction Cost Factors. The construction cost factors were developed based on large diameter pipeline projects and the development of detailed engineer's cost estimates for various pipeline installation and construction conditions. Table 6-2 provides a summary of the construction cost factors utilized in the cost analysis.

Table 6-2
Summary of Anticipated Construction Conditions and Associated Cost Factors

Urban Rating	
Open field or farm road	1.00
Collector Street	1.07
Arterial - Rural Zone	1.08
Arterial - Residential Zone	1.10
Arterial - Commercial Zone	1.20
Utility Factors	
No utilities	0.00
Average to above average utilities	0.15
Excessive utilities	0.30
Narrow ROW Factor	
100' or greater	1.00
Between 70' and 100'	1.16
Between 60' and 70'	1.30
Groundwater Condition	
No groundwater	1.00
Stagnant groundwater in clays	1.20
Flowing groundwater	1.80
Steepness Factor	
Grades less than 25%	1.00
Grades 25% or more	1.40
Special Conditions	
No special conditions	1.00
Ditch crossing (Crossing, plus 50 feet)	1.10
Above ground buried pipe (West of Willard Bay)	1.75
Small canal crossing (Crossing, plus 50 feet)	1.30
Large canal - Open cut (Crossing, plus 100 feet)	1.80
River crossing - Open cut (Crossing, plus 100 feet)	2.00
Large canal - Tunneled (Crossing, plus 100 feet)	2.80
River crossing - Tunneled (Crossing, plus 100 feet)	2.90
Freeway crossing - Tunneled (ROW lines, plus 100 feet)	3.00
Railroad crossing - Tunneled (ROW lines, plus 100 feet)	3.00

In addition to construction costs, other associated costs were applied to the pipeline segments. These included wetland mitigation costs and land acquisition costs.

Wetland Mitigation Cost Factor. The wetland mitigation cost was applied to the pipeline segments that were passing through undeveloped wetlands, as identified by the statewide wetlands polygon GIS coverage, recently updated by HDR. An assumed cost of wetland mitigation of $70,000 per acre ($1.61 per square foot) was established for this analysis, based on recent experience from the HDR Environmental Group. The cost was converted to actual cost based on segment length and available ROW area to be disturbed through the wetland area. The wetland mitigation cost for the pipeline segment was added into the total cost factor.

Land Acquisition Cost Factor. The land acquisition cost was estimated by using general land costs, developed by the HDR Real Estate Group, based on county land use maps. The estimated land costs were first developed by selecting all parcels contained within each of the major zoning categories and taking the market value and dividing it by the area. The 10 percent high and low outliers were removed for each category and a 50 percent cost contingency was added to develop the average cost per square foot (SQFT) by zoning category. Table 6-3 provides a summary of the zoning categories and their estimated land costs per SQFT. The land acquisition cost was included in each pipeline segment based on the calculated area required for ROW acquisition. The land acquisition cost for the pipeline segment was added into the total cost factor.

Table 6-3
Land Acquisition Cost Assumptions

Zoning Category (Land Use)	Total $/SQFT
Commercial, Industrial, or Manufacturing	4.25
Forest or Open Space	0.02
Multiple Use	0.05
Residential	7.44
Rural or Residential Agricultural	2.33
Unrestricted	0.72

Total Cost Factor. These cost factors were used in the GIS model to assign equivalent lengths to each of the pipeline segments. The equivalent length is a cost-weighted length of pipe normalized to the average installation condition. For example, 100 feet of pipe tunneled under the railroad (difficult conditions = cost factor of 3.00) may be equivalent in cost to 300 feet of pipe installed in average, open terrain conditions (cost factor of 1.00). Equivalent lengths were used to classify each segment according to cost of installation. The combination of segments between two points that generate the shortest equivalent length was considered the least cost alternative for the pipeline route.

The total cost factor for each segment was calculated by combining each of the categories in Table 6-2. Factors were either added or multiplied together depending upon their relationship to the total cost of the installed pipe. The utility congestion and urban rating factors were developed as additive factors to create an adjusted urban rating that reflected the general pipeline construction costs. The ROW width, crossings, and groundwater factors were all developed as percentage increases to the general pipeline construction costs.

Formula 6-1 was used to calculate the total cost factor for each segment.

Formula 6-1
Calculation of Total Cost Factors

	Urban Rating			
+	*Utility Rating*			
=	*Adjusted Urban Rating*	>>		*Adjusted Urban Rating*
			x	*Groundwater Condition Factor*
			x	*Narrow ROW Factor*
			x	*Special Conditions Factor*
			x	*Steepness Factor*
			=	***Construction Cost Factor***
			+	*Land Acquisition Cost*
			+	*Wetlands Mitigation Cost*
			=	***TOTAL COST FACTOR***

An equivalent length for each segment was calculated by multiplying the Total Cost Factor by the actual length of the segment. Figures 6-11A through 6-11D (Volume II) graphically summarizes the range of Total Cost Factors calculated for each of the pipeline route segments in the study area.

6.2.6 Perform Cost Analysis

Pipeline corridor options were developed following the assignment of equivalent lengths and elimination of fatal flaw segments from the study area. The challenge of creating various options from the limitless number of segment combinations required a logical process. It was understood that the list of options were required to represent all reasonable corridors available for the Bear River Pipeline within the study area. To accomplish this, the study area was divided into six separate regions. These regions are illustrated in Figure 6-12 (Volume II), and are summarized below from north to south:

1. Fielding Region – From the proposed Washakie Reservoir site to the vicinity of Fielding, generally representing the location of the northern diversion off the Bear River downstream of Cutler Dam.
2. Honeyville Region – From Fielding Region south, encompassing Tremonton and Elwood down to Honeyville.
3. Corinne Region – From Honeyville Region south, encompassing Bear River City down to Corinne and the north boundary of Brigham City.
4. Willard Bay Region - From Corinne Region south, encompassing Brigham City, Perry, and Willard and part of Willard Bay.
5. Plain City Region - From Willard Bay Region south, encompassing south of Willard Bay to Harrisville, Pleasant View, Farr West, and Plain City.
6. West Haven Region – From Plain City Region south, encompassing Marriott-Slaterville, west side of Ogden, and into West Haven to the proposed Water Treatment Plant.

Develop Routing Points. To have a variety of potential pipeline alignment options in all regions of the study area, routing points were developed. The routing points were located at major north/south pipeline routes passing between region boundaries. The locations of the routing points are illustrated in Figure 6-12 (Volume II).

The routing points between each region were connected with straight lines to establish the combinations of alignment corridors that were available for the pipeline. A total of 89 combinations were identified. These combinations are illustrated graphically in Figure 6-12 (Volume II). Combinations that deviated significantly from a logical north to south path between the West Haven WTP site and Washakie Reservoir site were not considered (zigzag pattern or long runs of east/west direction). The routing points allowed the evaluation of each of the shorter pipeline reaches between points rather than an evaluation of the full-length pipeline corridor.

Cost Analysis. The first portion of the route selection process schematically identified the combinations of pipeline corridors that were possible. These combinations were defined by straight-line connections between the routing points. The next step of the cost analysis required that these straight-line combinations be converted into actual pipeline alignments. These alignments were developed using a network analysis software package in the GIS system.

The network analysis software was used to identify the least cost path between each of the routing points based on the sum of the equivalent lengths from each individual pipeline segment. The least cost corridors between each of the routing points were then joined together in all reasonable combinations to create a list of 1,139 complete pipeline alignment options from Washakie Reservoir site to the West Haven WTP site.

Long List of Pipeline Alignment Options. The complete list was ranked based on cost (equivalent length) and a list of the top 15 pipeline alignments (long list) was developed for evaluation. It should be noted that no engineering analysis of the alignments had been considered to this point. Detailed figures illustrating the long list of alternatives are included in the Appendix (Volume II).

Many of the long list alignment options followed similar paths for a majority of the distance with only minor variations from the highest ranked option. The top 15 alignments from the cost analysis are illustrated in Figure 6-13 (Volume II) as a function of alignment variability represented in percentage. The higher percentage routes represent routes that more options followed – representing a highly preferred route in terms of cost.

Figure 6-14 illustrates the equivalent and actual lengths of each of the long list alignment options. Table 6-4 provides a summary of the top 15 least cost alignment options.

Figure 6-14: Long List of Pipeline Alignment Options

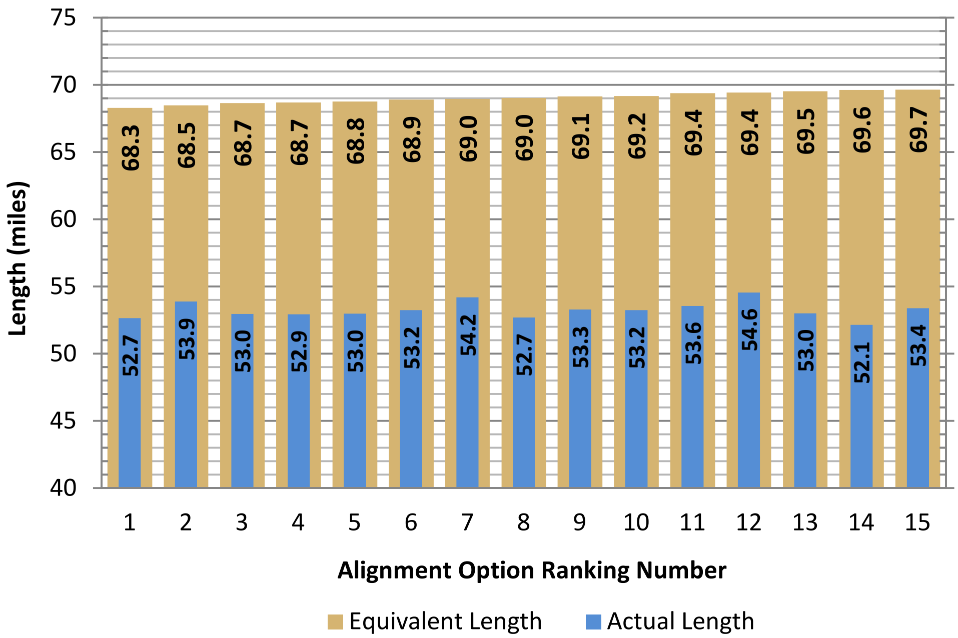


Table 6-4
Top 15 Least Cost Alignment Options

Option Rank	Actual Length (miles)	Equivalent Length (miles)	% Greater than Shortest Equivalent Length
1	52.7	68.3	0.0%
2	53.9	68.5	0.3%
3	53.0	68.7	0.5%
4	52.9	68.7	0.6%
5	53.0	68.8	0.7%
6	53.2	68.9	0.9%
7	54.2	69.0	1.0%
8	52.7	69.0	1.1%
9	53.3	69.1	1.2%
10	53.2	69.2	1.3%
11	53.6	69.4	1.6%
12	54.6	69.4	1.7%
13	53.0	69.5	1.8%
14	52.1	69.6	1.9%
15	53.4	69.7	2.0%

Differences in equivalent length do not vary significantly in the top 15 alignment options, representing a 2 percent increase from the highest ranked option to the option ranked fifteenth.

Only for comparison purposes, the estimated cost of one mile of 11-feet diameter pipeline could range from $8 million to $11 million ($1,500 to $2,100 per foot), depending heavily on installation conditions. This would put the entire pipeline cost difference between the highest ranked option and the option ranked fifteenth between $11 million and $15 million.

6.2.7 Develop Short List

An evaluation was performed on the ranked long list of pipeline options. The goal of the evaluation was to develop a short list of approximately six alignments that would satisfy the objectives of the project. The evaluation included only a general review of pipeline cost (equivalent length rating), compatibility with overall project objectives, and engineering related issues, all of which would be further refined during the short list evaluation portion of this study.

Significant points that were considered in developing the short list of pipeline alignment options are summarized below:

- The evaluation of the long list showed that many of the minor variations in the alignment options could be considered to be within the pipeline corridor space of a few base options and did not represent adequate variability to justify an additional option.
- Major options that were considered to provide alignment variability included options ranked number 1, 2, and 6.
- These three options, however, only provide variability north of Corinne. To the south all alignment options follow generally the same corridor along I-15, Highway 89, and 1900 West Street to the proposed West Haven WTP. None of these three options provided an optional alignment on the east side of the study area north of Brigham City. In order to provide additional options to those listed above, three additional options were added. These options are summarized below:
    1. **Collinston Diversion Option.** An option was developed to represent an alignment that passes through the area where an initial diversion from the Bear River is anticipated to be located. Initially this option was located just downstream of Cutler Dam, but was then relocated to the Collinston Diversion further downstream in a more feasible location for a diversion and pumping station along the river.
    2. **West of Willard Bay Option.** An option was developed that represented an alignment passing along the west side of Willard Bay. This option provides an alternative alignment to the alignment east of Willard Bay and along 1900 West into West Haven.
    3. **I-15 and Bear River Diversion Option.** An option was developed to allow for a potential phasing approach to the project construction. This option utilizes the Bear River for flow conveyance from the Collinston Diversion to a potential river diversion, pump station, and conveyance pipeline located near the I-15 crossing of the Bear River to deliver water to the south.

Recommended Short List Alignment Options. Based on the evaluation of the long list of alignment options, a short list of six options was developed as follows:

1. **Option No. 1 –** Shortest length and lowest pipeline cost. Follows Highway 13 a majority of alignment in the north. This alignment option is illustrated in Figure 6-15 (Volume II).
2. **Option No. 2 –** Longer length but second lowest pipeline cost. Follows West Side Canal north of Tremonton. This alignment option is illustrated in Figure 6-16 (Volume II)..
3. **Option No. 6 –** Provides variability to the other Highway 13 or West Side Canal options. Follows Union Pacific Railroad (UPRR) north of Corinne on the west side of the study area. This alignment option is illustrated in Figure 6-17 (Volume II)..
4. **I-15/Bear River Diversion Option –** Provides an alignment option that follows the I-15 corridor. This alignment option is illustrated in Figure 6-18 (Volume II).. This option would be the highest ranked option in the overall long list ranking since it has about 10 miles less pipe.
5. **Collinston Diversion Option –** Provides an option on the east side of the study area. Follows open space, the UPRR, and the West Branch Canal for a majority of the alignment and passes directly through the Collinston Diversion location on the Bear River. This alignment option is illustrated in Figure 6-19 (Volume II).. This option is ranked number 47^{th} in the overall long list ranking by equivalent length.
6. **West of Willard Bay Option –** Provides a more costly alignment option to the west of Willard Bay, passing through the Bear River Migratory Bird Refuge south of Corinne. This alignment option is illustrated in Figure 6-20 (Volume II).. This option is ranked number 957^{th} in the overall long list ranking by equivalent length.

The draft short list of alignment options was presented to the Bear River Project Work Group for review. Based on the discussions they felt that the short list adequately represented a good variety of alignment candidates for the Bear River Pipeline. All of the six options appear to meet the basic project objectives of delivering water from Washakie Reservoir to West Haven Water Treatment Plant.

The remaining un-selected options in the long-list were each reserved in case flaws were discovered with any of the six short-listed options following the further analysis. The following section summarizes the detailed evaluations of the short list alignment options.

6.3 SHORT LIST ANALYSIS

The purpose of the Short List Analysis was to evaluate each of the alignment options with respect to hydraulic performance, overall cost, non-cost issues, and general compatibility with the requirements of the project. The Short List Analysis involved the following tasks:

1. Perform a hydraulic and engineering cost analysis on each of the options.
2. Evaluate the options according to land acquisition issues.

3. Evaluate the options according to environmental issues.
4. Evaluate the options according to general non-cost issues.
5. Present a recommended final alignment corridor for the Bear River Pipeline.

Figures 6-15 through 6-20 (Volume II), illustrate each of the short list alignment options for the Bear River Pipeline. The short list options in these figures were divided up into “Sections” where general common surface features existed, such as the I-15 corridor versus the railroad corridor or highway ROW. These pipeline “Sections” will be referred to and used throughout the following short list analyses. Figure 6-21 (Volume II) shows all of the short list alignments combined in one map for reference and comparison.

6.3.1 Hydraulic and Engineering Cost Analysis

A general hydraulic analysis was performed for each of the six short list alignments. The purpose for the hydraulic analysis was to identify the hydraulic differences between the short list options, and to identify any potentially negative hydraulic aspects of each of the alignments. The hydraulic analysis was also used to develop preliminary pipe sizes, pipe pressure classes, and pumping station sizes for the pipeline. This data was used to rank each of the options relative to pipeline and pumping facilities capital cost.

NOTE: The hydraulic layouts represented in the short list analysis portion of the study are presented only for comparison purposes and do not represent final hydraulic layout of the final Bear River Pipeline Project.

At this stage in the study, the project was divided into general hydraulic reaches defined by the peak flow rate to be conveyed by the reach pipeline as illustrated in Figure 6-22 and tabulated in Table 6-5. The reaches were defined by the assumed delivery points along the pipeline. The locations of the delivery points along the pipeline have been assumed at this point in the study and are for comparison purposes only.

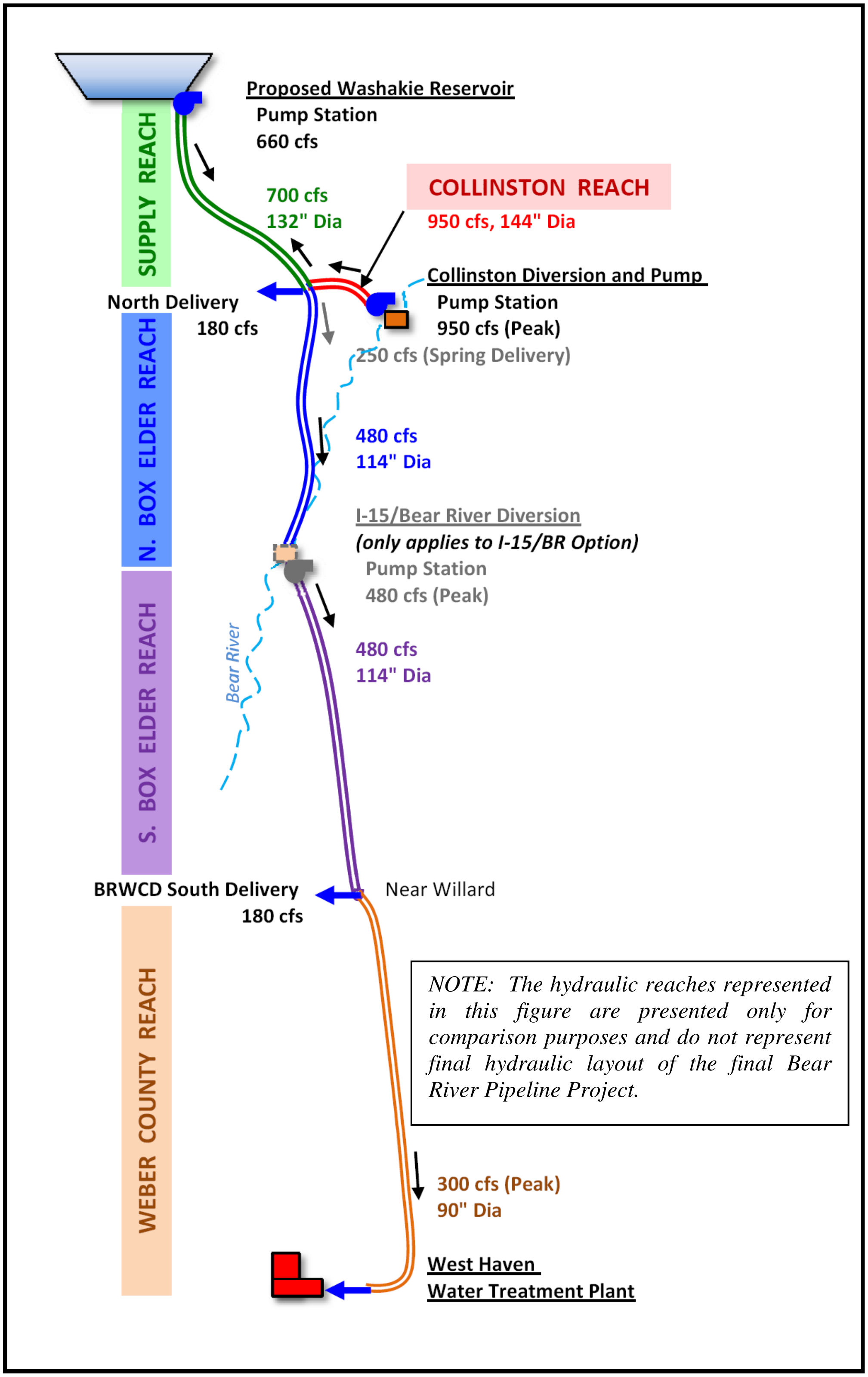
Figure 6-22 provides a schematic summary of the hydraulic reaches, including project delivery locations, pump stations, and conveyance pipelines with their associated peak flow rates and diameters.

Table 6-5
Hydraulic Reach Descriptions

Hydraulic Reach	Reach Description *	Peak Flow & Direction (cfs)	Diameter (inches)
Supply Reach	• Supply pipeline to Washakie Reservoir (north flow) • Delivery pipeline back to the Main Pipeline (south flow)	700 (north) 660 (south)	132
Collinston Reach	Supply pipeline from Collinston Diversion to the Main Pipeline (north flow) (south flow for I-15/Bear River Option)	950 (north) 660 (south)	144
North Box Elder Reach	Delivery pipeline from Collinston Reach to I-15/Bear River Diversion	480 (south)	114
South Box Elder Reach	Delivery from I-15/Bear River Diversion to south boundary of Box Elder County	480 (south)	114
Weber County Reach	From north Weber County boundary to the West Haven Water Treatment Plant	300 (south)	90

* NOTE: The hydraulic reaches represented in this table are presented only for comparison purposes and do not represent final hydraulic layout of the final Bear River Pipeline Project.

Figure 6-22
Assumed Hydraulic Reach Schematic for the Short List Analysis



It should be noted that the hydraulic assumptions, pump station locations, pipeline diameters, pump station sizes, reservoir/diversion elevations, and delivery points listed in the hydraulic profiles were developed for preliminary comparison purposes at this level of the analysis. They do not reflect any final recommendations and will be revised during the final analysis portion of this report.

Hydraulic profiles were developed to evaluate the hydraulic characteristics of each of the short list options. These profiles are illustrated in Figures 6-23 to 6-28 (Volume II). The profiles include the supply and delivery operational scenario flow rates, calculated pipeline sizes for each hydraulic reach, calculated pump sizes, hydraulic grade lines, and ground surface profiles with major surface features and assumed delivery points.

Based on initial hydraulic evaluations, minor modifications were made to following alignment options:

- **Option No. 6** was slightly modified to avoid a high elevation just downstream of Washakie before the Malad River crossing. A slight shift of the alignment to the west was able to avoid an elevation spike at I-15 and the resulting larger than necessary pumping horsepower.
- **Collinston Option – Diversion Location.** The initial alignment passed near Cutler Dam and was routed from there north and into high elevation areas on the northeast side of the study area. These high elevation areas would cause unnecessarily high pumping costs so the assumed diversion location for this option was located near Collinston on the Bear River. The combination of these changes made the revised Collinston Option much more feasible and cost effective.
- **Collinston Option – Alignment Modification.** The initial Collinston Option alignment passed through Brigham City downtown area along US Highway 89, rising to a peak alignment elevation through this area. This portion of the alignment would cause significant disruption of a narrow historical district. There were also concerns that this portion of the option could face significant difficulty, if not an overall option elimination from further consideration. In order to avoid these challenges and the high elevation stretch, the alignment was modified to pass along the I-15 corridor west of Brigham City. The minor pipeline cost increase of the change was more than offset by the reduced pumping costs, so the Work Group agreed to adjust the alignment through this stretch, while keeping the original alignment as an alternative. This change made the revised Collinston Option much more favorable for further evaluation.

The pump stations included the pumps at the Collinston Diversion to supply water from the Bear River to Washakie Reservoir, and at Washakie Reservoir to pump water into the Bear River Pipeline to the anticipated delivery points. The I-15/Bear River Option included an additional pump station at the I-15/Bear River Diversion, pumping to delivery points to the south.

Each option was evaluated for pipe and pumping size requirements. The supply reach pipeline/pumping from the Bear River was added to each option's total pipeline and pumping costs. Table 6-6 summarizes the total equivalent (cost-based) length of each hydraulic reach of the alignment and also includes the actual lengths for comparison. Table 6-7 summarizes the pump size requirements for the options, based on the hydraulic flow assumptions and pipe sizing. Figure 6-29 provides a graphical summary of the pipeline and pumping totals for each option.

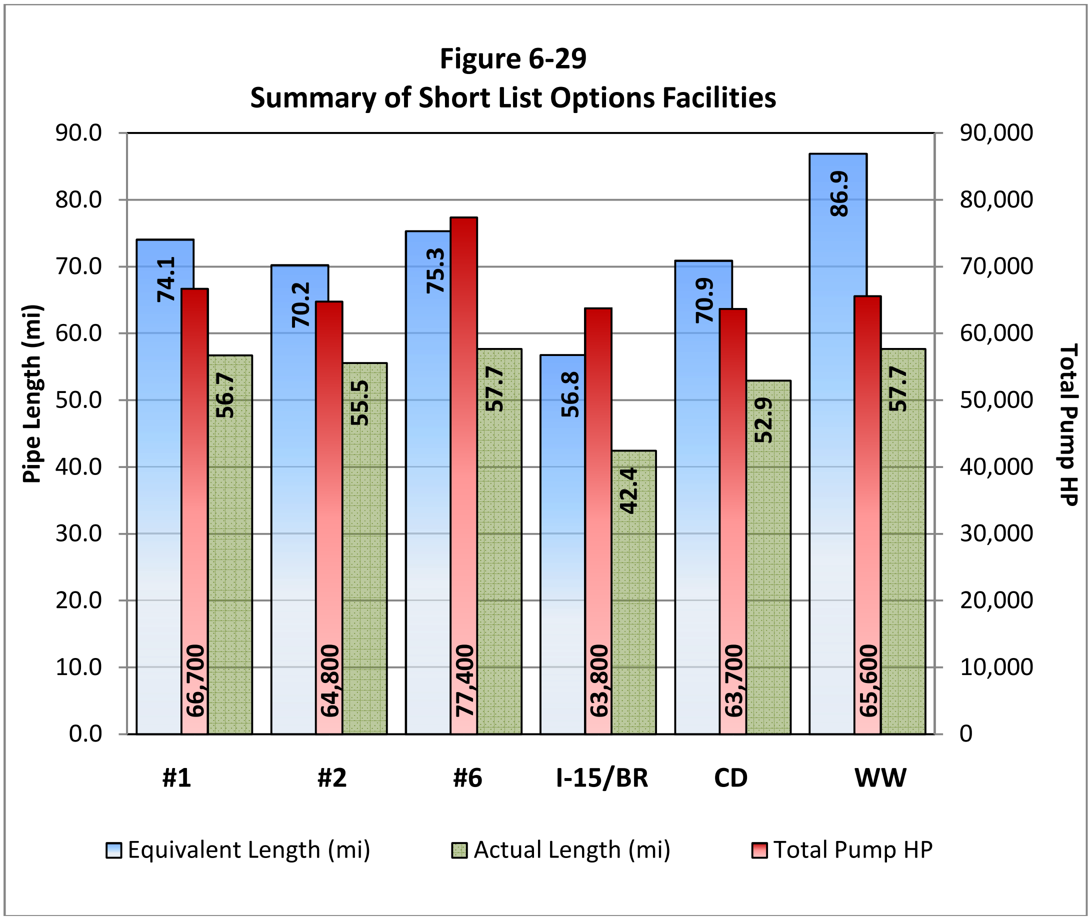
Table 6-6
Summary of Pipeline Lengths for the Short List Alignment Option
(Ranked by Equivalent Length)

Rank	Pipe Diameter	Total Equivalent Length (ft) *(Total Actual Length)*				Option Totals	
		144"	132"	114"	90"	(ft)	(miles)
1	I-15/Bear River Diversion Option	0 *(0)*	60,189 *(53,899)*	143,273 *(99,722)*	96,393 *(70,451)*	**299,855** *(224,072)*	**56.8** *(42.4)*
2	Option No. 2	6,968 *(6,333)*	53,221 *(47,566)*	214,218 *(168,923)*	96,393 *(70,451)*	**370,800** *(293,271)*	**70.2** *(55.5)*
3	Collinston Option	0 *(0)*	60,189 *(53,899)*	217,756 *(155,218)*	96,393 *(70,451)*	**374,338** *(279,568)*	**70.9** *(52.9)*
4	Option No. 1	30,437 *(22,092)*	41,386 *(37,042)*	222,844 *(169,943)*	96,393 *(70,451)*	**391,060** *(299,528)*	**74.1** *(56.7)*
5	Option No. 6	31,411 *(22,872)*	44,045 *(39,011)*	225,892 *(172,181)*	96,393 *(70,451)*	**397,741** *(304,515)*	**75.3** *(57.7)*
6	West of Willard Bay Option	6,968 *(6,333)*	53,221 *(47,566)*	258,565 *(162,216)*	140,154 *(88,362)*	**458,908** *(304,477)*	**86.9** *(57.7)*

Table 6-7
Summary of Pump Station Sizes for the Short List Alignment Option
(Ranked by Horsepower [HP])

Rank	Option	Washakie Pump HP	Collinston Pump HP	Bear River Div. Pump HP *	Total Pump HP
1	Collinston Option	24,400	39,300	0	**63,700**
2	I-15/Bear River Option	13,500	28,900	21,400	**63,800**
3	Option No. 2	25,400	39,400	0	**64,800**
4	West of Willard Bay Option	26,200	39,400	0	**65,600**
5	Option No. 1	25,300	41,400	0	**66,700**
6	Option No. 6	25,800	51,600	0	**77,400**

* Diversion and pump station only applies to the I-15/Bear River Option



The results of the short list hydraulic analysis indicated that the short list options did not vary significantly with respect to hydraulics. While the pipeline lengths and pumping sizes varied, the hydraulic evaluation results indicate that each of the short-listed options could serve as viable routes for the Bear River Pipeline.

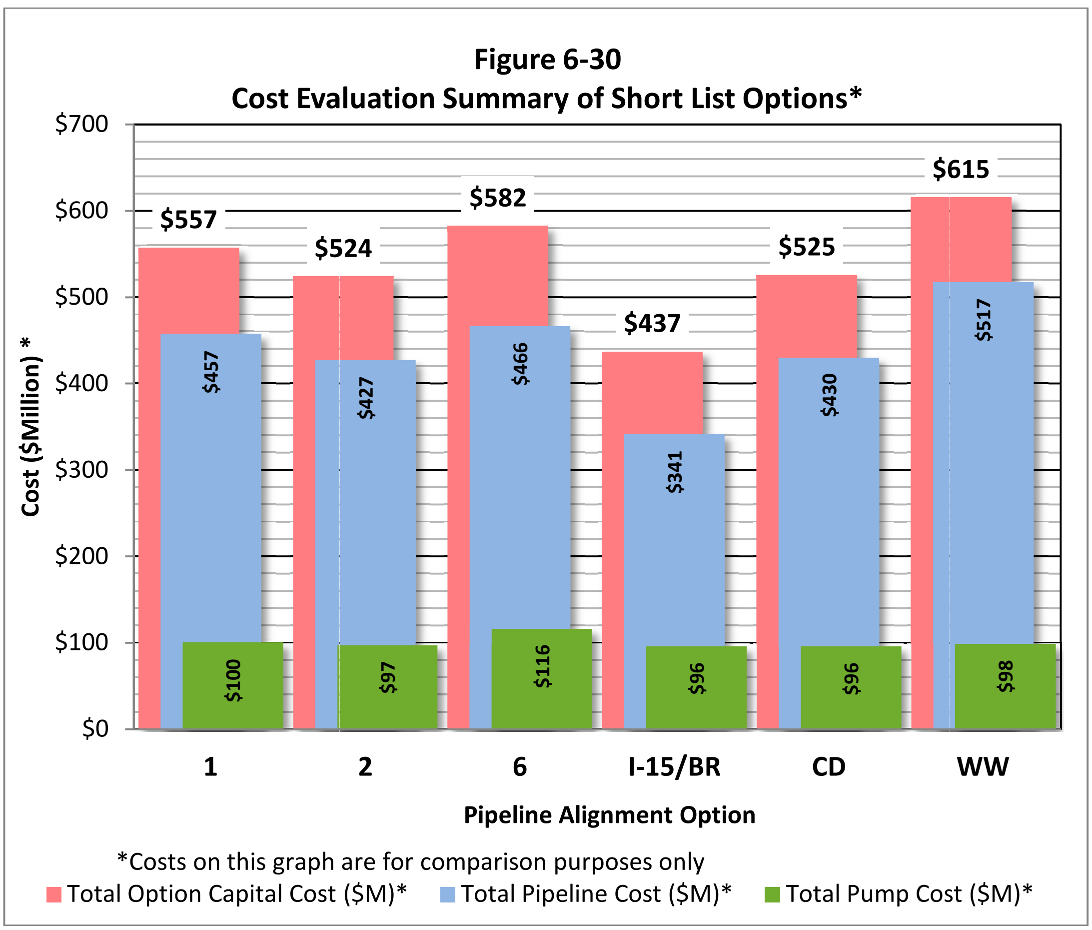
The total pipeline lengths and pump sizing for each option were used to estimate the comparative total cost of each alignment option. Pipeline unit cost per foot for various diameters and pumping unit cost per horsepower were both developed as part of this project and are summarized in the Pipeline Cost Technical Memorandum, included in the Volume I Appendix, Part 1. The total project costs at this stage in the study represent comparison costs only. Table 6-8 and Figure 6-30 both provide a summary of the cost comparison for the six options.

Table 6-8
Summary of Total Capital Costs for the Short List Alignment Option
(Ranked by Total Cost)

Cost Rank	Option	Total Pipeline Cost ($M)*	Total Pump Cost ($M)*	Total Option Cost ($M)*
1	I-15/Bear River Div. Option	$341.3	$95.7	**$437.0**
2	Option No. 2	$426.7	$97.2	**$523.9**
3	Collinston Option	$429.9	$95.6	**$525.5**
4	Option No. 1	$457.2	$100.1	**$557.3**
5	Option No. 6	$466.3	$116.1	**$582.4**
6	West of Willard Bay Option	$517.1	$98.4	**$615.5**

* Costs in this table are for comparison purposes and do not represent budgetary costs

The pipeline costs are the majority of the estimated project costs, with pumping costs representing 20-25 percent of the total cost. The options with the least amount of total pipe length were generally the least cost options (I-15/Bear River, Collinston, and Option No. 2).



The I-15/Bear River Option is the lowest cost, obviously due to its utilization of the Bear River for 10 miles of conveyance instead of a constructed pipeline. The additional diversion and pump station do not significantly add to the overall cost since the pipeline is generally so expensive compared to pumping costs. The estimated capital cost for this option is about $87 million lower than Option No. 2.

The Collinston Option and Option No. 2 are both very similar in cost, with Option No. 2 being an insignificant $1.6 million less. Further non-cost related evaluations of the top three lowest cost alignments are summarized in the following sections.

6.3.2 Real Estate Analysis

The purpose of the real estate analysis was to provide input and review of the short list alignments from a property, real estate, and ROW perspective. Using a high-level, landscape-wide approach, the real estate analysis portion of the study examined available information, existing conditions, and project objectives in the context of our local knowledge and understanding of the area. This analysis provided evaluation of real estate constraints and potential opportunities in relation to the proposed pipeline and associated facilities.

The project real estate team used GIS technology and up-to-date satellite imagery to conduct a "fly-through" of the corridors, noting each option's characteristics, expected ROW needs, proximity to existing corridors, and adjacent property ownership and use. The team identified areas of concern and opportunity where concurrent use of corridors would be challenging, as well as areas where a water pipeline could bring mutual benefit to the project and existing uses.

The next portion of the analysis focused on identifying real estate risk factors associated with each option. Examining each option in six to eight discrete "Sections", the real estate team summarized the potential impacts to communities, transportation corridors, and agricultural areas, where they existed. Risks associated with operating within restrictive ROWs and sensitive areas were also identified within the Sections of the proposed corridors. A summary of the short list real estate analysis has been included in Figures 6-31 through 6-36 (Volume II), shown as the blue text.

The real estate review completed to this point has been broad and not parcel-specific. The next step will be to conduct an in-depth, parcel-by-parcel analysis of each property's expected real estate costs and impacts for the recommended alternative.

The following paragraphs are the highlights of the real estate analysis for each of the short list alignment options:

1. **Option No. 1 (Figure 6-31 [Volume II]):** There are risk factors concerning restrictive ROWs adjacent to the Union Pacific Railroad as well as concerns with intersecting the incorporated areas of Elwood, Corinne, and Perry. The section along the Chevron Petroleum pipeline also scored low. There is some potential for mutual benefit on the portions that follow the West Side Canal but reduced confidence in shared use potential of the Highway 89 ROW. The potential need to rebuild any canal whose alignment is used was noted. Much of the alignment follows State Highways 13 and 126 where there

is a possibility for shared ROW. Portions that follow local roads could have slightly increased costs because of the possibility of needing to acquire adjacent private lands.

2. **Option No. 2 (Figure 6-32 [Volume II]):** This option incorporates more use of existing canals, which is beneficial, following the West Side and Corinne Canals in the north; but otherwise it has a very similar alignment to Option No. 1.
3. **Option No. 6 (Figure 6-33 [Volume II]):** A large portion of this alignment follows the Union Pacific Railroad ROW in the north; using portions of the Chevron Petroleum pipeline and I-15 frontage as well. Each of these existing corridors is characterized by restrictive uses on their ROW. There is additional risk associated with the capability of acquiring land for construction and staging areas in this portion of the alignment.
4. **I-15/Bear River Option (Figure 6-34 [Volume II]):** This option contains sections of proposed alignment along Union Pacific Railroad, I-15, Chevron Petroleum pipeline, and US Highway 89; presenting possible issues with restricted rights-of-way and shared use. There is a large section of this option that uses the Bear River itself as conveyance. With no significant real estate impacts expected with that river conveyance section, this option was identified as favorable in relation to real estate conditions.
5. **Collinston Option (Figure 6-35 [Volume II]):** Much of this alignment follows the Union Pacific Railroad and canals to the north, which carries risk associated with restricted rights-of-way for construction and staging. Then the alignment follows a section of I-15 (modified to avoid impacts to Brigham City) and US Highway 89 ROW in the central and south portion. There are some concerns with reduced confidence in the shared use potential of the I-15 and Highway 89 rights-of-way; but otherwise this option was identified as favorable in relation to real estate conditions.
6. **West of Willard Bay Option (Figure 6-36 [Volume II]):** This option uses the West Side and Corinne Canals in the northern sections of the alignment, then deviates significantly from the shared routes of the other options to follow rural roads and cross open space along the west side of Willard Bay. Risks associated with agency coordination and mitigation requirements contribute to the complexity of this option. Due to the federal ownership of much of this sensitive land, concerns over the lack of construction authority contribute to the lack of favorable real estate conditions; this option was identified as less favorable in relation to real estate conditions.

6.3.3 Environmental Analysis

The purpose of the environmental analysis is to provide input into the short list alignments review and to contribute to the recommended alignment selection process from an environmental permitting perspective. The project environmental team examined available information on environmental resources in the study area and conducted a field survey of each short list alignment to assess the relative environmental impact and associated permitting effort anticipated for each alignment. These impacts were then summarized and incorporated into the ranking procedure as part of the subsequent non-cost analysis for each alignment option.

Environmental resources identified in the environmental analysis as potentially present in the project study area included: wetlands, wildlife habitat, special status species, raptors and other protected migratory birds, historic structures and other historically important features. The available information on these resources was mapped using GIS. The six alignment options were plotted on aerial photographs, along with roads, railroads, water ways, and political boundaries. The Utah Natural Heritage Program (UNHP) was consulted for locations of potential raptor nests, special status plants and wildlife, and locations were plotted on the maps. National Wetland Inventory (NWI) mapping was also overlaid on the maps. This information was reviewed to gain a general understanding of the spatial distribution and relative importance of the targeted environmental resources and to guide the field survey.

Each of the short list alignments was field surveyed along nearly its entire length, except portions of the West of Willard Bay Option in the Great Salt Lake boundaries and in inaccessible wetland and open space areas. Other exceptions to a complete survey included where the alignment option paralleled railroads without public access, in which case the alignment was surveyed at crossings and with binoculars and a field scope. In general, each alignment was traveled and discrete resources (such as wetlands or raptor nests) or potential resources were identified using global position system (GPS) equipment. Resource locations were recorded in the GPS and later incorporated into the GIS mapping. Vague or continuous resources (such as wildlife habitat) were noted on maps and described in detailed field notes.

Post-field analysis of environmental constraints and permitting issues included summarizing notes and occurrences of sensitive or regulated environmental resources. Summaries were created for each of the six to eight “Sections” of each alignment option and are included in Figures 6-31 through 6-36 (Volume II), shown as the green text.

The following paragraphs summarize the primary environmental factors and impacts of each alignment option.

1. **Option No. 1 (Figure 6-31 [Volume II]):** This alignment parallels railroads, the West Side Canal (with relatively fewer environmental constraints), and paved highways for much of its length. Areas that are less environmentally favorable include the 5200 West Section and State Hwy 13 Section. These sections of the alignment have widespread, but small wetlands. The Chevron Petroleum pipeline also scored low because it crosses the Bear River Migratory Bird Refuge, which contains large wetlands and highly-valued bird habitat. Most of the remaining alignment is highly favorable from an environmental permitting perspective. Overall this option is highly favorable in relation to environmental impacts.
2. **Option No. 2 (Figure 6-32 [Volume II]):** This option is similar to Option No. 1; the main difference is that Option No. 2 follows the Corinne Canal, rather than the West Side Canal. The Corinne Canal has significantly more environmental resources associated with it, which contributed to a lower environmental favorability. Sections near 5200 West and the Chevron Petroleum pipeline also contributed to less environmental favorability. Overall this option is slightly less favorable, but does not have insurmountable environmental impacts.
3. **Option No. 6 (Figure 6-33 [Volume II]):** Two sections of the alignment kept this option from being a highly favorable option. The Main Street Tremonton section has extensive raptor nesting potential, historic structures, schools, narrow and historic downtown areas,

and wetlands. The Chevron Petroleum Pipeline section of the alignment runs through a very large wetland complex that is part of the federal Bear River National Migratory Bird Refuge. The remainder of this alignment option is highly favorable from an environmental permitting perspective. Overall this option is just slightly less favorable than Option No. 1.

4. **I-15/Bear River Option (Figure 6-34 [Volume II]):** Two sections of the alignment caused this option to be less favorable than other options. The same Chevron Petroleum pipeline section, which consists of large wetlands and a federal wildlife refuge has negative environmental impacts. The I-15 frontage section also has negative environmental impacts because it runs through very large wetland complexes. The Bear River Conveyance section, which is a non-constructed conveyance using the Bear River to bring water from the Collinston Diversion to the I-15 diversion site, was evaluated for environmental impacts. It is difficult to anticipate whether this section would be perceived as beneficial or detrimental to wildlife and wetlands. The two required diversion sites create negative environmental impacts, while additional water in the river creates positive environmental impacts. The remainder of the alignment is very favorable for environmental permitting. Overall this option is less favorable for environmental impacts mostly because of the I-15 corridor wetlands.
5. **Collinston Option (Figure 6-35 [Volume II]):** This option had similar environmental issues by following the West Side Canal, like Option No. 2. It also encounters significant wetlands in the natural gas easement and I-15 sections of the alignment, both causing significant impacts to very large wetland complexes. There are few other major environmental constraints along this alignment option. Overall this option is less favorable for environmental impacts mostly because of the I-15 corridor area wetlands.
6. **West of Willard Bay Option (Figure 6-36 [Volume II]):** This option has significant environmental impacts, mostly in the southern portion of the alignment where it crosses a federal wildlife refuge, a state wildlife management area, parallels a regulated dike, and impacts the shore of the Great Salt Lake. These areas are critical foraging and nesting habitat for waterfowl and shorebirds. It is unlikely that the U.S. Army Corps of Engineers would be able to permit this option as it would be difficult to satisfy their "least damaging practicable alternative" criterion. Overall this option is least favorable and would have difficult (and possibly insurmountable) environmental issues.

6.3.4 Non-Cost Analysis

A pipeline of the proposed size and length of the Bear River Pipeline will have a number of issues not easily related to cost that will impact the selection of a final alignment. The non-cost factors represent issues truly not cost related, but also represent significant costs that cannot be accounted for at this stage in the project, such as potential litigation costs for ROW acquisition. Non-cost factors can range from sensitive wetlands mitigation to temporary impacts to a community during construction. Certain non-cost factors may weigh more heavily into the evaluation of an alignment option, while others may only be of minor concern. In this section of the report the non-cost analysis will be performed as follows:

1. Develop a List of Pertinent Non-Cost Categories
2. Assign a Weighting Factor to each Non-Cost Category
3. Allow Project Work Group Input on Weighting Factors
4. Apply the Weighted Non-Cost Factors to the Options
5. Rank the Short List Options Based on Total Non-Cost Factor

Develop Non-Cost Categories. Five categories of non-cost issues were identified for the Bear River Pipeline Project. Each of these categories and their descriptions are described in detail below.

1. **Constructability**

   Constructability addresses the ability for the contractor to construct the pipeline in a timely manner without excessive interference from physical obstacles. These physical obstacles could include difficult site access, limited staging area, numerous bends, or other undesirable surface or construction conditions. The constructability also may include pipeline alignments that would require unusual design or construction methods, or areas with special geologic or seismic concerns.

2. **System Compatibility**

   System Compatibility addresses the requirement for the pipeline alternative to perform its proper function in the overall Bear River Pipeline transmission system, such as:

   - The proximity of the pipeline to water supply locations and preferred delivery points
   - The reliability of the pipeline to dependably deliver the necessary water supply
   - Expandability (relative ability to implement the project in phases) and the flexibility of the alignment option to be modified in response to potential changes in water needs or other project assumptions
   - Consideration of the potential differences in delivered water quality

   System Compatibility also includes consideration for:

   - General hydraulic compatibility
   - Favorable pipeline elevation profile and pumping conditions

   System Compatibility should take into account how the alignment may affect the following:

   - Future operations and maintenance (O&M) activities
   - Ease of O&M access

- Amount of potential development and utility congestion around the pipeline
- The overall ROW compatibility with a large diameter pipeline.

3. **Community Impacts**

   Community Impacts addresses the impact that the pipeline alternative will have on the local community. This includes the impact during construction on residential areas, commercial access, access to and from public facilities, and impacts to traffic or transportation. This category includes the actual or perceived permanent impacts on the community following pipeline construction such as:

   - General impact of utility disruptions and lengthy coordination with impacted utility agencies during construction.
   - Large underground utility barrier with associated disruption to future development
   - Permanent pipeline surface facilities (vaults, pigging structures, vents, etc.)
   - Open terrain land or farmland scars
   - Positive impacts such as a recreation/trail corridor

4. **Environmental Impacts**

   Environmental Impacts addresses the environmental, cultural, or historical sensitivity of the areas along and around the pipeline alignment and how construction will impact these areas. This also includes any permanent impacts that may exist after the pipeline has been constructed such as access roads, river diversions, berms, permanent surface facilities or structures, future O&M access, etc. This category also includes potential difficulties associated with permitting and public acceptance. Environmental Impacts could also be positive, as in the case of an alignment option that provided a readily accessible route for a recreational trail or future transportation corridor, permanent open space, or park land.

5. **ROW Issues & Land Use**

   ROW Issues & Land Use addresses the ease of easement or ROW acquisition along the pipeline alignment and possible negative land use changes over the pipeline corridor. This also includes general compatibility of the ROW land use with the pipeline, both during and after construction. For example:

   - The pipeline located adjacent to a light rail ROW versus a large canal ROW.
   - The pipeline located through the middle of a potential high density commercial area versus adjacent to an open highway ROW.

Project Work Group Input. The intent of this portion of the short list analysis was to allow the Work Group to provide direct input to the Bear River Pipeline route selection process. The non-cost categories and information were distributed to and discussed with each of the project stakeholders following the development of these non-cost categories. The Work Group included the four participating agencies: Cache County, BRWCD, WBWCD, JVWCD and the State Division of Water Resources, as defined in Chapter 5. The Work Group members were allowed to rank the importance of each category according to its relative overall importance on a scale from 1 to 100, with all five categories adding to 100. Table 6-9 provides a summary of the input received by the Work Group, with the overall average weighting factors.

Table 6-9
Summary of Project Work Group Input
on Non-Cost Weighting Factors

Non-Cost Category	Work Group Input								Average
	State DNR			Water Districts					
1. Constructability	10	25	25	5	25	30	30	20	**21.25**
2. System Compatibility	35	30	15	20	25	30	15	50	**27.5**
3. Community Impacts	35	20	20	50	10	10	30	15	**23.75**
4. Environmental Impacts	10	15	15	15	25	20	10	10	**15**
5. ROW Issues & Land Use	10	10	25	10	15	10	15	5	**12.5**
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Generally the first three categories were weighted as the highest importance of the five, with System Compatibility being rated the most important category and Constructability being rated second. There is some significant variability in the weighting factors for Community Impacts, ranging from 10 to 50, most likely reflecting input from Work Group members that will be far less impacted on a local level versus local Work Group members that could face more public accountability.

A summary of the actual weighting factors that were assigned to each non-cost category is provided in Table 6-10. Note that the sum of the weighting factors equals 100 percent.

Table 6-10
Recommended Weighting Factors for Non-Cost Categories

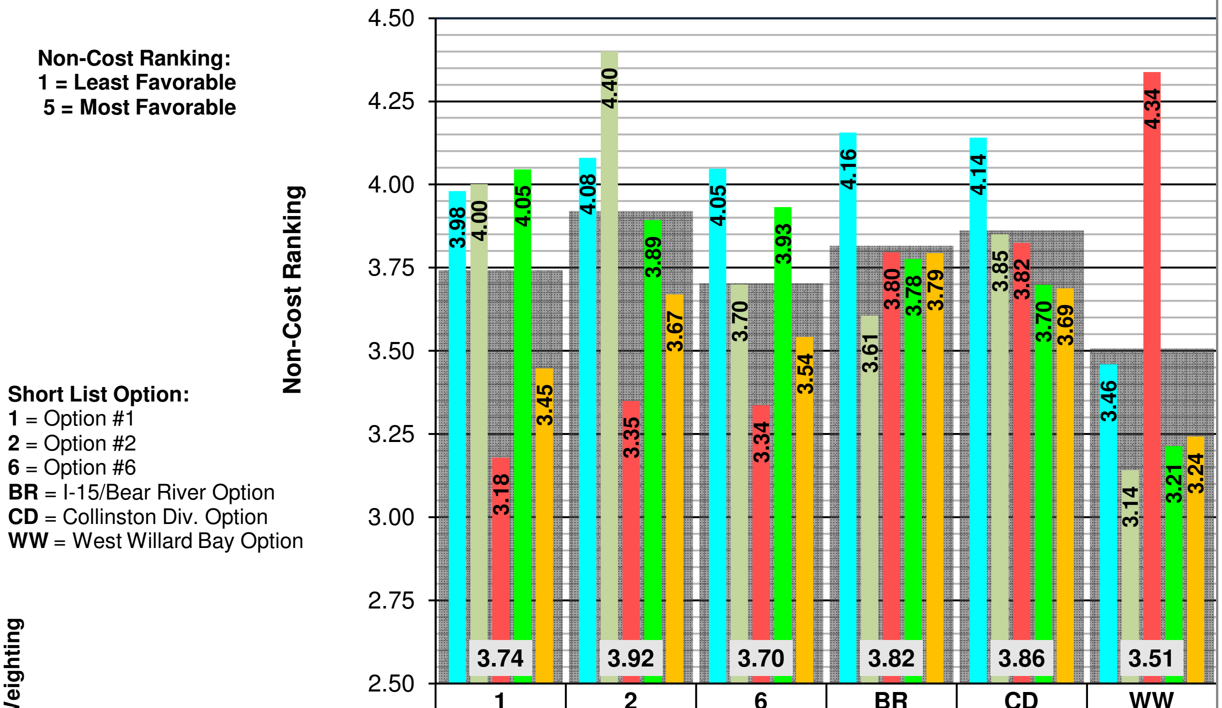
Non-Cost Category	Weighting Factor (%)
Constructability	21
System Compatibility	28
Community Impacts	23
Environmental Impacts	15
ROW Issues & Land Use	13
TOTAL	**100**

Short List Non-Cost Evaluation. A simple rating system was set up for the non-cost categories where each pipeline segment in the short list of alignment options was rated according to the five non-cost categories. A rating factor between one and five was assigned to each segment of pipeline, with one being the least favorable and five the most favorable, depending on its physical location and associated impact in relation to the non-cost categories.

Factors were normalized with respect to length of each segment so that a very low scoring but short segment would not skew a higher scoring longer section. The non-cost rating factors were input into each short listed alignment option based upon extensive field investigations, information provided by the environmental and real estate teams, and available GIS information.

The weighting factors were used to classify each category according to its relative importance in the non-cost evaluation. The weighting factors were based on direct input from the Project Work Group during coordination meetings, as discussed previously. Figure 6-37 summarizes the results of the non-cost scoring of the short list options. The detailed non-cost rating data for each short list option is included in the Appendix (Volume II) for reference.

Figure 6-37: Summary of Non-Cost Evaluation



Weighting %		1	2	6	BR	CD	WW
	Summary of Non-Cost Factors - Length Weighted	3.74	3.92	3.70	3.82	3.86	3.51
21	1. Constructability	3.98	4.08	4.05	4.16	4.14	3.46
28	2. System Compatibility	4.00	4.40	3.70	3.61	3.85	3.14
23	3. Community Impacts	3.18	3.35	3.34	3.80	3.82	4.34
15	4. Environmental Impacts	4.05	3.89	3.93	3.78	3.70	3.21
13	5. ROW Issues & Land Use	3.45	3.67	3.54	3.79	3.69	3.24

According to the overall results of the non-cost evaluation and rankings, Option No. 2 ranked the highest overall, by a significant margin, with the Collinston Option in second, and the I-15/Bear River Option in third. A description of the individual non-cost category rankings is provided in the following paragraphs.

Constructability (Weighted at 21%). The Collinston and I-15 Bear River Options both had the highest Constructability ranking. The high Collinston Option ranking is mostly due to the long stretches of land adjacent to the Union Pacific Railroad and West Branch Canal (sections averaging 5). I-15/Bear River Option does not require construction along the reach of river, making it a highly ranked option for this category. Option No. 2 was third in the ranking, but like the other options that follow the Highway 13 corridor, it had a slightly lower ranking because of interactions with the highway and some development/utility congestion (sections averaging 4).

System Compatibility (Weighted at 28%). Option No. 2 had the highest System Compatibility ranking, by a large margin, mostly due to the fact that it has long reaches of favorable alignment along canals and highway frontage, and also this option only requires a short supply pipeline and it has close proximity to project diversion points. The Collinston Option ranked second due to its long reaches of alignment along the railroad, canal, and I-15 corridors. The I-15/Bear River Option was poorly ranked because of the 10-mile section of Bear River conveyance that ranked very low for system compatibility since no pipeline would be available for water deliveries through that stretch of BRWCD service area.

Community Impacts (Weighted at 23%). West of Willard Option had the best Community Impacts ranking due to the very long reach of pipeline in non-developed areas. The Collinston Option ranked second with the I-15/Bear River Option ranked third. Both ranked higher than the others by a large margin, mostly due to highly favorable ranking along undeveloped ROW along either railroad or freeway. The other options ranked lower because of alignments that follow the Highway 13 corridor which will cause some public disruption during construction. Four of the options had poor rankings along the Highway 89 and 1900 West corridors due to high development and highly disruptive construction conditions.

Environmental Impacts (Weighted at 15%). Option No. 1 and No. 6 were ranked the highest for Environmental Impact because of their similar alignments located mostly within road or railroad rights of way. Option No. 2 was ranked third because of its interaction with slightly sensitive areas along the canals. The Collinston and I-15/Bear River Options both received lower rankings for the I-15 corridor sections passing through sensitive wetlands.

ROW and Land Use (Weighted at 13%). The I-15/Bear River Option was ranked the highest mostly because of the Bear River conveyance section that has no ROW issues. The Collinston Option was ranked second because of the long reaches of alignment adjacent to railroad ROW and canal, which generally received favorable rankings. Option No. 2 was ranked third because of its long reaches of shared ROW with canals.

Overall the top-rated Option No. 2 individually ranked first or second on four of the five non-cost categories when importance weighting was not included. The only non-cost category where

Option No. 2 did not score well was on Environmental Impacts, but it should be noted that the environmental issues that affected this option's ranking do not appear to be insurmountable.

6.4 RECOMMENDED PIPELINE ALIGNMENT

The selection of the Bear River Pipeline recommended final alignment was based on the hydraulic evaluation, engineering cost analysis, and the non-cost analysis. The following paragraphs provide a summary of the overall evaluation of each of the three top ranked options; the I-15/Bear River Option, Option No. 2, and the Collinston Option.

6.4.1 The I-15/Bear River Option

The I-15/Bear River Option was the lowest capital cost alignment option based on results of the cost analysis, but only ranked third in the non-cost evaluation mostly because of its poor System Compatibility score. The downside to this cost saving option is that it does not include a pipeline from the Collinston Diversion site to the I-15/Bear River Diversion, utilizing the Bear River for conveyance. The Project Work Group feels strongly that this option does not meet all of the objectives of the Bear River Pipeline Project, mainly that it be able to deliver water to various locations in Box Elder County. The I-15/Bear River Option would require that separate river diversions and pump stations be built at each location where water deliveries are desired along the river reach of the Bear River water delivery system. Because of this major System Compatibility deficiency, the I-15/Bear River Option was not selected as the recommended final alignment option.

6.4.2 The Collinston Option

The Collinston Option ranked second in the non-cost evaluation and ranked third in cost, closely behind Option No. 2. This option meets all the project criteria and has the added advantage of not requiring a supply pipeline since it passes through the Collinston Diversion. The alignment along the east side of the Bear River follows mostly railroad and I-15 ROW, which are both very compatible with a large diameter pipeline. The railroad and freeway corridors generally restrict closely adjacent development and also can limit, to a certain degree because of cost, numerous utility crossings. The downside of this option is that the east side of the Bear River is not considered compatible with delivery locations for Box Elder County, since the west side will have most of the new development and high water demands.

6.4.3 Option No. 2

Option No. 2 ranked first in the non-cost evaluation and ranked second in cost. Option No. 2 seems to meet all the objectives of the project overall. The main difference between this option and the Collinston Option (which is similar in cost) was that the alignment followed mostly canal and Highway 13 ROW on the west side of the Bear River, which is considered a significant advantage for future Box Elder County water delivery locations. The long stretch of wide highway corridor is also considered very compatible with a large diameter pipeline.

Following a review of the pipeline alignment options by the project team, all agreed that both Option No. 2 and the Collinston Option would serve as excellent routes for the Bear River

Pipeline. After discussion and review of the top two alignment options in meetings with the Project Work Group, it was decided that because of the higher non-cost ranking of Option No. 2, its favorable cost ranking, and its favorable delivery locations west of the Bear River, that Option No. 2 be presented as the Bear River Pipeline recommended final alignment.

A decision was made to establish a wide alignment corridor for the Bear River Pipeline that allows for acceptable small alignment variations to the Option No. 2 that fall within an alignment corridor. This corridor includes expanded areas that allow for flexibility or minor changes during future preliminary and final design, based on current availability of open, undeveloped land. The corridor boundary is presented to allow for unforeseen future changes that may occur because of utility conflicts, community issues, real estate issues, political pressures, etc. Figure 6-38 (Volume II) provides an illustration of the Bear River Pipeline recommended final alignment corridor. Detailed figures of the alignment have been provided in Volume II, with more detailed maps and information on the final alignment and alignment corridor.

The recommended alignment corridor is generally described in Chapter 7 of this report. The recommended alignment is approximately 293,271 feet, or 55.5 miles long. A detailed hydraulic analysis, real estate analysis, environmental analysis, project concept design, cost estimate, and description of the recommended alignment is provided in the following chapters of this report.

7.0 PIPELINE ENGINEERING ANALYSIS & CONCEPTUAL DESIGN

7.1 INTRODUCTION

The procedure presented in Chapter 6 included a cursory hydraulic analysis to help determine the recommended pipeline alignment by analyzing the terrain, determining pumping requirements, estimating the costs of pump stations and related facilities, and adding these estimated costs to the overall cost of each short list option. This analysis, coupled with the route selection process and the non-cost evaluation, revealed a recommended pipeline alignment corridor which is described in detail in section 7.1.3. Chapter 7 will present a detailed hydraulic analysis and conceptual design of the recommended pipeline alignment with associated pump station and diversion structures.

7.1.1 Purpose and Approach

The purpose of this detailed analysis is to incorporate the refined design assumptions into a hydraulic analysis of the proposed pipeline alignment and to apply the results to the conceptual design. The conceptual design will be used to create cost estimates and to act as an information base for future final design of the Bear River Pipeline.

The engineering analysis presented in Chapter 7 consists of a more detailed inspection of hydraulic reaches, design flow rates, bi-directional flow requirements, design assumptions, final pipeline sizing by reach and final pump station sizing. The conceptual design includes the investigation of materials, coatings and linings, joints, pipe trench design, pipeline appurtenances, operations and maintenance considerations, and geotechnical recommendations for the proposed pipeline. The conceptual design also includes design criteria, general layout and other applicable considerations for proposed pump stations and diversion structures.

7.1.2 Outline of Chapter

This chapter will consist of the following general outline:

Detailed Hydraulic Analysis

- Revised Hydraulic Criteria
  - Define Final Hydraulic Reaches
  - Design Flow Rates and Design Assumptions
- Hydraulic Scenarios
- Final Pipeline Sizing by Reach
- Hydraulic Profiles
- Final Pump Station Sizing

Pipeline Conceptual Design

- Pipe Design Criteria
- Pipe Materials and Design
- Pipe Material, Type, Wall Thickness, Joints
- Pipe Lining and Coating
- Pipe Trench Design
- Pipeline Appurtenances Design
- Pipeline O&M Considerations
- Plan and Profile Sheets

Geotechnical Evaluation and Recommendations

- Existing Studies and Data
- Field Reconnaissance
- Geologic Conditions and Constraints
- Recommendations
- Construction Considerations
    - Surface Geology
    - Seismicity
    - Geologic Hazards
    - Groundwater

Pump Station Concept Design

- Pump Station Design Criteria
- Pump Station Layout and Building/Parcel Size
- Diversion Design Criteria
- Conceptual Layout and Parcel Size

7.1.3 Description of Final Alignment Corridor

Table 7-1 summarizes the Bear River Pipeline final alignment, reach by reach, including approximate lengths, appurtenant structures, descriptions and comments (see Figure A13-1 to A13-6 [Volume II, Part 3], as reference map). Detailed plan and profile and utility drawings have been developed as part of the conceptual design. These drawings detail the alignment terrain, the locations of appurtenant structures, and approximate locations of underground utilities within the final alignment corridor.

Table 7-1
Summary of the Bear River Pipeline Final Alignment

Pipeline Alignment	Length (ft)	Description	Comments
Section 1 21600 North Street ROW	1,268	From the Proposed Washakie Reservoir to the Union Pacific Railroad	Open Space with some groundwater and one crossing of the Malad River
Union Pacific Railroad ROW	23,766	Adjacent to the Union Pacific Railroad ROW	Few utilities, one crossing of I-15 and one crossing of the railroad
Section 2 Open Field	2,901	From the Union Pacific Railroad to the West Canal	Open space with no utilities
West Canal	19,629	Adjacent to West Canal to the Corinne Canal	Some groundwater due to proximity to canal
Section 3 Open Space	6,332	Connects Collinston Diversion on the Bear River to the main pipeline; adjacent to West Canal, then through open fields	No utility congestion, low groundwater, some areas with steep slopes
Section 4 Corinne Canal	36,234	Adjacent to the Corinne Canal	Some groundwater due to proximity to canal
Section 5 State Highway 13	24,452	Wide ROW with Corinne Canal ROW and old Railroad ROW adjacent to Highway 13	Medium utility congestion, Highway 13 is major road
Section 6 5200 West	18,258	County Road	Small rural road with light utility congestion
Section 7 Open Field	3,136	Open field connecting county road 5200 West to an existing dirt road	No utilities
Dirt Road	6,147	Dirt road adjacent to an irrigation ditch	No utilities
Section 8 Union Pacific Railroad	4,586	Connecting dirt road to Highway 13	Adjacent to railroad, light utility congestion, crossing of small irrigation canal
State Highway 13	19,306	Major road with wide row through Corinne City	Major highway, medium utility congestion, crossing of Bear River

Table 7-1
(continued)

Pipeline Alignment	Length (ft)	Description	Comments
Section 9 Chevron Pipeline ROW	28,733	Adjacent to the Chevron Pipeline ROW, some sections run through Bird Refuge	No utilities, but groundwater present, especially near Bird Refuge
Open Space	5,273	Open field	Crossing of I-15 and railroad, some high groundwater present
Section 10 US Highway 89	44,276	Major road with wide ROW, through Willard and part of Perry	High traffic and utility congestion
Section 11 1900 West	41,245	Major commercial/industrial road	High utility congestion, crossing of I-15, Weber River and Willard Canal
Layton Canal	5,228	Adjacent to canal	Low utility congestion, chance of presence of high groundwater
2550 South Street	5,282	Connecting Layton Canal to the proposed West Haven Water Treatment Plant	Rural road with limited ROW expandability due to proximity to residential development
Total Pipeline	**293,271**		

7.2 DETAILED HYDRAULIC ANALYSIS

The hydraulic analysis performed as part of Chapter 6 resulted in the rough sizing of pump stations and the selection of the preferred pipeline alignment. The detailed hydraulic analysis in this chapter consist of a more detailed inspection of hydraulic reaches, design flow rates, bi-directional flow requirements, final pipeline sizing by reach, and final pump station sizing and configuration.

7.2.1 Revised Hydraulic Criteria

The revised hydraulic criteria consist primarily of the flow demands at the various major connection points. Final hydraulic reaches are determined by changes in pipe size; and changes in pipe size are determined by the design flow rates. The maximum potential delivery flow rates to the various entities along the Bear River Pipeline are summarized in Table 7-2.

Table 7-2
Maximum Delivery Flows
Along the Bear River Pipeline

Delivery Name	Flow (cfs)
BRWCD North Delivery	180
BRWCD Brigham City	162-180
BRWCD South Delivery	18
West Haven WTP	300

A schematic map of the hydraulic reaches is provided in Figure 7-1. The listed design flow rates were developed as part of Chapter 4, Project Assumptions. Further explanation of Figure 7-1 is provided in the following paragraphs.

The following sections summarize the critical hydraulic components of the pipeline, based on the expected operation of the Bear River Pipeline.

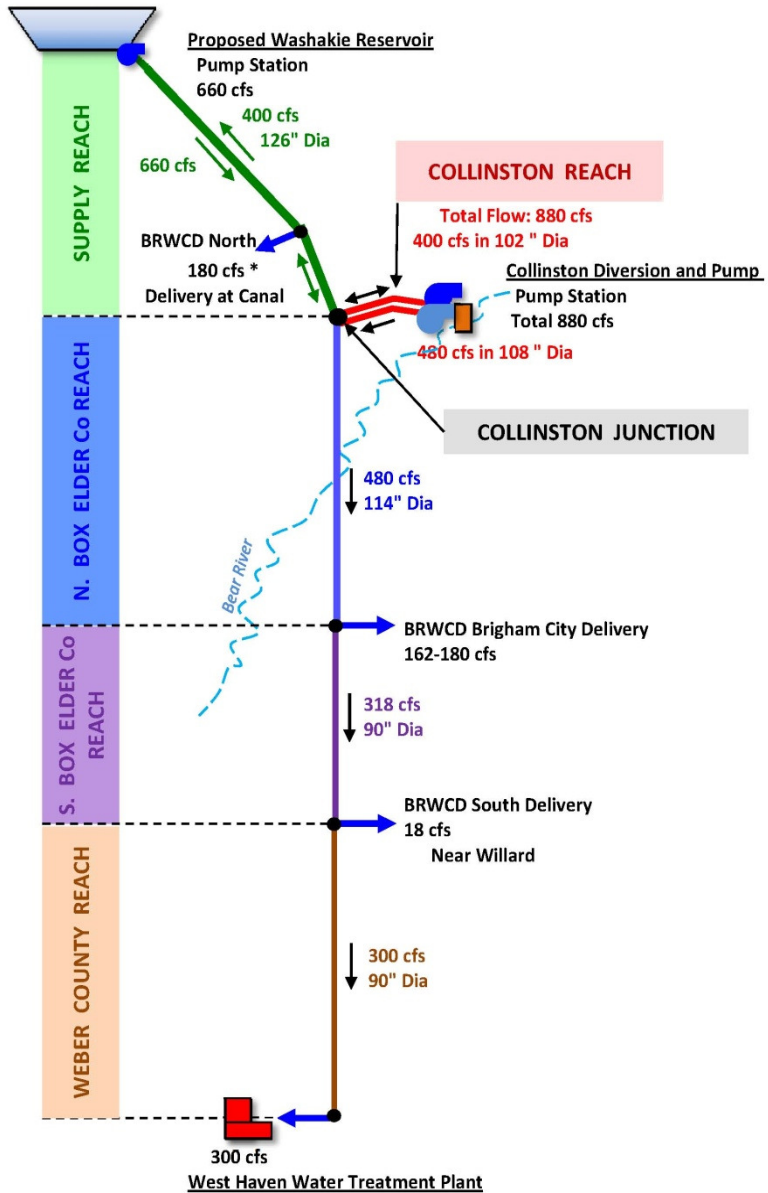
Supply Reach. The Supply Reach is designed for the maximum flow from Washakie Pump Station, conveying 660 cfs to the south, with 180 cfs delivery to the North BRWCD at the West Side Canal. It should be noted that this delivery will only be utilized when pumping from Washakie Pump Station. The reverse flow scenario for this reach involves pumping north from Collinston to Washakie Reservoir at a maximum rate of 400 cfs.

Collinston Reach. During this more detailed hydraulic analysis of the pipeline alignment it was determined that the Collinston Pump Station would have to pump a total of 880 cfs (more on pump station design in the following sections). The large pumping flow rate is based on the combination of these two flow scenarios:

1. The maximum delivery to Washakie Reservoir of 400 cfs
2. The maximum flow rate to the southern delivery points totaling 480 cfs

In order to accommodate pumping in two directions at significantly different heads, a dual pipeline will have to be constructed for the Collinston Reach (between Collinston Diversion Pump Station and the Collinston Junction with the main pipeline).

Figure 7-1
Bear River Pipeline Hydraulic Reach Schematic



** BRWCD North Delivery is only made when pumping from Washakie Reservoir to the south. The 180 cfs can also be conveyed to Collinston Div. for Cache County delivery.*

North Box Elder County Reach. This hydraulic reach is designed for the maximum flow to be conveyed to the south of 480 cfs. It also includes a section of pipeline north of the junction with the Collinston Reach, where a maximum flow of 480 cfs is experienced during north to south flow.

South Box Elder County Reach. This hydraulic reach is defined by the BRWCD Brigham City connection point which diverts 162 to 180 cfs out of the pipeline. The South Box Elder County hydraulic reach is designed for the maximum flow to be conveyed to the south of 318 cfs.

Weber County Reach. This hydraulic reach is defined by the southern BRWCD connection which diverts an anticipated maximum of 18 cfs, leaving maximum flow of 300 cfs in the pipeline to be delivered to the proposed West Haven WTP.

The design flow rate for each hydraulic reach is summarized in Table 7-3.

Table 7-3
Design Flow Rates by Hydraulic Reach

Reach	Flow (cfs)
Collinston Reach	880 *
Supply Reach	400 North 660 South
North Box Elder County Reach	480
South Box Elder County Reach	318
Weber County Reach	300

* This flow rate represents the total required flow for a simultaneous maximum delivery of 400 cfs to Washakie Reservoir and 480 cfs to the south.

7.2.2 Hydraulic Scenarios

The project assumptions that were developed in Chapter 4 were further refined in this chapter to represent hydraulic scenarios. The purpose of developing and evaluating all the hydraulic scenarios for the pipeline and pump station is to ensure that all the potential water supply and delivery scenarios are accounted for in the facilities conceptual design and cost estimating. The following sections provide a summary of each hydraulic scenario. Figure 7-2 (Volume II) provides a schematic of each of the six hydraulic scenarios that are summarized below.

Scenario 1. The first scenario represents the basic supply operation of the Collinston Diversion Pump Station at the Bear River. This scenario represents typical filling of the proposed Washakie Reservoir at a rate of 400 cfs. The pumping head for this scenario only minimally exceeds the terrain between Collinston Diversion and Washakie, adequate to deliver 400 cfs. Deliveries are not expected under this scenario, but can be made only to the North BRWCD at the West Side Canal if necessary.

Scenario 2. The second scenario represents typical delivery operation of the Washakie Reservoir Pump Station, pumping out of the reservoir to designated delivery points along the pipeline, summarized previously. Maximum flow from the pump station is 660 cfs at a pumping head required to convey water the entire length of the pipeline to the proposed West Haven WTP.

Scenario 3. The third scenario represents operation of the pipeline in both a supply and delivery situation. This scenario requires pumping from Collinston Diversion for both Washakie Reservoir filling and maximum deliveries to the project participants to the south, total flow of 880 cfs. Because of this, it requires that there be two different pumping and piping systems, one low head set of pumps to convey 400 cfs to Washakie and the other a higher head set of pumps to convey 480 cfs to the south deliveries. This scenario allows for maximum development of the peak flows in Bear River occurring late in the spring runoff season, see Chapter 4 for more details.

Scenario 4. This scenario occurs less frequently, but allows for some flexibility in supplementing water pumped from the Bear River with water from Washakie Reservoir. The pumping heads of the Collinston Pumps (high head) and the Washakie Pumps are both similar at the Collinston Junction to allow combining the flow rates to convey up the maximum required deliveries to the south.

Scenarios 5 and 6. These scenarios allow for additional flexibility in the pumping system to provide supply or delivery as needed. These may be less frequently utilized scenarios, but show that the dual head pumping system at Collinston Diversion allows for some flexibility in phasing/implementing of the project facilities. It should be noted that these two scenarios do not reflect design scenarios, but reflect only system capabilities to meet or partially meet the requirements of the other four scenarios described above.

7.2.3 Final Pipeline Sizing By Reach

The final pipeline size in each reach was calculated based on the conceptual design flow rates and design scenarios established in Chapter 4. The following hydraulic assumptions were made in calculating the pipeline diameters for the project:

- Hazen-Williams Friction Coefficient of 120
- Pipe diameters rounded up to standard 6-inch diameter increments
- Flow velocity in the range of 6.5 to 7.5 feet per second (fps), typically at 7.0 fps.

Table 7-4 provides a summary of the recommended pipeline diameters for each hydraulic reach of the Bear River Pipeline.

Table 7-4
Summary of Recommended Pipeline Diameters by Hydraulic Reach

Hydraulic Reach	Diameter (in)
Collinston Reach I *	102
Collinston Reach II *	108
Supply Reach	126
North Box Elder County Reach	114
South Box Elder County Reach	90
Weber County Reach	90

* These represent one reach with a double pipeline, Reach I to convey the maximum delivery of 400 cfs to Washakie Reservoir and Reach II to convey 480 cfs to the south at a higher pumped head.

7.2.4 Hydraulic Scenarios and Hydraulic Profiles

The detailed hydraulic analysis involved evaluating the proposed final alignment pipeline and pump stations. Hydraulic profiles for the following major pumping scenarios have been provided in Figures 7-3 and 7-4 (Volume II):

- Pumping 660 cfs from Washakie Reservoir Pump Station to West Haven WTP
- Pumping 400 cfs from the low head Collinston Pump Station I to Washakie Reservoir
- Pumping 480 cfs from the high head Collinston Pump Station II to West Haven WTP

Detailed calculations for the hydraulic profiles have been included in the Appendix of this report.

7.2.5 Final Pump Station Sizing

The Bear River Pipeline pump stations were sized to be able to provide the required water deliveries as outlined in previous sections of this chapter. The following hydraulic assumptions were made for the calculating the pump station sizing:

- Pump Efficiency 88%
- Motor Efficiency 94%

Table 7-5 provides a summary of the Bear River Pipeline pump station sizing. Detailed pump station hydraulic calculations have been included in the Appendix in Volume II of this report.

Table 7-5
Summary of Pump Station Sizing

Pump Station	Peak Flow (cfs)	Total Head (ft)	Total Horsepower
Washakie	660	275	24,000
Collinston I (Low Head)	400	260	14,000
Collinston II (High Head)	480	375	24,000

The conceptual design drawings of the proposed Washakie and Collinston Pumping Stations have been included in Volume II (PS-2) of this report. Also included in Volume II is a concept design schematic (PS-1) of the Bear River Pipeline supply and pumping system between Collinston Diversion and Washakie Reservoir, including valves and piping.

7.3 PIPELINE CONCEPTUAL DESIGN

The following sections summarize the concept design evaluation and recommendations for pipe design criteria, pipe materials, pipe coatings and trench zone backfill options for the Bear River Pipeline.

7.3.1 Pipe Design Criteria

The type and strength of material required for any particular pipeline is determined by the magnitude of the pressures the pipeline will experience. The maximum pressure requirements for the Bear River Pipeline project finished water pipelines are listed in Table 7-6. These criteria were developed at a conceptual level for evaluation of the pipe materials. Further surge evaluation and calculations are required to make a determination of the final Bear River Pipeline design criteria.

Table 7-6
Maximum Pipeline Pressure Ratings

Pipeline Reach	Maximum Design HGL (ft) [1]	Lowest Elevation on Pipeline (ft)	Maximum Design Pressure (psi)
Collinston I Reach	4,490	4,230	111
Collinston II Reach	4,645	4, 230	180
Supply Reach	4,645	4,350	128
North Box Elder County Reach	4,645	4,225	182
South Box Elder County Reach	4,645	4,219	185
Weber County Reach	4,645	4,240	175

Notes:

1. Estimated maximum HGL is based upon a static elevation at each respective pump station, plus dynamic head from pumping. Actual design HGL to be confirmed during the preliminary and final design phases of the project.

7.3.2 Pipe Materials and Design

Pipe Materials Evaluation. The Bear River Pipeline is unique in that it will consist of sections of varying diameters, from 90-inch pipe to large 126-inch pipe. The selection of a pipe material for the pipeline is an important part of the conceptual design process. The pipe material can impact many aspects of the project such as costs, delivery schedule, pipe protection measures during construction, and construction methods. The following pipe materials were evaluated:

- Plastic Pipe
- Ductile Iron Pipe
- Pre-Tensioned Concrete Cylinder Pipe (PCCP)
- Welded Steel Pipe.

Plastic Pipe. The two plastic materials available are HDPE and PVC. The HDPE is manufactured up to a 54-inch diameter at a maximum pressure of 150 psi (not including surge pressures). PVC is manufactured up to a 48-inch diameter. As the maximum available diameter for this material is much smaller than that required on the pipeline, plastic pipe will not be considered further.

Ductile Iron Pipe. Ductile iron pipe is manufactured up to 60-inches in diameter, which is too small to be considered for the Bear River Pipeline.

Pre-tensioned Concrete Cylinder Pipe (PCCP). PCCP is a combination of reinforced concrete pipe and mortar-coated steel pipe. It is cylindrical pre-tensioned steel bar lined and coated with concrete. The pre-tensioned pipe is manufactured in the size and pressure class required by the

Bear River Pipeline project finished water pipelines. The costs are also competitive to standard welded steel pipe, with PCCP costing between 5% and 10% more than steel depending on pipe size.

Welded Steel Pipe. Welded steel pipe has a good history of performance in large diameter pipeline applications similar to the Bear River Pipeline. Many of the larger water districts in the west have standardized to welded steel pipe for large diameter pipelines. Steel pipe also has a good life span in the ground if it is properly installed and cathodically protected. Steel pipe meets the design criteria for all pipe sizes in all reaches of the Bear River Pipeline.

The pipe materials that meet the Bear River Pipeline design criteria are welded steel and PCCP. These are both good pipe materials with competitive costs. However, advantages of steel pipe include local availability, ease of fabricating pipe specials, ease of installing future connections, ease of transition into vaults and structures, and slightly lower costs. Based on these advantages, welded steel pipe is recommended for the pipeline. Steel pipe will be used to develop conceptual level design and cost estimation data for the pipeline. The following sections of this report discuss and evaluate the options for steel pipe coatings and pipe zone material.

The PCCP material option will not be further evaluated in this study due to its lack of standardized use in the water industry. PCCP may be further evaluated in the future preliminary design if further consideration is warranted for alternatives to steel pipe.

Pipe Coating Evaluation.

Polyurethane Coating and Lining. Polyurethane is a relatively new coating material in the water industry. The coating is usually a 40 to 50-mil thick factory spray-applied coating. The primary advantage to polyurethane coating is its ability to adhere to the steel better than tape wrap or mortar coatings. Polyurethane can also be used as a lining. According to the steel pipe manufacturers, polyurethane mainly competes with a single tape wrap coating system because it has superior adhesion properties to the steel and offers an additional hard coat protection that tape wrap alone cannot. Polyurethane is a relatively new coating and lining material, but it is becoming increasingly common and accepted in the culinary water transmission industry.

Mortar Coating and Lining. Mortar coating is common to most municipal steel pipe installations. The mortar coat is factory applied to the outside of the steel pipe. Mortar coating protects the steel during installation, but may crack or disbond over time, allowing corrosion of the pipe to take place. While there is no pipe size limit on mortar coatings, shop-applied mortar lining is currently limited to 96-inch pipe. Pipe larger than 96 inches can be lined with mortar by spinning the pipe in the field. Applying mortar in the field is more time consuming as each joint requires the mortar to be applied by hand.

Dielectric (Tape Wrap) Coating. Dielectric coating systems typically consist of polyethylene tape material that is wrapped in layers, which act as a protection against corrosion. Tape coating can be easily damaged during construction and after construction in the event of a utility ‘dig in’. To protect the pipe, the option of using a combined system of tape coating with rock shield (mortar coat) can be used. This option combines the pipe corrosion protection of tape wrap with the exterior mortar overcoat that protects the integrity of the tape coat during and after installation. Larger water districts such as Central Utah Water Conservancy District (CUWCD) and Southern Nevada Water Association (SNWA) have standardized around this dual coating system for their large transmission pipelines.

Relative costs for the pipe coating and lining options were obtained from regional steel pipe manufacturers based on the following alternatives:

1. Cement Mortar Coating or Lining (1-inch thickness)
2. Polyurethane Coating or Lining (40-mil thickness)
3. Dielectric Coating (80 mil polyethylene tape)
4. Dual Coating System (80-mil tape wrap with cement mortar rock shield).

Table 7-7 compares the major advantages and major disadvantages of the various coating and lining options being considered for the Bear River Pipeline.

Table 7-7
Summary of Steel Pipe Coatings and Linings

Coating/Lining Type	Major Advantages	Major Disadvantages
Cement Mortar Linings and Coatings	• Standard steel pipe coating • Protects pipe during transportation, handling and installation of pipe • Least expensive coating option • Shop-applied lining is least expensive steel pipe lining (limited to 96" Diameter)	• Mortar linings and coatings can crack over time • Cracked mortar lining or coating can cause corrosion and can reduce the pipe service life • Field applied mortar linings for pipes greater than 96" are time consuming to apply • Added labor cost of applying mortar lining in the field reduces cost effectiveness
Polyurethane Linings and Coatings	• Increased toughness, abrasion resistance, and high adhesion • Factory applied linings and coatings are 100% solids • Problems with application of polyurethane linings and coatings are easily detected with visual inspection and adhesion testing • Lining is competitively priced for diameters greater than 96" when compared to field applied mortar linings	• Relatively new lining and coating material • Polyurethane coatings costs roughly 15-25% more than mortar coating
Dielectric Coating (Tape Wrap)	• Excellent dielectric properties • Cost comparable to standard mortar coating	• Easily damaged during construction and prone to utility "dig in" • Limited resistance to ultraviolet radiation and hydrocarbons • Quality control issues with hand wrapped fabricated specials
Dual Coating System	• Provides pipe corrosion protection of dielectric coating • Provides protection of dielectric coating with mortar overcoating	• Most expensive coating as it is essentially two coatings (25-35% more than standard mortar coating)

The linings available for the size of pipe being considered for the Bear River Pipeline are field applied mortar lining and polyurethane lining. As the costs of these two options are comparable, it is recommended that the polyurethane lining be used due to its superior toughness and ease of installation. Likewise it is recommended that polyurethane be used as the pipe coating due to its increased toughness and protection when compared to mortar coating and its decreased cost when compared with a dual coating system.

Pipe Joints. Steel pipe is constructed in the field using various types of joints. The type of joint used for a steel pipeline is determined by the design parameters of the steel pipeline. The two types of steel pipe joints discussed in this section are gasket type joints and welded joints.

<u>Gasketed Joints.</u> Gasketed joints are widely used in water pipelines of many sizes. These joints can provide many benefits including a watertight seal up to approximately 250 psi working pressure, a certain amount of flexibility for minor joint deflections and settlement, and simple installation. However, gasketed joints are generally only manufactured up to 48-inch in diameter making them much too small to be considered for the Bear River Pipeline.

<u>Welded Joints.</u> Joint efficiency of welded joints refers to the relative strength of the weld compared to a straight run of non-jointed pipe. The welded joints on steel pipe can be defined by the following three types:

1. Single Lap Weld
2. Double Lap Weld
3. Butt Weld

Single Lap Welds: In a single lap weld, the pipe is fit together in a slip joint (lap) configuration and a single weld fillet is applied to the joint, either on the inside or the outside of the pipe. This type of weld provides a watertight seal as well as a degree of joint restraint. The joint efficiency of a single lap weld is approximately 45 percent.

Double Lap Welds: Double lap welds are joints welded both on the inside and outside of the lap joint. This type of joint provides increased strength over the single lap welds. The double lap type of weld uses air tests to test the welded joint, an easier testing method than the ultrasonic type tests performed on single lap welded joints. The key feature of the double lap weld is that it provides full joint restraint under a range of operating conditions. Double lap welds are about twice as expensive as single lap welds because the work at each joint is essentially doubled. The joint efficiency of a double lap weld is approximately 60 percent.

Butt Welds: Butt welds consist of two straight ends of pipe welded together at the ends. A butt weld has a larger weld fillet, which is more labor and materials intensive. A key feature, unique only to the butt weld, is that it is able to withstand longitudinal forces up to the strength of the pipe wall. This type of weld is ideal for steep slopes, potential wash-out areas, and for joint restraint in severe conditions (i.e. above ground transmission piping). Joint efficiencies of butt-welded pipe, if properly installed, can reach 100 percent (equal to a straight run of non-jointed pipe).

The major advantages and disadvantages for each type of weld have been summarized in Table 7-8.

Table 7-8
Summary of Steel Pipe Joint Data

Joint Type	Major Advantages	Major Disadvantages
Single Lap Weld	• A standard steel pipe weld • Provides some joint strength • Fastest joint weld to install • Least expensive welded joint type	• Less joint restraint than other types of welds • Not as reliably tested in the field
Double Lap Weld	• Provides full joint restraint • Easily and reliably tested weld • Higher joint efficiency than single lap	• More expensive and time consuming than single lap • Increases time of pipeline installation over single lap weld • Cost roughly 2 times a single lap weld
Butt Weld	• Maintains full pipe wall strength throughout pipeline (no weak point at the joint) • 100% efficient	• Expensive weld and seldom performed in buried applications • Increases time of pipeline installation significantly • Cost roughly 2.7 times more than a single lap weld

The recommended pipeline joint for the Bear River Pipeline is a combination of single lap welded joints in the unrestrained section of pipe with double lap welded joints in the required restrained sections of pipe. Further evaluation of this option should be performed in the pre-design and final design process.

Pipe Wall Thickness. Preliminary calculations were performed on the required wall thickness of each pipe diameter of the Bear River Pipeline. These calculations were based on the operating pressures of the pipeline pump station as well as the estimated surge pressures. The wall thickness was calculated based on the AWWA M-11 standard steel pipe wall thickness calculations. A wall thickness was calculated by reach, based on the lowest elevation in each reach. The findings are summarized in Table 7-9. It should be stressed that these wall thicknesses were developed for cost estimation purposes only and should be re-evaluated in more detail during the preliminary design process. Final wall thicknesses must be determined based on internal pressures, external loading, temperature differences, and other criteria.

Table 7-9
Summary of Conceptual Pipe Wall Thickness Recommendations

Pipeline Reach	Maximum Design Pressure (psi)	Steel Wall Thickness (in)
Collinston I Reach	111	9/16
Collinston II Reach	180	9/16
Supply Reach	128	9/16
North Box Elder County Reach	182	9/16
South Box Elder County Reach	185	9/16
Weber County Reach	175	9/16

Note:

1. Estimated maximum HGL is based upon a static elevation of each respective pump station, plus dynamic head from pumping. Actual design HGL to be confirmed during the preliminary and final design phases of the project.

Pipe Zone Backfill Evaluation. The pipe zone is the region of backfill material under and around a pipe. Proper installation of pipe zone material is vital to maintaining the strength, stability, and protection of a pipeline. Well-compacted sand backfill is typically the material of choice for use in the pipe zone surrounding flexible pipe. The alternative material evaluated in this memorandum is a controlled low-strength material (CLSM). CLSM is a low-strength, cement-treated, backfill slurry (usually around 200 psi strength) that is poured into the trench around the pipe. CLSM is installed as a slurry mix that is better able to fill the area under and around the pipe than mechanically compacted backfill materials, therefore providing excellent support to help reduce pipe deflection or settlement. With sand, poor compaction due to contractor error around the base of the pipe can have negative impacts on the integrity of the steel pipe. With CLSM this error is reduced or eliminated.

An additional benefit of CLSM is that it encases the pipe in a much harder material than the surrounding soil and helps prevent contact with the pipe and pipe zone from encroaching utility construction.

The pipe zone backfill cost estimates were obtained from recent local construction projects. The additional costs of using CLSM in place of sand backfill were evaluated as two installation options:

1. 70 percent CLSM Bedding: CLSM backfill to 70 percent of the pipe diameter with sand backfill up to 12 inches above the top of the pipe.
2. Full CLSM Encasement: CLSM backfill up to 12 inches above the top of the pipe.

The additional costs per foot for both CLSM options are summarized in Table 7-10.

Table 7-10
Summary of Pipe Zone CLSM Backfill Unit Costs

	Additional Cost per Foot for:	
Dia. (in.)	**Replace Sand with CLSM to 70 Percent of the Pipe Diameter**	**Replace Sand with CLSM to 12 Inches Above Pipe**
126	$228	$544
114	$193	$458
108	$177	$418
102	$162	$381
90	$134	$311

Notes:
1. All costs are in dollars per foot of pipeline trench.
2. The pipe zone trench dimensions were assumed to be 12 inches of pipe bedding, 24 inches of side clearance, 4-foot vertical walls, and one to one (1:1) side slopes.
3. It was assumed that CLSM required no forming and cost $100/CY, includes labor. Sand cost $12/CY which includes compaction.

The cost increase for the CLSM options for the different pipe sizes varies. The additional cost for these options applied to the entire length of each reach is seen in Table 7-11.

Table 7-11
Summary of Pipe Zone CLSM Backfill Costs

	Additional Cost per Reach in Millions of Dollars for:	
Dia. (in.)	**Replace Sand with CLSM to 70 Percent of the Pipe Diameter**	**Replace Sand with CLSM to 12 Inches Above Pipe**
126	$6.37	$15.20
114	$27.58	$65.42
108	$1.12	$2.65
102	$1.03	$2.41
90	$15.61	$36.10

It is assumed that there will be a high degree of construction inspection on site throughout the Bear River Pipeline project. With proper inspection during installation, sand backfill can provide excellent pipe zone support. Costs of the CLSM options appear to be much higher than the cost of dedicated inspectors on-site to monitor sand backfill installation. For this reason, it is recommended that sand be used as the standard pipe zone backfill material for the pipeline. To improve the installation of this material, it is recommended that the "saturation and internal vibration method" be used to place the pipe zone backfill. It is also recommended that, in special cases, the CLSM material be used to encase the pipe. Such cases would occur in highly congested intersections where future utility dig-ins may be expected, at creek crossings, and at other sensitive areas of the pipe alignment. The use of CLSM backfill should be determined by the design engineer on a case-by-case basis for the local protection of the pipeline.

7.3.3 Pipeline Plan and Profile Sheets

Plan and profile sheets (PP-1 to PP-16) for the entire proposed alignment of the Bear River Pipeline have been included in Volume II of this report. The plan and profile sheets represent a conceptual design of the pipeline facilities which include major utility crossings, pipeline appurtenances, mainline valve vault locations, metering vaults, and pump station locations.

7.4 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

7.4.1 Introduction

A high-level geological/geotechnical assessment was performed to identify constraints or fatal flaws related to geologic or geotechnical conditions along the recommended Bear River Pipeline alignment (shown on Figure 6-38 [Volume II]). The evaluation included limited review of available existing data for the project and surrounding area and windshield survey observations of site conditions along the preferred alignment.

No constraints or fatal-flaws related to geologic or geotechnical conditions that would be expected to preclude construction of the pipeline along the preferred alignment were identified during the assessment. Based on information obtained through the assessment, construction of the pipeline along the other short-listed alignments (shown in Figures 6-31 to 6-36 [Volume II]) would not be expected to present significantly differing conditions or lesser constraints than as described above.

7.4.2 Existing Data Review

Existing data reviewed for this assessment consisted primarily of geologic maps and reports available through the Utah Geological Survey (UGS) and a preliminary engineering and design report for the proposed Washakie Reservoir at the north end of the pipeline for supply storage. These included the following:

- Digital Geologic Map of Utah (Hintze, 2000)
- Geologic Map of Utah (Hintze, 1980)
- Geology of Box Elder County, Utah, East Half (Doelling, 1980)
- Landslide Map of Utah (Harty, 1991)
- Shallow Groundwater and Related Hazards (Hecker, 1988)

- Liquefaction Potential Map for the Northern Wasatch Front, Utah (Anderson, 1990)
- Index Map of Oblique Aerial Photography, Wasatch Fault Investigation Reports and Oblique Aerial Photography - North of Brigham City and Cache Valley Faults (Bowman, 2009)
- Washakie Reservoir Project Preliminary Engineering and Design Report (CH2M Hill, 2010)

The United States Geological Survey website was also accessed to obtain seismic and quaternary fault data.

Regional Geology. The project is located on the extreme east side of the Basin and Range Physiographic Province along the Malad Valley and Bear River Valley in north-central Utah. The mountains of the Wasatch Range located just east of the project form the western boundary of the Middle Rocky Mountains Physiographic Province. The north-south oriented Malad Valley and Bear River Valley are bounded on the west by the West Hills and Promontory Point and on the east by the mountains of the Wasatch Range. Valley fill within the valleys includes Quaternary age alluvium/colluvium and lake deposits of historic Lake Bonneville. Rocks of the West Hills consist of the Permian-age Wells Formation comprised of interbedded limestone and sandstone. Faulting in the West Hills (as mapped) is minimal. Rocks of the Wasatch Range vary in age from Precambrian to Cenozoic and include metamorphic, igneous/volcanic, and sedimentary rocks. Faulting along the Wasatch Range (as mapped) is extensive (Hintze, 1980; 2000).

Site Surficial Geology. Surficial geology along the project alignment and adjacent/nearby areas is mapped by Hintze (1980 and 2000) as including Alluvium and Colluvium (Qa), Lake Bonneville Deposits (Ql), Older Alluvial Deposits (Qao), and Marshes (Qm). Alluvium and Colluvium units are mapped as occurring along the margins of the Malad and Bear River Valleys. The Lake Bonneville Deposits, Older Alluvial Deposits, and Marshes are mapped as occurring on the valley floors.

Doelling (1980) mapped these areas as including Lake Clays (Qlc), described as chiefly clay or silt deposits of Lake Bonneville with minor amounts of predominately fine grained alluvial, colluvial, or aeolian deposits, and Gravel (Qg) described as graveliferous deposits of all types with minor clay, silt, and sand. No bedrock outcrops are mapped along or immediately adjacent to the project alignment. Gravel units are mapped as occurring along the margins of the Malad and Bear River Valleys. Lake Clays are mapped as occurring on the valley floors.

No bedrock units are mapped as occurring along or immediately adjacent to the project alignment.

Seismicity and Faults. The USGS 2009 Earthquake Probability Mapping program (USGS, 2009) was researched for the project site by latitude/longitude values representing the approximate geographic center of the preferred alignment (41.58 deg N latitude, -112.12 deg W longitude). Based on the program output, the probability of various magnitude (M) earthquakes occurring within about 30 miles (50 kilometers) of the site in a 50-year period is as follows: for

M greater than 5.0, 60 to 80 percent; for M greater than 6.0, 25 to 40 percent; for M greater than 7.0, one to 5 percent.

Probabilistic earthquake ground motion values were obtained from the USGS National Seismic Hazard Mapping Project, Earthquake Hazards Program (USGS, 2002). Interpolated, probabilistic ground motion values of peak ground acceleration (PGA) in rock for 2 and 10 percent probabilities of exceedance in 50 years were obtained for the approximate geographic center of the preferred alignment and are presented in the following Table 7-12.

Table 7-12
Probabilistic Ground Motion, (g)

	PGA(1)	
Site Location	**10% PE in 50 years (RP = 475 years)**	**2% PE in 50 years (RP = 2,475 years)**
41.58 deg N latitude, -112.12 deg W longitude	0.46g	1.67g

Notes: (1) Values are for "firm rock" sites with shear-wave velocity of 760 meters/second (2,500 ft/sec) in the top 30 meters (100 feet) of the profile.
PGA - Peak Ground Acceleration
PE - Probability of Exceedance
RP - Return Period

As indicated above, the PGA values are for firm rock categorized as Site Class B in accordance with the International Building Code (IBC), Chapter 16, Section 1613.2, Table 1613.5.2 (ICC, 2006). These values should be evaluated and adjusted as appropriate based on the subsurface profile encountered in the course of geotechnical investigation of the project alignment. Seismic ground motion values for design should be adjusted using appropriate attenuation factors for actual in-place subsurface materials as presented in Chapter 16 of the IBC (2006).

The USGS Earthquake Hazards Program, Quaternary Fault and Fold Database of the United States (USGS, 2003) was searched to identify known faults at or in the vicinity of the project site. The project alignment traverses the floors and sides of the Malad Valley and Bear River Valley just west of the Wasatch Fault Zone, one of the longest and most tectonically active normal faults in North America. The fault zone shows evidence of recurrent Holocene surface faulting. Half of the estimated 50 to 120 post-Lake Bonneville surface-faulting earthquakes in the Wasatch Front region have been on the Wasatch Fault Zone. This fault zone has 10 sections, or seismogenic segments, that are thought to behave, at least somewhat, independently. The project alignment traverses nearby to the west of three of these sections including (from north to south): the Clarkston Mountain Section, an 11.8-mile long Late Quaternary segment (most recent deformation within the last 130,000 years) with a reported slip rate of less than 0.2 millimeters per year; the Collinston Section, an 18.6-mile long Late Quaternary segment with a reported slip rate of less than 0.2 millimeters per year; and the Brigham City Section, and a 23-mile long Latest Quaternary segment (most recent deformation within the last 15,000 years) with a reported slip rate of 1.0 to 5.0 millimeters per year.

Oblique aerial photographic fault mapping (Bowman, 2009) illustrates Wasatch Fault Zone fault locations overlaid on aerial photomapping in the vicinity of the project alignment. Based on this mapping, numerous lineaments of the Wasatch Fault Zone exist along the west flanks of the mountains of the Wasatch Range (along the east side of the Malad and Bear River Valleys) and several extend immediately adjacent or onto the valley floor. Locations where the preferred alignment appears to extend very close to or cross these mapped faults include just east of Fielding, Utah (about Alignment Stations 480+00 to 500+00) and the Perry and Willard, Utah areas (about Alignment Stations 1900+00 to 2480+00).

The Washakie Reservoir Project Preliminary Engineering and Design Report (CH2M Hill, 2010) addressed seismicity and faults for the area located at and adjacent to the north and east of the north end of the project alignment. The seismic analysis provided in the Washakie report was specific to one portion of the proposed reservoir embankment located east of the north end of the pipeline alignment. The controlling seismic source used in the analysis was the combined Clarkston and Malad Segments of the Wasatch Fault Zone (lateral lineaments of which are believed to extend across the Malad Valley and planned reservoir footprint) and an estimated maximum moment magnitude earthquake of 7.2 was used. Deterministic seismic hazard analyses were conducted and predicted relatively high levels of shaking at the ground surface (peak ground acceleration values of 0.3 to 0.5 g) for the embankment design.

Landslides. Utah has a landslide hazard rating of “severe” and landslides are one of the most common geologic hazards in Utah with almost 10,000 mapped across the state. While most landslides in the state occur in mountainous regions, many also occur in valley areas along steep slopes bordering streams, particularly in the Wasatch Front where deltaic deposits of Pleistocene Lake Bonneville have been deeply incised by streams. Earthquake-induced lateral-spread failures typically occur on gentle slopes over broad areas on valley floors where silty or sandy soils and shallow groundwater conditions conducive to liquefaction exist. These conditions also exist along many river channels, reservoir shores, and valley bottoms (Harty, 1991).

The “Landslide Map of Utah” (Harty, 1991) illustrates locations of numerous landslides of various types along the west flanks of the Wasatch Front (along the east side of the Malad and Bear River Valleys) including a number of historically active (defined by the map as occurring between the years 1847 to 1991) deep-seated landslides and shallow landslides nearby or extending onto the preferred alignment. Locations where the preferred alignment appears to extend very close to or cross these mapped landslides include just south and east of Fielding, Utah (about Station 480+00 to 620+00) and the Perry and Willard, Utah areas (about Station 1900+00 to 2400+00).

Groundwater and Liquefaction. The Basin and Range Physiographic Province consists of wide, flat, north-trending structural basins separated by narrow, linear mountain ranges many of which are topographically closed and internally drained. In these basins, thick accumulations of lacustrine and alluvial fill exist that contain abundant groundwater that generally is shallow in central areas of the basins. The project alignment exists within the Lower Bear River Drainage Area and Wasatch Front Valleys portions of the Basin and Range province, both of which are described as areas of lacustrine and alluvial deposits with groundwater conditions reported as shallow, saturated, and/or artesian over extensive areas. The “Shallow Groundwater and Related Hazards in Utah” map (Hecker, 1988) indicates that the entire project alignment and surrounding area exist in areas where depth to groundwater is generally less than 10 feet, which are most likely to experience shallow groundwater problems, and wherein investigations are advised prior to land development to assess depths to groundwater and resulting hazards.

The Liquefaction Potential Map for the Northern Wasatch Front, Utah (Anderson, 1990) was reviewed to identify relative liquefaction potential for the project alignment and surrounding areas. This map delineates areas within its bounds as having very low, moderate to low, moderate to high, or high liquefaction potential based on two factors: critical earthquake acceleration required for liquefaction, and approximate 100-year probability of exceedance. The liquefaction potential map indicates that the vast majority of the project alignment and surrounding areas possess moderate to low, moderate to high, or high liquefaction potential. Locations along the preferred alignment with high liquefaction potential include areas at and nearby crossings of the Malad River and Bear River and all areas south (up-station) of Corinne, Utah (about Alignment Stations 1560+00 to 2880+00). Very low liquefaction potential areas appear to exist only along the northern-most reaches of the alignment near its planned tie-in to the proposed Washakie Reservoir and along the east side of the Malad Valley (about Alignment Stations 10+00 to 280+00). Areas of moderate to low liquefaction potential exist between Plymouth and Fielding, Utah (about Alignment Stations 360+00 to 480+00).

7.4.3 Geological/Geotechnical Reconnaissance

A high-level reconnaissance of the preferred pipeline alignment was performed by windshield survey observations and stopping at selected locations along roadway rights-of-way. During the reconnaissance, observations were made to identify general surface conditions, surficial geologic conditions, areas where shallow groundwater conditions likely exist, and any other observable geological and geotechnical conditions that could affect construction or performance of the proposed pipeline.

General Surface Topographic Conditions. Surface topography ranges from undulating and gently sloping to nearly flat across the majority of the preferred alignment and nearby areas, except where the alignment crosses or parallels nearby significant drainages including the Malad River, the Bear River, and their tributaries. These drainages are deeply incised in some areas, especially in the northern portions of the project alignment (Stations 00+00 to about 800+00). Where deeply incised, these drainages form canyon-like features with very steep to nearly vertical slopes ranging from as great as several hundred feet in height to as little as 20 feet. Undulating to gently sloping terrain generally exists from about Stations 00+00 to 280+00 where the alignment traverses the eastern flanks of the West Hills before crossing the Malad River and entering the valley floor, and from about Stations 1900+00 to 2380+00 where the alignment leaves the valley floor extending east up-slope to and then along the west flanks of the Wasatch Front. From about Station 2380+00 to its southern terminus at Station 2880+00, the alignment traverses nearly flat terrain of the valley floor.

Surficial Geologic Conditions. The land surface over the majority of the project alignment and adjacent areas is covered with thick native vegetation or agricultural crops, or comprises various improvements including roadways and rights-of-way, railroad lines and rights-of-way, unlined earthen irrigation water supply canals, and occasional commercial, agricultural, and residential buildings. As such, surficial geologic materials generally were not directly observable.

Information regarding surficial materials is based on observations of roadway, railroad, irrigation canal, and natural drainage cuts and exposed soil areas mainly associated with agricultural fields or salt flat and marsh areas.

The majority of the alignment appeared situated in relatively fine-grained soil deposits consisting predominately of clays, silts, and fine sands with lesser amounts of gravel. More upland areas near the valley margins along flanks of the West Hills or Wasatch Front (about Stations 00+00 to 280+00 and 1900+00 to 2380+20 as described above) consisted of relatively coarser-grained soils with appreciable amounts of gravel.

Large boulders and rock blocks (ranging in size from several to as much as 10 or more feet in maximum dimension) in an alluvial/colluvial soil matrix (sometimes referred to as "BIM" rock or block-in-matrix rock) were observed adjacent and nearby to the east of the pipeline alignment from about Stations 2360+00 to 2370+00. BIM rock conditions were observed at the ground surface in natural slopes above (up-slope of) the alignment and in cut slopes of material pits located just south of the alignment along the west side of US 89. Surficial geology is mapped for this area of the preferred alignment as Lake Bonneville deposits (Ql) by Hintz (1980, 2000), and as Gravel (Qg) by Doelling (1980). This area coincides with the general location of several deep-seated landslides mapped nearby or extending onto the preferred alignment as previously discussed.

No bedrock outcrops were observed along or nearby the pipeline alignment. The observed materials as described above generally are consistent with the mapped surficial geologic materials as previously discussed.

Shallow Groundwater. Apparent shallow groundwater conditions were observed only along valley floor portions of the alignment and predominately in areas not under agricultural production. Observed conditions as indicators of apparent shallow groundwater included large areas (as opposed to small isolated areas nearby irrigation canals or roadway/railroad drainage areas) with wetland vegetation such as cat tails and salt marsh grasses, bare soil exposures with precipitate deposits (salt flats), and adjacent/nearby open water areas. Based on these indicators, shallow groundwater conditions were apparent only along the central portions of the alignment from about Stations 1520+00 to 1910+00, within low-lying areas just east of the Bear River Migratory Bird Refuge and north of Willard Reservoir. These observed areas agreed with mapped wetlands as previously discussed. Apparent shallow groundwater conditions were also observed at crossings of major drainages, including the Malad and Bear Rivers and their major tributaries.

Relative to the existing data review, the entire project alignment and surrounding areas extending to the valley sides and mountain flanks comprise areas identified as having shallow groundwater (depth to groundwater of generally less than 10 feet). As such, the visual indicators used for the field reconnaissance were not sufficient to identify shallow groundwater conditions except where groundwater is shallow enough to support wetland vegetation, saturated ground surfaces, or surface water bodies.

7.4.4 Summary

Information on geologic conditions and potential hazards as obtained through review of existing data and site reconnaissance as discussed above is summarized in Table 7-13 below.

Table 7-13
Identified Potential Geologic Hazard Summary

	Potential Geologic Hazard				
	Faults	**Landslides**	**Shallow Groundwater**	**High Liquefaction Potential**	**Bed Rock or BIM Rock**
Approximate Locations Along Recommended Pipeline Alignment	Sta. 480+00 to 500+00 and Sta. 1900+00 to 2480+00	Sta. 480+00 to 620+00 and Sta. 1900+00 to 2400+00	Entire alignment and surrounding area	Malad River and Bear River crossings, and Sta. 1560+00 to 2880+00	Sta. 2360+00 to 2370+00

7.4.5 Geologic and Geotechnical Conditions/Constraints and Construction Considerations

Based on the results of the assessment, a number of potential geological and geotechnical constraints were identified. These constraints, along with construction considerations applicable to each, are discussed below.

Geologic Materials (Lake Deposits and Alluvium). Lake deposits and alluvium reportedly comprise surface geologic deposits over the entire project alignment and surrounding areas. Both of these deposits can include unconsolidated or low-strength soils that could compress or collapse under applied loads. Special subgrade preparation may be required. This may range from preparation and compaction of native subgrade, to over excavation and replacement with engineered fill, subgrade reinforcement with geotextile materials, or a combination of these mitigations.

Lake deposits and alluvium (especially lake deposits known to exist in the project area) can include high-salt content soils and/or salt lenses or deposits that may possess high potential for corrosion of steel or concrete. Steel and concrete incorporated into the project likely will need to be protected against chloride or sulfate corrosion.

Apparent BIM rock conditions were observed adjacent and nearby the project alignment at one location (about Alignment Stations 2360+00 to 2370+00) and similar conditions could exist in the subsurface along portions of the alignment that traverse nearby or across the flanks of the Wasatch Front (about Alignment Stations 1900+00 to 2380+20). While not observed at the ground surface, buried bedrock may also exist in these areas. BIM rock or bedrock in the subsurface along the project alignment would result in constraints to excavations and could require the use of special excavation equipment or blasting.

Subsurface conditions including unconsolidated or low-strength soils, high-salt content soils and salt deposits, and BIM rock or bedrock should be addressed during investigation for design.

Seismicity. The project alignment and vicinity are located in a moderately-high to high seismic region centered along the Wasatch Front. The probability of various magnitude (M) earthquakes occurring within about 30 miles (50 kilometers) of the site in a 50-year period is as follows: for M greater than 5.0, 60 to 80 percent; for M greater than 6.0, 25 to 40 percent; for M greater than 7.0, 1 to 5 percent. For the approximate geographic center of the project alignment, interpolated, probabilistic ground motion values of peak ground acceleration (PGA) in rock for two- and 10-percent probabilities of exceedance in 50 years are 1.67g and 0.46g, respectively. As such, strong to very strong ground shaking can be expected along the alignment.

Strong to very strong ground shaking could cause lateral-spread failures to occur on gentle slopes over broad areas on valley floors where silty or sandy soils and shallow groundwater conditions conducive to liquefaction exist. Areas conducive to lateral-spread will need to be delineated. Pipeline design and construction should consider avoidance or mitigation of soils prone to lateral spread. The seismic conditions of the area will need to be addressed during design and construction and should account for earthquake-induced ground shaking, liquefaction and settlement of soils, and ground movements as appropriate for the site soil conditions and design earthquake.

Quaternary Faults. The project alignment traverses three seismogenic segments of the Wasatch Fault Zone. Quaternary deformation along this fault zone is well documented to have occurred during the last 15,000 to 130,000 years. Vertical fault displacements can be expected along the alignment, especially along portions located close to the flanks of the Wasatch Front, in response to moderate to strong earthquakes.

Quaternary fault locations and seismic conditions of the area will need to be addressed during design and construction and should account for fault-related movements for the design earthquake. Exploratory trenching of faults may be prudent along portions of the alignment in close proximity to or which cross mapped or suspected faults.

Landslides. Numerous historic to recent landslides are documented along the Wasatch Front, including a number of historically active (years 1847 to 1991) deep-seated and shallow landslides nearby or extending onto the preferred alignment. Earthquake ground shaking could induce landslides along the Wasatch Front.

Characterization and exploration of identified or suspected landslides may be required along segments of the alignment and previous landslide locations will need to be delineated. Pipeline design and construction should consider avoidance or mitigation of identified or potential landslides.

Shallow Groundwater. Shallow groundwater conditions (depth to groundwater generally less than 10 feet) reportedly exist across the entirety of the project alignment and the surrounding area. In some places, artesian conditions are reported. These conditions are expected to affect in excavation slope stability and subgrade support.

During excavation and construction, sidewall benching or shoring, laying-back of slopes, and dewatering will likely be required. Long-term dewatering or pipeline anchoring may also be required to counteract buoyancy for portions of the pipe in shallow groundwater areas that may be empty during maintenance. Groundwater conditions and design considerations should be addressed in the course of investigation for design.

Liquefaction and Lateral Spreading. The lake deposits and alluvium, site seismicity, and shallow groundwater conditions combine to make liquefaction a potential concern along the project alignment. In areas where loose sands and silts exist in the presence of shallow groundwater, earthquake-induced ground shaking can be expected to result in liquefaction. Lateral-spread failures may occur on gentle slopes over broad areas on valley floors where silty or sandy soils and shallow groundwater conditions conducive to liquefaction exist.

Areas conducive to liquefaction or lateral-spread will need to be delineated. Pipeline design and construction should consider avoidance or mitigation of soils prone to liquefaction or lateral spread. Special subgrade preparation may be required. Depending on the proposed facilities, mitigations may include vibratory compaction, over-excavation and replacement with engineered fill, deep soil improvement with stone columns or other technique, subgrade reinforcement with geosynthetics, or deep foundation systems. Subsurface soil conditions should be addressed during investigation for design.

None of the above identified conditions or constraints are considered fatal flaws or preclude construction of the pipeline along the preferred alignment. Based on information obtained through this high-level assessment, construction of the pipeline along other alternative alignments would not be expected to present significantly differing conditions or lesser constraints than as described above.

Standard engineering mitigations exist for all of the identified conditions and constraints. Actual design and construction considerations can be identified only through geotechnical investigation in support of design. Based on results of geotechnical investigation, engineering mitigation measures required for construction and long-term performance of the pipeline can be evaluated and incorporated into the design.

Geotechnical investigations to support preliminary and final design should include data collection, field and laboratory testing, and engineering analyses that permit evaluation and basis for mitigation of the above conditions, and/or identify areas that may alter the selection of the final alignment.

Field explorations should include standard penetration tests (SPT) and/or cone penetration tests (CPT) to characterize soil relative density and consistency and permit evaluation of potential for liquefaction and lateral spreading. Depth to groundwater should be documented for all subsurface investigation locations which encounter groundwater. Field logging of test pits and test borings should characterize soil classification, plasticity and cementation, to aid in identifying potential liquefaction-prone areas. Test pits and test borings should also be located in areas of suspected or know landslides in order to evaluate landslide deposits and assess the potential for reactivation due to excavations or earthquakes. Detailed geotechnical/geologic reconnaissance and geophysical surveys also will aid in identification and delineation of problematic soils and site conditions.

Laboratory testing of recovered samples should include index property tests including grain size and plasticity analysis to further identify and delineate liquefaction-prone soils. Direct shear tests should be included to identify and delineate soils prone to lateral spreading.

Engineering analysis should include site-specific probabilistic hazard analysis to assess seismic conditions expected in the vicinity of the Wasatch Fault Zone. These analyses should be specific to and appropriate for the planned pipeline at various locations along the alignment and take into account actual subsurface conditions.

7.5 DIVERSION CONCEPT DESIGN

Generally the Collinston Diversion on the Bear River will be designed to intake up to 880 cfs from the Bear River. The typical range of flows would be from 200 cfs to 480 cfs. The concept layout of the diversion includes a side intake river diversion. The river will be diverted using a check dam to allow the minimum flows to be collected at the pump station and also sized so that flood flows can pass without causing upstream inundation or damage to the adjacent pump station.

Basic concept drawings of the diversion intake structure at the Collinston Pump Station and Diversion have been provided on drawings PS-1 and PS-2 of Volume II of this report.

7.6 CACHE COUNTY DELIVERY FACILITIES

The focus of this Concept Report has been on the Bear River Pipeline Project and associated facilities. As outlined in Chapter 4, in order to deliver Bear River water to Cache County from Washakie and also to take water from the Bear River directly into Cache County, additional water conveyance facilities would have to be constructed.

This section provides only a general concept layout of the required Bear River Project facilities for Cache County. The facility sizing is based on the 180 cfs required maximum delivery flow to Cache County. The sizing is also based on input from Cache County as to the location and expected delivery flow rates that will be required in the future as the Project is developed.

The delivery system to Cache County is generally comprised of the following:

- Water delivery from Washakie Reservoir to Cache County
    - 180 cfs delivered/pumped from Washakie to Collinston Diversion Pump Station
    - Transferred via a pipeline from Collinston Pump Station to Cutler Reservoir

  - o Transferred from Cutler Reservoir via various pumping stations and pipelines as described below
- Water delivery from the Bear River to Cache County
  - o Three pump stations located on Cutler Reservoir
  - o One pump station upstream of Cutler Reservoir on the Bear River and Cub River confluence

The location, sizing, and expected flow rates of the proposed Cache County delivery facilities has been provided in Figure 7-5 (Volume II).

7.7 GEOTECHNICAL REFERENCES

Anderson, Loren R., Keaton, Jeffery R., and Bay, James A., 1990, Liquefaction Potential Map for the Northern Wasatch Front, Utah.

Black, B.D., DuRoss, C.B., Hylland, M.D., McDonald, G.N., and Hecker, S. (compilers), 2004b, Fault number 2351c, Wasatch fault zone, Collinston section, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, <http://earthquakes.usgs.gov/regional/qfaults>, accessed 07/20/2010 09:09 AM.

Black, B.D., DuRoss, C.B., Hylland, M.D., McDonald, G.N., and Hecker, S., compilers, 2004c, Fault number 2351d, Wasatch fault zone, Brigham City section, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, <http://earthquakes.usgs.gov/regional/qfaults>, accessed 07/20/2010 09:17 AM.

Black, B.D., DuRoss, C.B., Hylland, M.D., McDonald, G.N., Haller, K.M., and Hecker, S., compilers, 2004a, Fault number 2351b, Wasatch fault zone, Clarkston Mountain section, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, <http://earthquakes.usgs.gov/regional/qfaults>, accessed 07/20/2010 09:13 AM.

Bowman, S.D., Beisner, K., and Unger, C., 2009, Index Map of Oblique Aerial Photography, Wasatch Fault Investigation Reports and Oblique Aerial Photography - North of Brigham City and Cache Valley Faults, Box Elder, Cache, and Weber Counties, Utah, and Franklin and Oneida Counties, Idaho.

CH2M HILL, 2010, Washakie Reservoir Project Preliminary Engineering and Design Report.

Doelling, H. H., 1980, Geology of Box Elder County, Utah, East Half, Utah Geological Survey Bulletin 115.

Harty, K. M., 1991, Landslide Map of Utah, Utah Geological and Mineral Survey Map 133.

Hecker, S., Harty, K.M., and Christenson, G.E., 1988, Shallow Groundwater and Related Hazards in Utah, Utah Geological and Mineral Survey Map 110.

Hintze, L. F., 2000, Geologic Map of Utah, Utah Geological Survey.

Hintze, L. F., Willis, Grant C., Laes, Denise Y. M., Sprinkel, Douglas A., and Brown, Kent D., 2000, Digital Geologic Map of Utah, Utah Geological Survey.

International Code Council (ICC), 2006, International Building Code, Country Club Hills, Illinois, January.

United States Geological Survey (USGS), 2002, National Seismic Hazard Mapping Project, Hazard Map Analysis Tool, <http://gldims.cr.usgs.gov/nshmp2008/viewer.htm>, last updated May 13, 2008, accessed July 20, 2010.

United States Geological Survey (USGS), 2003, Quaternary Fault and Fold Database of the United States, Version 1.0, USGS Open-file Report 03-417,
< http://earthquake.usgs.gov/regional/qfaults/>, accessed July 20, 2010.

United States Geological Survey (USGS), 2009, Earthquake Probability Mapping website, <http://geohazards.usgs.gov/eqprob/2009/>, accessed July 20, 2010

8.0 PIPELINE ENVIRONMENTAL ANALYSIS

8.1 INTRODUCTION

The environmental project team collected existing environmental information to identify the major environmental constraints in the pipeline study area. This data gathering was supplemented by brief field reconnaissance of the entire study area. This information was used to screen alternatives presented in Chapter 6.

This chapter presents the results of a more detailed evaluation of the recommended alignment, and it was based on additional data collection and fieldwork within the corridor of the recommended alignment (see Figure 8-1 [Volume II]). The alignment was divided into eleven study sections for the effort and these sections are shown on Figures 8-2 thru 8-8 (Volume II).

8.1.1 Resource Identification Methods

Information Gathering. Prior to field work, the project team used information from the Utah Conservation Data Center (dwrcdc.nr.utah.gov/ucdc) to generate a list of state sensitive and federally listed wildlife species and their habitat requirements within the study area. Table 8-1 (Sensitive and Special Status Species Potentially Present in the Study Area) on pages 8-3 to 8-4 provides the list of sensitive species considered, their protection status, and the mapped habitat types suitable for the species. The team prepared maps including aerial maps and locations of recorded observations of raptors and other special-status species maintained by the Utah Natural Heritage Program. Maps also included mapped National Wetland Inventory (NWI) wetlands, existing canals and streams, railroads, and municipal roads. The team consulted the National Register of Historic Places (at nationalregisterofhistoricplaces.com) for a list of known historical sites and districts near the study area. Gathered information was then compiled on maps that were used to guide the field surveys.

Methods. A 200-foot-wide corridor centered on the recommended alignment was used as the study area for analyzing potential direct impacts of the recommended alignment on environmental resources. A team of two biologists from HDR conducted surveys on July 21, 22, and 28, 2010, by driving the study area, making notes of habitat types on the aerial maps, and taking photos along the entire route. Public and canal roads provided access to the vast majority of the recommended pipeline alignment. Where access was restricted, the team observed the alignment from a short distance away.

Photo points and other geographic information (such as the locations of schools, parks, and historic structures) were mapped using a Trimble GeoExplorer XP GPS unit and were later transcribed onto maps using ArcMap geographic information software (GIS). Field notes were collected manually and in the Trimble unit and transcribed into ArcMap. Photos of the various habitat types in the corridor are provided in the Volume I Appendix, Part 7.

The early reconnaissance-level environmental surveys indentified the following habitat types as representative of distinct wildlife habitats: developed land, cropland, hayfields, pastures, riparian, wetlands, floodplains, shrub-steppe, and open water. The project team identified these habitat types because each type was fairly uniform within the study area and because each type provided unique habitat characteristics. Sensitive or special-status species that could use each habitat type within the study area are listed in Table 8-1. In addition to the species listed in Table 8-1, the team assessed nesting habitat for raptors and migratory birds since they also receive federal protection.

The project team used GIS software to analyze acres of impact to wildlife habitats by classifying each parcel along the recommended alignment as one of the above habitats and then overlaying a 200-foot-wide buffer centered on the recommended alignment. Acreages of direct impact to each habitat type are presented in Table 8-2. Roads, railroads, and large canals lie on the centerline of much of the recommended alignment; habitat analysis did not include these acreages. Roads, however, comprised 25% (340 acres) of the study area; railroads comprised 4.6% (61 acres), and canals made up 8% (106 acres) of the study area.

Water resources, including waterways, floodplains, and wetlands were mapped prior to field work using publicly available GIS resources. The project team then searched in the field and adjusted mapping according to the present current conditions. For wetlands, the project team relied on NWI mapping only and did not formally delineate wetlands in the field. Acres of direct impact to waterways (open water, other waters of the U.S. like streams and canals) cannot be estimated because the design of the pipeline is not complete and because it is not yet clear if (or how) the pipeline will affect adjacent and crossed waterways.

Cultural and historic resources were also mapped prior to fieldwork using publically available GIS and map resources. Resources marked as historic or of cultural value were identified and located with GPS in the field and later transcribed onto maps.

Socioeconomic considerations were analyzed after identifying the land uses and types, relative economic status, and socially significant resources (parks, schools, trails, churches, gathering places).

Table 8-1
Sensitive and Special-Status Wildlife Species Potentially Present in the Study Area

Common Name	Scientific Name	Status*	Habitat/Comments
Birds			
American white pelican	*Pelecanus erythrorhynchos*	SPC	Open Water, Riparian, Wetlands. Rivers and bays, such as Bear River Bay
Bald eagle	*Haliaeetus leucocephalus*	SPC	Open Water, Riparian. Roosting and foraging occurs within study area; nesting less likely
Bobolink	*Dolichonyx oryzivorus*	SPC	Wetlands (meadows), Pastures (wet), Hayfields
Burrowing owl	*Athene cunicularia*	SPC	Shrub-steppe, rangelands, deep soils
Ferruginous hawk	*Buteo regalis*	SPC	Shrub-steppe, open rangeland
Grasshopper sparrow	*Ammodramus savannarum*	SPC	Shrub-steppe, open and barren areas
Greater sage-grouse	*Centrocercus urophasianus*	SPC	Shrub-steppe, rangelands with sage brush
Lewis's woodpecker	*Melanerpes lewis*	SPC	Riparian. Ponderosa forest, cottonwood riparian, oak woodlands, orchards
Long-billed curlew	*Numenius americanus*	SPC	Pasture, wetlands, hayfields, mud flats, croplands
Mountain plover	*Charadrius montanus*	SPC	Shrub-steppe, desert rangelands, arid or disturbed areas
Northern goshawk	*Accipiter gentilis*	CS	Forests
Sharp-tailed grouse	*Tympanuchus phasianellus*	SPC	Shrub-steppe, rangelands, grasslands, croplands (winter)
Short-eared owl	*Asio flammeus*	SPC	Shrub-steppe, rangelands, grasslands
Yellow-billed cuckoo	*Coccyzus americanus*	C	Riparian trees
Fish			
Bluehead sucker	*Catostomus discobolus*	CS	Open Water. Possible in Bear River near Brigham City.
Bonneville cutthroat trout	*Oncorhynchus clarkii utah*	CS	Open Water. Cool streams with intact riparian habitat in Bonneville Basin.
June sucker	*Chasmistes liorus*	E	Open Water. Endemic to Utah Lake and tributaries.
Lahontan cutthroat trout	*Oncorhynchus clarkii henshawi*	T	Open Water. Lahontan Basin and Pilot Peak Range only
Least chub	*Iotichthys phlegethontis*	CS	Open Water. Largely extirpated; slow water with dense vegetation, pools, and streams in western Utah
Yellowstone cutthroat trout	*Oncorhynchus clarkii bouvieri*	SPC	Open Water. Native to Snake River basin (extreme northwestern Utah)
Mammals			
Gray wolf	*Canis lupus*	E	Extirpated from Utah

Table 8-1
Sensitive and Special-Status Wildlife Species Potentially Present in the Study Area (continued)

Common Name	Scientific Name	Status*	Habitat/Comments
Kit fox	*Vulpes macrotis*	SPC	Shrub-steppe, Floodplains, Pastures, rangelands, grasslands, open desert
Preble's shrew	*Sorex preblei*	SPC	Wetlands. Known in Utah only from south shore of Great Salt Lake
Pygmy rabbit	*Brachylagus idahoensis*	SPC	Shrub-steppe, deep soils, big sagebrush
Townsend's big-eared bat	*Corynorhinus townsendii*	SPC	Caves, mines, buildings; absent from study area
Invertebrates			
California floater	*Anodonta californiensis*	SPC	Raft River range is nearest historic population
Deseret mountainsnail	*Oreohelix peripherica*	SPC	Only in foothills and mountains surrounding the study area
Fat-whorled pondsnail	*Stagnicola bonnevillensis*	C	Known populations west of study area (west of Corinne), in ponds
Lyrate mountainsnail	*Oreohelix haydeni*	SPC	Probably only in surrounding foothills and mountains, limestone outcrops
Northwest Bonneville pyrg	*Pyrgulopsis variegata*	SPC	Only in far western Box Elder and Tooele Counties
Utah physa	*Physella utahensis*	SPC	Possible populations near study area, in ponds
Wasatch mountainsnail	*Oreohelix peripherica wasatchensis*	SPC	Population in the mountains east of study area
Western pearlshell	*Margaritifera falcata*	SPC	Probably extirpated, but small probability at any small springs
Amphibians			
Columbia spotted frog	*Rana luteiventris*	CS	Open Water, Riparian. Perennial springs and seeps.
Great Plains toad	*Bufo cognatus*	SPC	Pastures, Hayfields, Croplands, Shrub-steppe. Desert, grassland, and agricultural habitat; known habitat between Honeyville and Corinne
Western toad	*Bufo boreas*	SPC	Open Water, Wetlands, Floodplains. Streams, springs, pools, wetlands
Plants			
Ute ladies'-tresses	*Spiranthes diluvialis*	T	Wetlands, Floodplains, Pastures. Cool, spring-fed and floodplain wet meadows.

*Status
C = Candidate Species, candidate for listing under Federal ESA
CS = Conservation Species, species managed under a conservation agreement
SPC = Wildlife Species of Concern
T = Threatened Species, listed as Threatened under Federal ESA
E = Endangered

8.2 SUMMARY OF ENVIRONMENTAL ANALYSIS OF THE RECOMMENDED ALIGNMENT

The purpose of this environmental analysis was to characterize the environmental resources existing within the recommended alignment study area that would be impacted (either permanently or temporarily) by constructing the pipeline project along the recommended alignment. The resources present and the potential impacts to those resources from construction are summarized for the entire study area in the following section. A description of the resources and impacts for each section of the pipeline project is presented in Section 8.3, after the project-wide descriptions.

8.2.1 Habitat for Wildlife and Threatened and Endangered Species

The project team did not observe any of the species in Table 8-1 during the field surveys. In addition to the species listed in Table 8-1, the project team assessed nesting habitat for raptors and migratory birds. The recommended alignment area has an abundant raptor and migratory bird nesting habitat spread throughout the habitat types described below.

The following subsections provide brief descriptions of each habitat type. Threatened, endangered, and sensitive species and the habitats they may use within the recommended alignment are listed in Table 8-1. Acres of direct impacts to each habitat type from each pipeline section are summarized in Table 8-2 below.

Table 8-2
Acres of Each Habitat Type within the 200-Foot-Wide Study Area of the Recommended Alignment

	Habitat Type								
Section	Cropland	Floodplain	Hayfield	Pasture	Riparian	Shrub-Steppe	Developed	Wetland	Grand Total*
1	35	7	6	1		18	8		128
2	22	5	20				4	3	90
3	14	14							30
4	20	5	54	12	11	1	4	6	165
5	6		23	3			24		112
6	31		18	3					71
7	38	4			1				55
8	36	8					17	0	110
9	19	4				18		72	131
10	25		8	7	1	4	55	2	222
11	5		1	16	11	1	93	2	230
Grand Total	**252**	**47**	**129**	**42**	**25**	**41**	**204**	**83**	**1346**

*Section Grand Totals include roads (340 acres), canals (106 acres), and railroads (61 acres).

Croplands. An area was considered cropland if it was planted in an annual crop, planted in an annual cover crop, or plowed (not cleared for development). Corn and wheat fields constituted the majority of the cropland along the recommended alignment. In addition, species listed in Table 8-1, raptors readily forage in croplands and game birds such as ring-necked pheasant forage and nest in crop fields and are protected under hunting regulations by the Utah Division of Wildlife Resources. The project team observed several hundred white-faced ibis (*Plegadis chihi*) foraging on the perimeter of irrigated crop fields.

Hayfields. The project team classified all areas of perennial hay crops, including grass or alfalfa, with evidence of routine hay cutting as hayfields (as opposed to a pasture, which is not uniformly cut). Hayfields generally provide similar foraging opportunities as pastures and wet meadows, but the routine cutting prevents nesting or breeding by most wildlife. Hayfields along the recommended alignment were generally large, irrigated alfalfa fields adjacent to crop fields. Raptors and kit foxes both prey opportunistically on rodents and will readily hunt in hayfields. Sensitive species that might use hayfields are listed in Table 8-1 and acres of direct impacts to hayfields are quantified for each pipeline section in Table 8-2.

Pasture. The pasture habitat type was defined by perennially vegetated areas used primarily to graze livestock. Pastures were differentiated from grass hayfields based on animal grazing in pastures versus routine mechanical cutting in hayfields. Pastures provide habitat for many different wildlife species, depending on their size and condition. Pastures in the area were generally large (over 40 acres) and well vegetated with mixed-height grasses, providing relatively high quality habitat in the area. Sensitive species that might use pastures are listed in Table 8-1 and acres of direct impacts to pastures are quantified for each pipeline section in Table 8-2.

Shrub-steppe. Shrub-steppe habitats in the study area contained upland grasses and shrubs including sagebrush (*Artemisia tridentata* ssp.), rubber rabbitbrush (*Ericameria nauseosa*), sunflowers (*Helianthus* sp.), Great Basin wildrye (*Leymus cinereus*), crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*Thinopyrum intermedium*), slender wheatgrass (*Elymus trachycaulus*), cheatgrass (*Bromus tectorum*), curly cup gumweed (*Grindelia squarrosa*), and other weedy species. Shrub-steppe habitat within the alignment study area was generally of poor quality, with abundant cheatgrass and other invasive species.

Floodplain. Floodplains habitats are valuable because they are somewhat limited in the arid West. Floodplains also provide important migratory corridors through developed and fragmented wildlife habitats. The recommended alignment crosses four major floodplains: the Malad River, the Bear River, Black Slough, and the Weber River. The floodplains for these rivers create wooded riparian corridors that provide habitat for many of the species listed in Table 8-1.

Riparian. Riparian habitat was defined by a structurally complex, woody overstory vegetation and proximity to water. The riparian areas in the study area are present mainly on the Corinne Canal, the Bear River, Mill Creek, and the Weber River. Riparian corridors can provide very high-value habitat for wildlife, and many species use them as migration corridors and for cover while accessing water and food. Fragmented riparian areas that lack structurally complex, vegetated stream banks provide less value to wildlife. Sensitive species that might use riparian areas are listed in Table 8-1 and acres of direct impacts to riparian areas are quantified for each pipeline section in Table 8-2.

Open Water. Table 8-3 lists open-water habitats intersected by the recommended alignment from north to south. Special status species that might inhabit open waters within the study area are listed in Table 8-1. Most of the natural streams in the study area provide poor quality habitat for the native fishes and amphibians listed in Table 8-1 due to flow alterations, eutrophication, and sedimentation (Bosworth 2003, USFWS 2001, Sigler and Sigler 1996). Because they do not flow year round, canals (which account for 8% of the study area) usually provide very poor-quality habitat for most native fishes and amphibians. Canals can be regulated as jurisdictional waters of the United States, however, because they can provide hydrology to natural streams and other jurisdictional waterbodies.

Wetlands. Wetlands are defined by soils that are saturated seasonally or year-round and vegetation that is adapted to saturated soils. Wetlands provide valuable habitat for many species of wildlife and plants. Of particular importance is the Bear River Bay, which is downstream of the project and provides habitat for millions of migratory birds, is a primary breeding area for American white pelicans, and a popular recreation area. Sensitive species that might use wetlands in the study area are listed in Table 8-1 and acres of direct impacts to wetlands are quantified for each pipeline section in Table 8-2.

Developed. Developed habitats were defined as areas where the majority of the area was covered in pavement, structures, or imported fill material. The analysis of the developed land type did not include railways, roads, or canals. Developed habitat provides the lowest habitat value for all wildlife considered in this analysis. Raptors and other migratory birds may be found in developed areas.

Table 8-3
Open Water Habitats
Streams and Canals in the Study Area

Name of Waterway	Alignment Sections (see Figure 8-1 thru 8-8 [Volume II])
Streams	
Malad River	1, 2, 7
Bear River	3, 4, 8
Black Slough	9
Three-mile Creek	10
Willard Creek	10
Sixmile Creek	11
Fourmile Creek	11
Mill Creek	11
Weber River	11
Canals	
West Side Canal	2
Corinne Canal	4
North Ogden Canal	11
Willard Canal	11
North Slaterville Canal	11
South Slaterville Canal	11
West Weber Canal	11
Layton Canal	11
Hooper Canal	11

8.2.2 Water Resources

Waterways and Floodplains. The recommended alignment would affect several streams and canals listed in Table 8-3 above. None of the waterbodies listed in Table 8-3 are on Utah's current 303(d) List of Impaired Waters (UDWQ, 2006). There are about 47 acres of floodplain within the 200-foot-wide study area. The alignment would cross the Malad River at three locations, and these crossings would cause direct impacts to the river and adjacent wetlands. The first crossing would be at the proposed Washakie Reservoir, and the direct impacts would result from the reservoir itself and likely changes to channel morphology, capacity, and flow regime downstream. The second crossing would be at the junction of Sections 1 and 2 of the study area (see Figure 8-2 [Volume II]). The third crossing would be south of the town of Bear River City on State Route (SR) 13 (see Figure 8-5 [Volume II]). The Malad River within the study area is considered severely degraded habitat due to decades of dewatering, channel modification and eutrophication. The final design of the pipeline and the construction methods used will determine the exact nature and extent of the impacts to the Malad River floodplain. Most likely, the direct impacts to the river and floodplain from constructing the pipeline would be short term and temporary. As mentioned, constructing the pipeline would also have long-term indirect effects on fluvial processes from constructing an upstream reservoir and diverting water out of the floodplain. These indirect effects might outweigh the direct impacts from construction.

The recommended alignment would directly affect the Bear River in two locations: the Collinston Diversion (Figure 8-3 [Volume II]) and a crossing near Corinne, Utah, on SR 13 (see Figure 8-5 [Volume II]). The Bear River, at these crossings, is also degraded due to a century of dewatering from agricultural diversions and channel bank modifications. As with the Malad River, constructing the pipeline project would cause both long-term and temporary direct impacts to the Bear River. Long-term impacts would be caused by modifications to the channel in the area of the diversion. Temporary impacts would be due to construction activities in the Bear River channel. Proper timing and use of construction best management practices (BMPs) would reduce temporary direct impacts. Constructing the pipeline would also have long-term indirect effects from diverting water out of the Bear River floodplain. The severity of the direct and indirect impacts would depend on the design of the Collinston Diversion facility and the nature, magnitude, proportion, and timing of the diversion. Indirect impacts to the Bear River floodplain could include changes in channel morphology and floodplain functions including wildlife habitat and wetland recharge.

Wetlands. The recommended alignment would directly affect about 83 acres of wetlands, based on NWI mapping and a 200-foot-wide construction corridor. If the pipeline is constructed below the natural grade (not in a berm) and the lands above the trench are restored to their pre-construction condition, the alignment could have mostly temporary wetland impacts. Permanent direct impacts to wetlands might occur at the locations of diversion facilities, maintenance facilities, and other structures that support the operation of the pipeline. A full analysis of direct permanent impacts to wetlands depends on more detailed information about the pipeline design. Most (87%) of the wetland acreage in the study area is in Section 9, which includes part of the Bear River Migratory Bird Refuge (BRMBR). Avoiding permanent, aboveground structures in Section 9 would greatly reduce permanent wetland impacts from the pipeline.

Installing the pipe in a gravel-bedded trench could cause indirect impacts to wetlands. Trench bedding can act as a conduit that can drain shallow groundwater that might supply hydrology to wetlands. The final pipeline design should consider the potential draining effect of granular trench bedding, and where appropriate, take steps to avoid indirect or unintended wetland impacts.

Indirect impacts to wetlands might also include impacts to the floodplain wetlands along the Bear River and Malad River through the loss of hydrology (diversion). However, the hydrologic source of these needs to be determined. The indirect effects of diversion on floodplain wetlands are not yet clear. Most of these wetlands likely depend in some way, even if indirectly through floodplain recharge, on Bear River water. The BRMBR and the Bear River Bay wetland complexes receive water from the Bear River and provide highly important habitat for migratory birds. Indirect impacts from diverting Bear River water could affect large wetland complexes downstream, so the effects of this diversion deserve detailed analysis.

8.2.3 Cultural and Historic Resources

Several historic areas were identified during the field surveys, including Utah Century Farms and either designated or obviously historical houses, barns, or businesses. The most prominent historic feature on the recommended alignment is the Willard Historic District, which includes the Willard Pioneer Cemetery (See Figure 8-7 [Volume II]) and numerous historic houses, including stone houses built by the famous mason Shadrach Jones. Several cultural resource areas may be present within the study area, including the Lower Bear River Archaeological Discontiguous District, but the locations of such resources are restricted and were not available for this report. About 2% of the study area includes obvious historic features, but there are additional historic farms and houses directly adjacent to the study area.

8.2.4 Socioeconomic Considerations

Constructing the pipeline on the recommended alignment could affect several parks, schools, and churches, near the study area by creating noise, dust, and safety concerns. The study area does not contain any designated trails or obvious environmental justice areas. The recommended alignment also crosses the BRMBR, which has designated public hunting areas and is a popular recreational bird watching area. The Block B hunting unit in the BRMBR is crossed by the recommended alignment. Since the alignment crosses the hunting area near the edge, by I-15 and a dirt access road, direct hunting impacts would most likely be from restricted access to hunting areas and indirect impacts from construction noise.

Constructing the pipeline on the recommended alignment would temporarily remove about 423 acres of farmland from production. This farmland includes 252 acres of cropland (primarily wheat and corn), 129 acres of hayfields (alfalfa and grass hay combined), and 42 acres of pastures. Temporary impacts assume that the land would either not be purchased by DWRe or would be leased back to the farmer if it were purchased. Depending on the season and timing of construction, this temporary lost acreage could have a negative economic impact on farmers because of reduced production. In many sections of the study area, ditches and irrigation canals run parallel to the recommended alignment, and a 200-foot-wide construction footprint could disrupt irrigation systems in that area and cause greater economic impacts to farmers. Temporary relocation of ditches and field drains, and post-construction reclamation would reduce the economic impact to farmers.

The greatest potential for economic impacts to farmers is in Sections 4, 5, and 6 (Figures 8-3 and 8-4 [Volume II]). Section 4 parallels the Corinne Canal, and many fields were irrigated directly from the canal during the field surveys. Sections 5 and 6 follow SR 13 and 5200 West, which have ditches on both sides. Restoring fields and ditches to their pre-construction conditions would reduce these impacts to temporary economic impacts.

8.3 IMPACTS FROM SPECIFIC SECTIONS OF THE RECOMMENDED ALIGNMENT

Section 8.3 describes various sections of the project and the resources present and the potential impacts to those resources. Presenting impacts section by section was intended to facilitate planning and comparison with the other analyses contained in this Concept Report. Describing the resources and impacts within each section was also intended to identify areas of special environmental concern.

8.3.1 Section 1 – Union Pacific Railroad

Habitat for Wildlife and Threatened and Endangered Species. Table 8-2 above summarizes the acres of direct impacts to wildlife habitat in the Section 1 study area. Figure 8-2 (Volume II) shows the habitat classifications in Section 1. Most of the developed habitat in this section was part of the Nucor Bar Mill–Plymouth facility. The entire shrub-steppe habitat in this section was within the Malad River floodplain.

The recommended alignment would have short-term and temporary direct impacts to these habitats. The acreage of habitat impact in Section 1 is probably insignificant compared to the amount of similar habitat that exists nearby. Construction disturbance in the Malad River floodplain corridor would cause greater temporary impacts to wildlife than construction of the pipeline in Section 1. The Malad River provides a natural migration corridor as well as the only vegetated crossing under Interstate 15 (I-15) in the area. The timing and season of construction would influence the severity of this impact.

The proposed Washakie Reservoir and pipeline diversion facility would also remove habitat. Environmental impacts associated with Washakie Reservoir are documented in DWRe's 2010 report on the Washakie Project. Constructing a reservoir would (at a minimum), convert shrub-steppe uplands and croplands to an open freshwater habitat.

Indirect impacts from the recommended pipeline alignment in Section 1 and the proposed Washakie Reservoir include reducing riparian habitat from realigning the Malad River. Indirect impacts may also result downstream from effects of the newly constructed channel (such as sedimentation, altered flow regime). These indirect effects can be complex and will depend on the design and operation of the facilities.

Water Resources. The water bodies and floodplains in the Section 1 study area are the Malad River (and its tributaries) and its floodplain. Within Section 1, the recommended alignment would impact about seven acres of the Malad River floodplain. NWI mapping also shows wetlands downstream of the proposed Washakie Reservoir associated with the Malad River floodplain. Realigning the Malad River could have indirect effects on these downstream wetlands depending on how the new channel affects flow and sedimentation rates.

Cultural and Historic Resources. The field surveys did not identify any obvious cultural or historic resources in the Section 1 study area. The Plymouth Cemetery, which is about 0.85 mile east of the recommended alignment on 20800 North, is the historical area nearest to Section 1.

Socioeconomic Considerations. The field surveys did not identify any parks, trails, recreation areas, or obvious environmental justice areas in or near the Section 1 study area. Constructing the pipeline could temporarily remove about 42 acres of farmland (including about 1 acre of pasture and 6 acres of hayfields) in Section 1 from production. Farmland impacts from the proposed Washakie Reservoir are not included. Impacts to farmland would be similar to those in the corridor-wide discussion in Section 8.2.4.

8.3.2 Section 2 – West Side Canal

Habitat for Wildlife and Threatened and Endangered Species. Table 8-2 summarizes the acres of direct impacts to wildlife habitat in the Section 2 study area. Figure 8-2 and 8-3 (Volume II), shows the habitat classifications in Section 2. The riparian habitat in Section 2 was disturbed and weedy, apparently from construction of the West Side Canal flume. Floodplain wetlands, hayfields, and native rangeland vegetation are adjacent to the flume impact area. The presence of basin big sagebrush in the lower floodplain indicates the potential for pygmy rabbit habitat. Habitat in the floodplain is also suitable for kit fox and sharp-tailed grouse.

Constructing the pipeline on the recommended alignment in Section 2 would cause short-term and temporary direct impacts to wildlife habitat. Habitat would be lost for one season during construction of the pipeline and then restored to its pre-construction condition. Hayfields and wheat fields are widespread in the area, so the temporary loss of 90 acres of primarily agricultural habitat is not expected to have significant effects on wildlife in the area.

Water Resources. Several small wetlands are present within the Malad River floodplain and adjacent to the West Side Canal. Within Section 2, the recommended alignment would affect about 3 acres of wetlands, all of which are adjacent to the West Side Canal. The West Side Canal, however, could be a jurisdictional water of the U.S. Constructing the pipeline would not directly affect wetlands in the Malad River floodplain (see Section 8.2.2, Water Resources).

Cultural and Historic Resources. The field surveys did not identify any obvious cultural or historic resources in the Section 2 study area.

Socioeconomic Considerations. The field surveys did not identify any parks, trails, recreation areas, or obvious environmental justice areas in or near the Section 2 study area. Constructing the pipeline would temporarily remove about 42 acres of farmland in Section 2 from production. Impacts would be similar as those in the corridor-wide discussion in section 8.2.4.

8.3.3 Section 3 – Supply Pipeline from Collinston Diversion

Habitat for Wildlife and Threatened and Endangered Species. Table 8-2 summarizes the acres of direct impacts to wildlife habitat in the Section 3 study area. Wildlife habitats for Section 3 are shown on Figure 8-3 (Volume II). Constructing the pipeline on the recommended alignment in Section 3 would cause short-term and temporary direct impacts to agricultural habitats. Given the wide availability of agricultural habitat in the immediate area, the 14 acres of floodplain temporary direct impacts should not have significant effects on wildlife.

Table 8-2 does not include all of the acreage of direct impacts from the Collinston Diversion facility, since this facility is not fully designed. Riparian habitat on the Bear River near the proposed point of diversion is high quality, and constructing the diversion facility would permanently remove some of this habitat.

Indirect impacts from the Collinston Diversion on the Bear River floodplain could have larger effects on wildlife than direct impacts. If wetlands and riparian vegetation in the Bear River floodplain were significantly reduced due to flow alterations, this would severely degrade the value of the floodplain habitat.

Depending on the proportion of water diverted from the Bear River, the Bear River Bay and the BRMBR could lose a significant water source. This would affect the BRMBR's ability to manage wetlands and support nesting migratory birds, and it could reduce foraging habitat available for bald eagles and American white pelicans. Diverting water from the Bear River has more potential to affect environmental resources indirectly, than direct effects from construction of the pipeline and deserves a detailed analysis. See Section 13.2 of this report for more information.

Water Resources. The supply pipeline and Collinston Diversion facility would directly affect the Bear River and its floodplain. The diversion facility is not fully designed, so the project team could not calculate the acreage of direct impacts. Indirect impacts to the Bear River downstream of the diversion could result from reduced flows. The effects on the Bear River from diversion are dependent on the exact design and operation of the Bear River Project system, and are outside of the scope of this project. Evaluation of such impacts should be the focus of a separate detailed and specific analysis.

Cultural and Historic Resources. The field surveys did not identify any obvious cultural resources in the Section 3 study area. The Hampton's Ford Stage Stop and Barn area is just downstream of the Collinston Diversion and the Cutler Hydroelectric Power Plant Historic District is just upstream of the diversion; both areas are on the National Register of Historic Places.

Socioeconomic Considerations. The field surveys did not identify any parks, trails, recreation areas, or obvious environmental justice areas within the Section 3 pipeline corridor study area. Diverting water from the Bear River would probably affect the downstream agricultural operations within the floodplain. Many of the fields in the floodplain appear to be dry-farmed and may rely on floodplain recharge to provide irrigation to crops.

Constructing the pipeline on the recommended alignment in Section 3 would temporarily remove about 14 acres of farmland, a dry wheat field and a sprinkler-irrigated alfalfa field, from production. The irrigation systems in this section do not appear to be at great risk of being disrupted by pipeline construction, so the impacts to these fields should be limited to the footprint of construction.

Downstream of the diversion in Elwood, Utah, Hansen Park is situated on the banks of the Bear River. Hansen Park is shown on Figure 8-4 (Volume II). Further downstream in the Bear River City Park is also situated on the banks of the Bear River. The loss or reduction of flowing water and subsequent decline in riparian vegetation (trees) could diminish the cultural value of the park.

8.3.4 Section 4 – Corinne Canal

Habitat for Wildlife and Threatened and Endangered Species. Table 8-2 summarizes the acres of direct impacts to wildlife habitat in the Section 4 study area. Section 4 habitats were primarily agricultural (see Figure 8-3 [Volume II]). The Corinne Canal had a large, wooded riparian corridor, and several wetlands were associated with hayfields and pastures. Records from the Utah Natural Heritage Program indicated numerous raptor nests in the area.

Agricultural habitats in Section 4 generally provide good foraging habitat for long-billed curlews and raptors. Habitat might also be suitable for bobolink nesting and foraging, though none were observed during the surveys. Quality habitats in Section 4 benefit from proximity to the Bear River floodplain.

Constructing the pipeline on the recommended alignment in Section 4 would cause short-term and temporary direct impacts to wildlife habitat. Large riparian trees along the Corinne Canal should be preserved to the extent possible to minimize long-term impacts to wildlife. Assuming that preserving riparian habitat is feasible, impacts to wildlife from construction in Section 4 would likely be minor and short term. If riparian vegetation along the Corinne Canal is lost, then migratory birds and raptors would lose habitat, and most other wildlife would be discouraged from using the area due to the lack of cover for a longer term.

Water Resources. The Corinne Canal parallels Section 4 of the recommended alignment. Several small wetlands (six acres total) are present in Section 4 adjacent to the Corinne Canal and the recommended alignment. Corinne Canal may be jurisdictional and, if so, wetlands would be jurisdictional and subject to Section 404 permitting from USACE. These wetlands should be restored to pre-construction conditions when construction is complete to reduce impacts to temporary impacts only. Care should be taken during design and construction of the pipeline to avoid indirectly draining the nearby wetlands via the pipeline trench.

Cultural and Historic Resources. The field surveys did not identify any obvious cultural or historic resources in the Section 4 study area.

Socioeconomic Considerations. The field surveys did not identify any parks, trails, recreation areas, or obvious environmental justice areas in or near the Section 4 study area. Constructing the pipeline would temporarily remove about 86 acres of farmland (including 12 acres of pasture) in Section 4 from production. Several fields in Section 4 were irrigated directly from the Corinne Canal. Impacts to farmlands would be similar as those in the corridor-wide discussion in section 8.2.4.

8.3.5 Section 5 – State Highway 13 and Corinne Canal

Habitat for Wildlife and Threatened and Endangered Species. Table 8-2 summarizes the acres of direct impacts to wildlife habitat in the Section 5 study area. Wildlife habitats in Section 5 are shown on Figure 8-4 (Volume II). Section 5 follows SR 13 through the towns of Tremonton and Elwood. Habitat in Section 5 is suitable mainly for species of raptors. There is some agricultural habitat adjacent to the highway that would provide marginal foraging habitat for long-billed curlew and that might provide habitat for bobolink.

Water Resources. The only waterway in Section 5 of the recommended alignment is the Corinne Canal, which runs parallel to the recommended alignment on the west side for the entire length of Section 5. As mentioned above, the Corinne Canal may be a jurisdictional water of the United States. There were no NWI-mapped wetlands in Section 5 of the recommended alignment. Field reconnaissance did not identify any large wetland areas.

Cultural and Historic Resources. The field surveys did not identify any obvious cultural or historic resources in the Section 5 study area. Some of the homes that would be directly impacted (see discussion below) from construction may potentially be historic.

Socioeconomic Considerations. The field surveys did not identify any parks, trails, recreation areas, or obvious environmental justice areas in or near the Section 5 study area.

Constructing the pipeline would require the removal of several potentially historic homes and businesses on SR 13 in Elwood. A 200-foot-wide construction footprint centered on SR-13, would require the removal of nearly every home and business with frontage on SR 13. About 34 homes and eight businesses (not including farms) would be within the 200-foot-wide construction footprint, and construction would occur in front of several more homes and businesses. SR 13 is a major transportation route in the area, so constructing the pipeline would probably cause temporary traffic impacts as well.

The Corinne Canal runs parallel to SR 13 along Section 5. Constructing the pipeline would temporarily remove about 32 acres of farmland (including three acres of pasture) in Section 5 from production. Impacts would be similar as those in the corridor-wide discussion in section 8.2.4.

8.3.6 Section 6 – County Road 5200 West

Wildlife and Threatened & Endangered Species Habitat. Table 8-2 summarizes the acres of direct impacts to wildlife habitats in the Section 6 study area. Wildlife habitats in Section 6 are shown on Figure 8-4 (Volume II). Section 6 follows 5200 West through croplands and hayfields. Section 6 has fewer trees than do the northern sections, so raptor nesting would be a lesser concern in Section 6. Croplands and hayfields provide foraging habitat for long-billed curlew, and several very large, wet pastures and hay meadows might provide habitat for bobolink.

Water Resources. The field surveys did not identify any named waterways in Section 6. Ditches run parallel to the recommended alignment on both sides of 5200 West. Construction of the pipeline would temporarily affect these ditches and might temporarily disrupt the irrigation systems in the area. No NWI-mapped wetlands are present in Section 6.

Cultural and Historic Resources. The field surveys did not identify any obvious cultural or historic resources in the Section 6 study area.

Socioeconomic Considerations. The field surveys did not identify any parks, trails, recreation areas, or environmental justice areas in or near the Section 6 study area. Constructing the pipeline is likely to obstruct all or most of 5200 West, one of the major transportation routes in the area. Obstructing 5200 West is likely to affect the agricultural community economically, to some degree.

Constructing the pipeline would temporarily remove about 52 acres of farmland (including three acres of pasture) in Section 6 from production. Irrigation ditches run parallel to 5200 West on both sides, and may require relocation during construction. Impacts would be similar as those in the corridor-wide discussion in section 8.2.4.

8.3.7 Section 7 – Farm Roads and Fields

Habitat for Wildlife and Threatened and Endangered Species. Table 8-2 summarizes the acres of direct impacts to wildlife habitats in the Section 7 study area. Wildlife habitats in Section 7 are shown on Figure 8-5 (Volume II). A majority (69 percent) of the land in Section 7 is cropland; roads and canals comprise another 21%. The survey team observed white-faced ibis foraging on the edges of irrigated crop fields during the field surveys. The potential for raptor nesting is high in Section 7 due to the abundant foraging habitat and relatively low human presence; even though fewer nest trees are available. The Malad River floodplain is weedy and dry where the recommended alignment crosses it. The floodplain slopes were vegetated with basin big sagebrush and bunchgrasses and might provide habitat for burrowing owl, grasshopper sparrow, sharp-tailed grouse, and kit fox. Many other migratory birds not listed in Table 8-1 could also nest in the shrub-steppe floodplain vegetation. Aquatic habitat in the Malad River in the area of the recommended alignment in this section is of no value to native aquatic species.

Water Resources. The recommended alignment crosses the Malad River near the town of Bear River City. The Malad River was stagnant and highly eutrophic at the time of the field surveys in July 2010. Constructing the pipeline would cause short-term and temporary impacts to the Malad River and floodplain from the temporary diversions, such as cofferdams, that would be necessary to construct the pipeline. Proper use of construction BMPs would reduce sedimentation and erosion impacts to the Malad River.

There are no NWI-mapped wetlands in Section 7 of the recommended alignment.

Cultural and Historic Resources. The field surveys did not identify any obvious cultural or historic resources in the Section 7 study area.

Socioeconomic Considerations. The field surveys did not identify any parks, trails, recreation areas, or environmental justice areas in or near the Section 7 study area.

Constructing the pipeline would temporarily remove about 38 acres of farmland in Section 7 from production. Depending on the season and timing of construction, this temporary lost acreage could have a negative economic effect on farmers because of reduced production. Disrupting irrigation systems could exacerbate the economic impact to farmers by removing entire fields from production. The recommended alignment follows large irrigation ditches for most of Section 7. A 200-foot-wide construction footprint could disrupt the irrigation systems in the area and cause greater economic impacts to farmers. After construction, fields and ditches should be restored to their pre-construction condition to reduce this impact to a short-term and temporary impact.

8.3.8 Section 8 – Union Pacific Railroad

Habitat for Wildlife and Threatened and Endangered Species. Table 8-2 summarizes the acres of direct impacts to wildlife habitat in the Section 8 study area. Wildlife habitats in Section 8 are shown on Figure 8-5 (Volume II). Section 8 was mostly cropland, developed during the field surveys, and does not provide any high-quality terrestrial habitat. Critical-value habitat for the Great Plains toad (a Species of Concern) is present in the agricultural and wetland areas near the recommended alignment between Honeyville and Corinne. The Bear River, which is crossed in Section 8 of the recommended alignment, provides aquatic and riparian habitat. The Bear River near Section 8 of the recommended alignment probably does not support native fishes due to eutrophication, altered flow regimes, and high turbidity. However, that conclusion was based on limited visual observations only and surveys for bluehead sucker and Bonneville cutthroat trout should be conducted to determine the presence or absence of these candidate species.

Water Resources. Section 8 of the recommended alignment crosses the Bear River. Constructing the pipeline on the recommended alignment in Section 8 would cause direct temporary impacts to the Bear River and its floodplain. If surveys determine that native fishes are present in the river, BMPs should be used to maintain flows, reduce erosion and sedimentation within the floodplain, and allow fish passage.

There was 0.28 acre of NWI-mapped wetlands in Section 8 of the recommended alignment. Impacts to these wetlands are expected to be temporary impacts from constructing the pipeline. The final pipeline design should consider the potential draining effect of granular trench bedding on nearby wetlands and add mitigation measures to avoid undesirable or unintended effects on wetlands.

Cultural and Historic Resources. The field surveys did not identify any cultural or historic resources in the Section 8 study area.

Socioeconomic Considerations. The field surveys did not identify any trails, recreation areas, or environmental justice areas in or near the Section 8 study area.

The recommended alignment travels through the main commercial area of Corinne, Utah. Several businesses could be affected during construction of the pipeline. Constructing the pipeline would also indirectly affect a city park on the south side of the Union Pacific Railroad tracks adjacent to the recommended alignment in Corinne.

Constructing the pipeline would temporarily remove about 36 acres of farmland adjacent to the Union Pacific Railroad in Section 8. Impacts to farmlands in Section 8 would be similar to those discussed in the corridor-wide discussion in section 8.2.4 above.

8.3.9 Section 9 – Chevron Petroleum Pipeline

Habitat for Wildlife and Threatened and Endangered Species. Table 8-2 summarizes the acres of direct impacts to wildlife habitats in the Section 9 study area. Wildlife habitats in Section 9 are shown on Figures 8-5 and 8-6 (Volume II) Section 9 provides the highest quality migratory bird nesting habitat in the study area. The southern three-quarters of Section 9 consist of grasslands (14%) and large wetlands (55%) that are part of the BRMBR. The areas in and around Section 9 are prime foraging areas for bald eagles and American white pelicans.

Direct impacts to wildlife habitat would be short-term and temporary, resulting from construction of the pipeline. Above-ground facilities should be avoided in the BRMBR if possible to reduce impacts to nesting birds and other wildlife. Reducing direct impacts to wildlife would entail timing construction to occur outside sensitive periods for wildlife (such as bird nesting periods), using construction BMPs, and promptly restoring land above the pipeline to pre-construction conditions.

Indirect impacts to migratory birds would include noise and disturbance from construction equipment and would extend beyond the 200-foot-wide study area. These indirect impacts would be greater if construction in the BRMBR occurs during the migratory bird nesting period (usually May 1 to August 31). Indirect draining of wetlands from granular pipeline trench bedding could also affect wildlife habitat. As mentioned above, indirect effects of a change in river hydrology to the BRMBR were not addressed, but will be an important consideration for environmental permitting.

Water Resources. The recommended alignment crosses the Black Slough and its associated floodplain. Constructing the pipeline would directly impact about three acres of the Black Slough floodplain. About 72 acres of wetlands would be affected during construction of the pipeline along Section 9 of the recommended alignment. If land above the pipeline is restored to its pre-construction condition, impacts could be temporary and short-term. However, final pipeline design should carefully consider the potential draining effect of granular trench bedding on adjacent wetlands to avoid indirect or unintended impacts to wetlands.

Cultural and Historic Resources. The field surveys did not identify any cultural or historic resources in the Section 9 study area.

Socioeconomic Considerations. The field surveys did not identify any obvious environmental justice areas in or near the Section 9 study area. The recommended alignment crosses the BRMBR, which is an active recreational birding and hunting area. The recommended alignment crosses mainly the grassland tracts within Unit 5 of the BRMBR. The recommended alignment would cross the BRMBR near the edge of the Block B hunting unit, potentially creating direct and indirect impacts to hunters, depending on the season. The recommended alignment also crosses within about 1,000 feet of the main entrance and visitor's center where many people enjoy the bird observation deck and the wetland trail. Indirect impacts to the visitor's center could result from construction noise and traffic delays at the Forest Street crossing.

Constructing the pipeline would temporarily remove about 19 acres of farmland in Section 9 from production. The recommended alignment follows a large irrigation supply ditch from SR 13 to 800 North. Impacts to farmlands in Section 9 would be similar to the discussion of corridor-wide impacts in section 8.2.4.

8.3.10 Section 10 – US Highway 89

Wildlife and Threatened & Endangered Species Habitat. Table 8-2 summarizes the acres of direct impacts to wildlife habitat in the Section 10 study area. Wildlife habitats in Section 10 are shown on Figures 8-6 and 8-7 (Volume II). Section 10 is the second-most-urbanized section of the recommended alignment with 25% developed land, not including roads, which occupy an additional 48% of Section 10. Section 10 does not provide any high-quality habitat. Raptor nesting is probably the only potential use of the area by sensitive wildlife, though the proximity to US Highway 89 makes it low-quality habitat. The northwest part of the section follows a narrow city street with orchards, pastures, and wetlands on both sides that might provide habitat for bobolink and Lewis's woodpecker. East of US Highway 89 is probable habitat for many more species, but the project would not disturb these habitats if it is constructed on the recommended alignment.

As with the other sections, direct impacts to wildlife habitat would be temporary. Raptor nesting habitat would be permanently reduced if large trees along US Highway 89 were cut down during construction. The impact to raptors would probably be insignificant because large trees are widely available in the area and better habitat is available nearby.

Water Resources. Section 10 of the recommended alignment crosses Three-mile Creek in Perry, Utah, and Willard Creek in Willard, Utah. Both streams pass under US Highway 89 via culverts. Constructing the pipeline would likely require reconstructing the culverts. Impacts to these waters would be temporary during construction of the pipeline. Construction BMPs would reduce impacts to the waters.

About two acres of wetlands would be impacted by a 200-foot-wide construction footprint in Section 10 of the recommended alignment, near the southern terminus of the section. Impacts to wetlands would be temporary and short-term if land above the pipeline is restored to pre-construction conditions. However, final pipeline design should carefully consider the potential draining effect of granular trench bedding on adjacent wetlands to avoid indirect or unintended impacts to wetlands.

Cultural and Historic Resources. Section 10 of the recommended alignment runs through the historic downtown of Perry, Utah, and the Willard Historic District. Several historic structures (including houses, fruit stands, and barns) and orchards are present along US Highway 89. A historic cemetery, the Willard Pioneer Cemetery, is located on US Highway 89 in Willard (see Figure 8-7 [Volume II]) near the Willard Creek debris dam. The Willard Creek debris dam abuts the US Highway 89 right-of-way and might also be a historic structure. Within the Willard Historic District, several historically significant homes built by Shadrach Jones in the late 1800s still stand.

Socioeconomic Considerations. The field surveys did not identify any parks, trails, recreation areas, or obvious environmental justice areas in or near the Section 10 study area.

The recommended alignment follows 2700 South, in Perry, and would pass within about 650 feet of the Perry Elementary School. Further south in Willard, Utah, the alignment would pass directly in front of the Willard Elementary School, the Willard Police Department, and two churches. Indirect impacts from noise, dust, restricted access and safety concerns could result from construction. The recommended alignment would disrupt about 26 Utah Transit Authority (UTA) bus stops on US 89. These bus stops would probably need to be relocated during construction and be handicap accessible. The recommended alignment in Section 10 could impact 40 acres of farmland (orchards and pasture). Orchards could be especially affected by construction from the loss of mature producing trees.

The northwest end of Section 10 follows 2600 North in Perry. The road is narrow, and the 200-foot-wide construction footprint might impact several homes, including some that may be historic. Pipeline construction could cause significant traffic impacts along US Highway 89 if a 200-foot-wide area is required. US Highway 89 is the only north-south transportation route in the area besides I-15. Impacts to US Highway 89 would disproportionately affect agricultural businesses that cannot use the interstate freeway as well as local residents that would have to travel out of their way to drive to a freeway interchange.

8.3.11 Section 11 – 1900 West (State Highway 126)

Habitat for Wildlife and Threatened and Endangered Species. Table 8-2 summarizes the acres of direct impacts to wildlife habitat in the Section 11 study area. Wildlife habitats in Section 11 are shown on Figures 8-7 and 8-8 (Volume II). Section 11 is the most developed section (40% developed land, 38% roads, 5% canals) of the recommended alignment. The habitat that is available is of low value to wildlife due to the degree of fragmentation and development. The riparian areas associated with the Weber River and the Mill Creek floodplain provide suitable habitat for yellow-billed cuckoo and other migratory birds. Suitable raptor nesting and foraging habitat is present throughout the section.

Water Resources. Section 11 crosses the Weber River as well as several canals and small creeks. Waterways crossed by Section 11 are, from north to south, the North Ogden Canal, Willard Canal, Sixmile Creek, Fourmile Creek, North Slaterville Canal, Mill Creek, South Slaterville Canal, Weber River, West Weber Canal, Hooper Canal, and Layton Canal (see Table 8-3). The recommended alignment enters the Layton Canal right-of-way at 2100 South 1900 West, and follows the Layton Canal to the southern pipeline terminus at 2550 South. Each of these waters is potentially a jurisdictional water of the U.S. and may be subject to USACE permitting. Impacts to the above-listed waterways are expected to be short-term, temporary, and resulting from construction only. The Layton Canal is a large canal crossed by the alignment and reconstruction of a portion of the canal will likely be necessary.

Construction would cause about two acres of direct, temporary wetland impacts in north section of Section 11. The pipeline is expected to be buried, and land above the pipeline would be restored to pre-construction condition, resulting in temporary impacts only. However, final pipeline design should consider the possible draining effect of trench bedding and the impact it could have on nearby wetlands and waterways.

Cultural and Historic Resources. The field surveys did not identify any cultural or historic resources in the Section 11 study area.

Socioeconomic Considerations. The field surveys did not identify any trails, or obvious environmental justice areas in or near the Section 11 study area.

The recommended alignment in Section 11 crosses in front of the Farr West City Park, a church, a daycare/preschool (Kinder Academy), and the Weber Fire District Station 61. A 200-foot wide construction corridor would directly impact several of these institutions. Indirect impacts from noise, dust, restricted access, and safety concerns could also result from construction near the schools, parks, and churches. The Weber Fire District Station 61 is only accessed from 1900 West, so access during construction will need to be addressed. The alignment also passes within 750 feet of the Farr West Elementary School.

Section 11 of the recommended alignment would require the removal of many businesses and homes on SR 126 (1900 West). A 200-foot-wide construction area centered on 1900 West would require several residential and commercial acquisitions. Indirect impacts to the homes and businesses from construction and traffic impacts along SR 126 could be substantial as well. SR 126 is a major north-south transportation route and is the commercial center of the cities of

Farr West, Marriot-Slaterville, and West Haven. Every major east-west route in the study area must also cross SR 126 to reach I-15, so construction of the pipeline could introduce traffic impacts.

8.4 POTENTIAL MITIGATION

8.4.1 Wildlife Habitat

Most of the sensitive or special-status species listed in Table 8-1 that are likely to be affected by constructing the pipeline along the recommended alignment are birds. Construction within a certain distance (buffer) of an active raptor nest is prohibited by the U.S. Fish and Wildlife Service (USFWS). Protection buffers for raptor nests vary by species and circumstance but usually range from a 0.25-mile radius for prairie falcons and owls to a 1-mile radius for peregrine falcons and bald eagles (Romin and Muck 1999).

All other migratory bird nesting habitat should be surveyed for active nests within 10 days of all clearing and grubbing activity during the nest season (usually considered May 1 to August 31). All vegetated land usually qualifies as potential migratory nesting bird habitat and should be surveyed before construction.

Mitigation for impacts to wildlife habitat could include timing construction to occur outside the migratory bird nesting period or clearing and grubbing prior to May 1 to the extent possible. If neither of these options is practical, pre-construction surveys should be conducted to ensure that wildlife are not harmed and special-status species are not taken (the Endangered Species Act defines "take" as "… to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."). Active nests must be protected or relocated under a permit from USFWS and the Utah Division of Wildlife Resources.

8.4.2 Water Resources

Mitigation for temporary impacts to wetlands typically ranges from a commitment to restore wetlands within one year to creating replacement wetlands to mitigate for the temporary loss. Permanent impacts would be necessary where an area would need to be drained or where hydrologic impacts cannot be avoided. Permanently lost acres of wetlands generally need to be replaced with created or restored wetlands. The USACE often requires wetlands to be created or restored at ratios greater than 1:1 for permanent impacts; this is often a function of the lag time from wetland impact to wetland mitigation. If permanent impacts to wetlands are anticipated, planning and implementing wetland mitigation before the start of construction can greatly reduce the ratios and cost of mitigation. See also Section 13.2 in this report.

As mentioned, the greatest potential to impact wetlands may result from the indirect impacts of change to the flow regime of the Bear River and Malad River and, if siting in-line storage, direct impacts from reservoir areas. This will have to be addressed, along with the direct permanent impacts, as the mitigation strategy is developed.

8.4.3 Cultural and Historic Resources

The field surveys did not identify any obvious cultural resources. A cultural and archaeological records review should be performed by a qualified specialist before construction. The records review might result in the need to conduct field surveys for resources. Several state and federal laws govern the protection of, and mitigation for damage to, cultural, historic, and archaeological resources, including the federal statutes of the Antiquities Act, Archaeological Resources Protection Act, National Historic Preservation Act, and Native American Graves Protection and Repatriation Act as well as the Utah State Antiquities Act. Protection and/or mitigation for cultural and historic resources will depend on the results of records reviews and surveys and the appropriate governing statute.

8.4.4 Socioeconomic Considerations

Owners' businesses, farmland and farm-related businesses within the pipeline right-of-way will be compensated according to the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, and other state and federal guidelines if the owners' properties are affected by project construction. See Chapter 13 for more information. For indirect farmland impacts, DWRe, in coordination with the property owner, would determine, based on cost comparison, whether to restore access to any remaining parcel or purchase the remainder of the farmland. Temporary construction easements could be put in place and the DWRe should negotiate compensation for temporary disruptions to farming operations.

A programmatic agreement would be negotiated with the State Historic Preservation Office (SHPO) to outline documentation requirements for impacted sites. For historic properties, DWRe would be required to conduct a Utah State Intensive Level Survey (ILS) in advance of construction. For significant archeological sites, a Data Recovery effort would be required. This would entail creation of a Treatment Plan, in coordination with SHPO, outlining methods that will be used to recover and document information about the site and its cultural significance.

A comprehensive public information program should be implemented to inform the public about construction activities and to minimize temporary impacts. Information would include the periods when construction is scheduled to take place, work hours, and alternate routes. Construction signs would be used to notify motorists about work activities and changes in traffic patterns such as detours. In addition, night and weekend work could be scheduled to shorten the duration of construction as long as permit requirements are satisfied.

Utility service could be temporarily disrupted during construction. The affected utilities could include electrical, gas, water, sewer, phone, cable, and storm drainage. DWRe would consult with all utilities affected by construction to complete utility agreements before construction. Utility service would be maintained throughout most construction activity.

8.5 CONCLUSIONS AND RECOMMENDATIONS

Construction of the Bear River Pipeline along the recommended alignment has the potential for a wide variety of environmental impacts as discussed in this chapter. Chapter 13 in this report contains an environmental compliance plan that identifies the process for addressing these potential impacts.

8.6 REFERENCES

Bosworth, III, William R. 2003. Vertebrate Information Compiled by the Utah Natural Heritage Program: A Progress Report. Publication Number 03-45. Salt Lake City, UT: Utah Division of Wildlife Resources. 329 pp.

Connelly, J.W., M.W. Gratson, and K.P. Reese. 1998. Sharp-tailed Grouse (*Tympanuchus phasianellus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Retrieved from the Birds of North America Online, bna.birds.cornell.edu/bna/species/354, on August 17, 2010.

Fertig, Walter, Rick Black, and Paige Wolken. 2005. Rangewide status review of Ute ladies'-tresses (*Spiranthes diluvialis*). Prepared for the U.S. Fish and Wildlife Service and Central Utah Water Conservancy District. September 30, 2005. Available online at: www.fws.gov/mountain-prairie/species/plants/uteladiestress/SPDI_Status%20review_Fertig2005.pdf. Accessed August 17, 2010.

Haug, E.A., B.A. Millsap, and M.S. Martell. 1993. Burrowing Owl (*Athene cunicularia*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Retrieved from the Birds of North America Online, bna.birds.cornell.edu/bna/species/061, on August 17, 2010.

Romin, Laura A., and James A. Muck. 1999. U.S. Fish and Wildlife Service, Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances. Salt Lake City, UT. May. Available online at: fs.ogm.utah.gov/pub/mines/coal_related/MiscPublications/ USFWS_Raptor_Guide/RAPTORGUIDE.PDF

Sigler, W.F., and J.W. Sigler. 1996. Fishes of Utah: A Natural History. University of Utah Press. Salt Lake City. 375 pp.

[USFWS] U.S. Fish and Wildlife Service. 2001. Status review for Bonneville Cutthroat Trout (*Onchorynchus clarki utah*). Denver, CO: United States Department of the Interior. October, 2001. Available online at: http://www.fws.gov/mountain-prairie/species/fish/bct/bct_status_review.pdf.

[UDWQ] Utah Department of Water Quality. 2006. Utah's 2006 Integrated Report, Volume II – 303(d) List of Impaired Waters. Utah Department of Environmental Quality. April, 2006. Available online at: www.waterquality.utah.gov/documents/2006_303d_submittal_3-31-06.pdf

9.0 PIPELINE REAL ESTATE ANALYSIS

The objective of the Pipeline Real Estate Analysis was to develop a process that would provide logical steps toward evaluating the properties impacted by the recommended pipeline corridor alignment and prioritize property for possible early acquisition or corridor preservation. The approach consisted of three basic steps.

- Identify parcels in the real estate study corridor
- Determine the priority acquisition parcels
- Evaluate the available market value of properties within the real estate study corridor

9.1 STEP 1: IDENTIFY PARCELS IN THE REAL ESTATE STUDY CORRIDOR

The first step in conducting a review of potentially impacted properties along the recommended pipeline corridor alignment was to establish the real estate study corridor.

The pipeline corridor alignment developed in Chapter 6 was used as a basis for the real estate study corridor. The study corridor is based on the centerline of the pipeline alignment and expanded based on possible flexibility in pipe placement, land availability and existing development. The study corridor was widened where potentially beneficial alignment alternatives could be routed if needed and without significant cost increase or construction difficulty. Other expanded areas were included in the potentially impacted corridor to allow for construction staging or special construction land needs. The projected property cost was based on a standard 80-foot wide alignment.

Once the study corridor was identified, a GIS analysis was conducted overlaying the study corridor area onto real estate parcel boundaries. All properties within the study corridor were identified as "impacted parcels". This analysis identified 1,713 properties as "impacted parcels" within the study corridor.

9.2 STEP 2: DETERMINE THE PRIORITY ACQUISITION PARCELS

Once the parcel database was built, a further review of property characteristics and ownership was conducted in order to identify land that could provide the highest potential future opportunities for corridor preservation. Public agencies, water districts, and canal companies were identified as primary candidates for potential partnerships, agreements, and negotiations regarding their ownership within the study corridor. One hundred fifty four public/canal properties, approximately ten percent of the "impacted parcels", were added to the priority acquisitions list.

The remaining 1,559 private properties were screened using criteria to identify which parcels could be candidates for early acquisition. Using satellite imagery and parcel attributes, the presence of structures was evaluated on each property. Properties without significant structures are generally expected to sustain less of an impact to their current use. Thus their value may be more clearly established should portions be needed for the pipeline right-of-way. Specifically, properties were described as having "no significant improvements" in Weber County where the market value for improvements was listed as less than $50,000 and in Box Elder County where the building description was blank in the County Assessor's record. Some additional manual designations were made based on visual assessment and satellite imagery. Approximately 55% of the private impacted parcels (850 privately owned properties), appeared to have no significant site improvements and were added to the preliminary priority acquisition list.

The additional screening criterion of "significant size" was then applied to the private lands on the preliminary priority acquisition list. Private parcels that were less than 1 acre in size in Weber County and less than 5 acres in size in Box Elder County were removed from the preliminary priority acquisition list. Large properties with the proper zoning can potentially be developed to a greater extent than smaller and more restrictively zoned properties. Therefore, larger properties zoned as commercial/industrial or multi-family were given a relatively higher acquisition priority. At this stage, small parcels are not as significant for priority acquisitions because of the uncertainty regarding the specific alignment footprint. This screening based on parcel size and zoning reduced the list of private lands for priority acquisitions to 481 or about 30% of the total private impacted parcels.

Next, a general "use category" was assigned to the remaining private parcels on the priority acquisition list, using the available assessor information describing each property's present use. Properties that were identified as "greenbelt" were assumed to have little risk of impending development and therefore removed from the list. A total of 168 private parcels or about 10% of the total private impacted parcels remained on the priority acquisition list.

At this point, a subjective review of the remaining private lands on the list was initiated. A GIS fly-through of the study corridor was conducted to examine the candidate properties and approximately half were removed due to the proximity of other viable pipeline routes in the area, small exposure of the property to the study corridor, and apparent low risk of significant future development. A total of 78 private parcels, (or about 5% of the total private impacted parcels) were included in the final priority acquisition list, with the previously-identified 154 public/canal properties. The screening process is summarized in the Table 9-1.

The list was then sorted by public/canal ownership type, use category, size, and market value and submitted for a final review to the project participating agencies. Recommendations regarding property acquisition are outlined in Chapter 13.

Table 9-1
Parcel Screening Process

Screening Process	Total
Parcels Within Variable Width Study Corridor (Impacted Parcels)	1,713
Impacted Parcels of Public/Canal ownership	**154**
Private Impacted Parcels	1,559
Private Impacted Parcels w/o Significant Improvements	850
Private Impacted Parcels of Significant Size and w/o Significant Improvements	481
Private Impacted Parcels of Significant Size and w/o Significant Improvements and Not Greenbelt	168
Removed in Subjective Review/Fly Through	90
Total Private Impacted Parcels on Priority Acquisition List	**78**
Grand Total Private Impacted Parcels and Public/Canal Ownership on Priority Acquisition List	**232**

9.3 STEP 3: EVALUATE THE AVAILABLE MARKET VALUE OF PROPERTIES WITHIN THE REAL ESTATE STUDY CORRIDOR

Using the "impacted parcels" list developed in Step 1, the average cost per square foot for each pipeline section (as defined in Chapter 6) was calculated. This was done by dividing the assessed market value of each parcel (included in the county assessor dataset) by the parcel's total area (taken from the assessor's dataset representing the assumed area on which the assessed market value was based).

An 80-foot wide study corridor was evaluated in this study. An estimated 100-foot wide corridor is needed in order to construct the pipeline. It was assumed in this study that a 20-foot width will be the average usable width within public ROW where it exists. The 20-foot width in public ROW with the 80-foot wide study corridor will provide the 100-foot wide corridor necessary for construction. Without having detailed survey and design information or agency agreements in place, it is not possible to know specifically the extent of private property impacts versus usable space within the public rights-of-way that the alignment follows. This appears to be a reasonable corridor width assumption and is the best way to estimate costs with the current level of understanding. Additional area may be needed for other facilities such as pump stations, clean-outs and diversions.

A multiplier of 1.5 was applied to the market value for impacted parcels in order to represent a realistic and conservative market valuation at this stage. Without detailed information regarding property impacts and appraisal review of the parcels affected, truly accurate property cost projections are not possible.

Next, all cost/square-foot values were summed and the total was divided by the total number of parcels in each pipeline section to derive the average cost/square-foot for each of the six pipeline sections. To determine an estimated cost to acquire an 80-foot wide corridor, the length (in feet) of the recommended alignment in each pipeline section was multiplied by a width of 80 feet each to obtain section's acquisition area. This value was then multiplied by the average cost/square-foot for each pipeline section to determine an estimated cost. The estimated costs for each pipeline section were summed. This resulted in an estimated acquisition cost for an 80-foot wide corridor along the recommended alignment of approximately $40 to $50 million.

10.0 ANALYSIS OF PROJECT STORAGE REQUIREMENTS

10.1 INTRODUCTION

The Bear River Basin, is located in northeastern Utah, southeastern Idaho, and southwestern Wyoming, and comprises 7,500 square miles of mountain and valley lands. A map of the Basin is shown in Figure 10-1. The Bear River crosses state boundaries five times and is the largest stream in the western hemisphere that does not empty into an ocean. The watershed area ranges in elevation from over 13,000 to 4,211 feet and is unique in that it is entirely enclosed by mountains, thus forming a huge basin with no external drainage outlets. The Bear River is the largest tributary to the Great Salt Lake.

As part of the Project, water will be diverted from the Bear River and seasonally stored in reservoirs for later use by the project stakeholders. The water rights for the project in the Bear River System can only be effectively developed through storage. The water available for diversion under the State's rights on the Bear River system occurs primarily in the winter and spring months; there is very little flow available for use during the summer months, when the Project stakeholders have their peak demands. Preliminary hydrologic modeling conducted by Division of Water Resources, State of Utah (DWRe) shows that the Project will require approximately 240,000 acre-feet of storage to reliably deliver the full Bear River Project supply of 220,000 acre-feet per year. Because there are limited sites capable of storing the full 240,000 acre-feet of water, the development and evaluation of potential combinations of reservoirs is necessary.

This Chapter examines potential reservoir sites for use by the Project throughout the Bear River Basin and makes a recommendation on the final list of reservoir sites to be included as part of the Project. It also examines how those reservoirs will be incorporated into an overall Bear River Project.

10.2 BACKGROUND

Historically, DWRe has examined numerous potential reservoir sites in the Bear River Basin, each of which has been studied at various levels of detail. As part of its scope of services with DWRe on the Bear River Pipeline Project, the Bowen Collins and Associates team (BC&A) was asked to investigate reservoir storage in the Bear River Basin to develop an overall comprehensive list of potential reservoir sites for the Bear River Project. Part of the analysis was to update the Bear River Basin reservoir sites previously studied by DWRe and others. Where a site had been previously studied, analysis was completed to the same conceptual level as for new sites identified as part of this study effort.

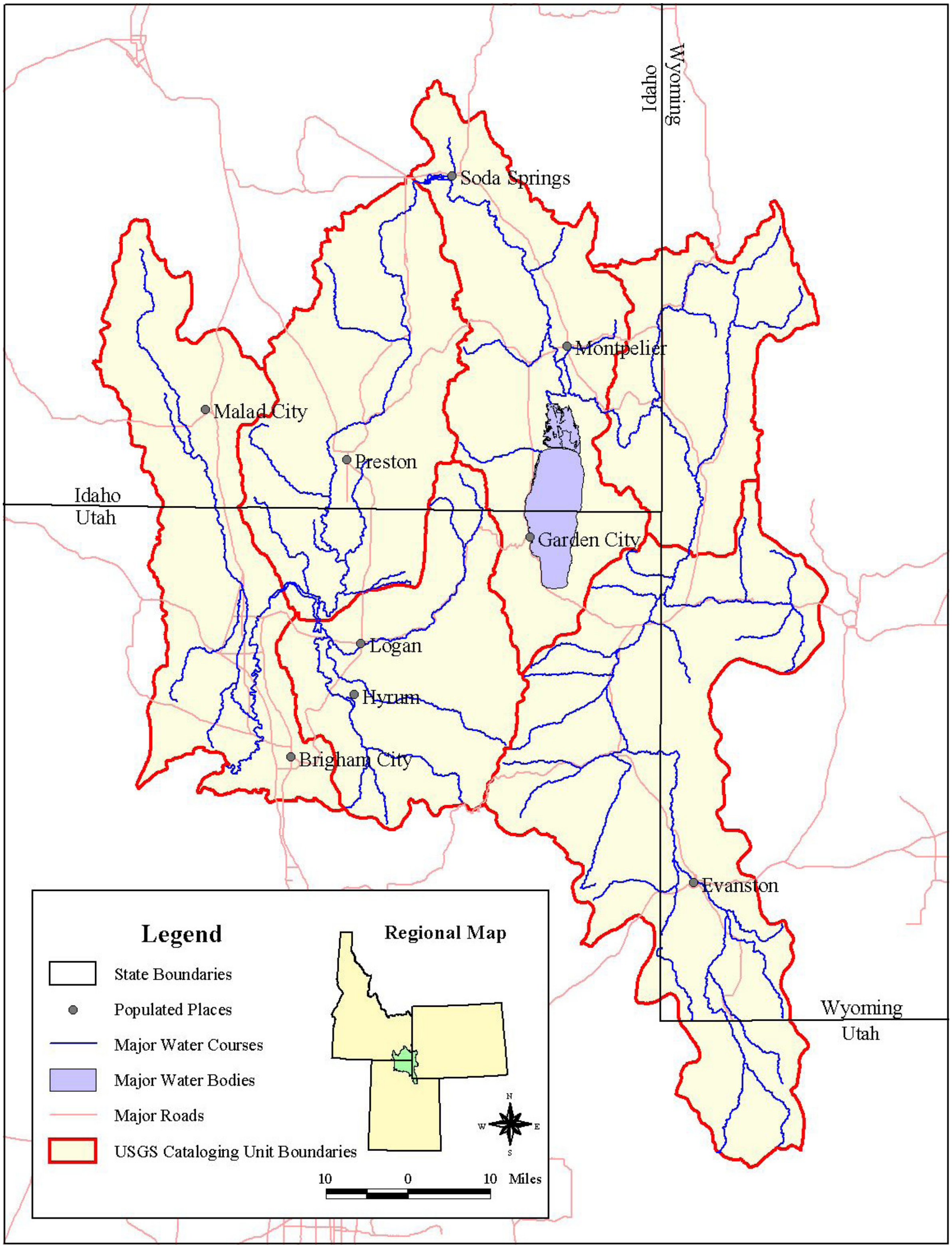


Figure 10-1
Basin Map

10.3 NEED FOR ADDITIONAL STUDY

For the last several years DWRe has focused on possibly using the Washakie Reservoir site in northern Utah for Project storage. As part of this study effort, and based on a site investigation performed by DWRe on the Washakie site (DWRe, 2009), it became apparent that the Washakie site has issues related to its effectiveness in providing storage for the Project. First, the site was studied by DWRe extensively including a geotechnical analysis. The results of the study showed the site to be difficult to build upon, and extremely expensive. This resulted from a number of issues, primarily including poor foundation conditions, pumping requirements, and the need to reroute the Malad River. In addition, further hydrologic analysis of the Bear River determined that Washakie alone, at 160,000 acre-feet of storage, could not provide enough storage for the Project. Costs were also very high for the reservoir and were estimated at $600 million. Second, further hydrologic modeling for the project determined that almost 240,000 acre-feet of storage was needed to firm-up the Project's 220,000 acre-feet supply. The Washakie site only provides for 160,000 acre-feet of storage.

For these reasons, DWRe decided to examine all potential storage sites in the Bear River Basin that could potentially be used to develop storage for the Project. While a number of the sites within the Basin had been studied in the past, they had been studied at different times and typically at lower levels of detail. This current analysis included updating the Bear River Basin reservoir sites previously studied by DWRe and others to a uniform level of detail. The analysis of all sites included in this study effort was completed to the same conceptual level.

10.4 PREVIOUS STUDIES

The following sections briefly describe the previous studies performed by DWRe on Bear River Basin reservoir sites. These studies are described in more detail in Chapter 2.

10.4.1 Lower Bear River Valley Preliminary Feasibility Study, May 1982

An initial phase of this study was to locate and evaluate potential reservoir storage projects in the Bear River area below Cutler Dam.

- Five mainstream sites were examined – Honeyville, Fielding, Willard Bay Extension, Large Bear River Bay Reservoir and Small Bear River Bay Reservoir
- Six off stream gravity-flow sites were examined – Belmont, Plymouth, Lampo, Willard #2, Public Shooting Grounds and East Promontory
- Two off stream pumped-flow sites were studied – Whites Valley and Washakie.

10.4.2 Cache Valley Preliminary Feasibility Study, December 1982

This study identified and evaluated potential reservoir storage projects in the Bear River area above Cutler Dam in Cache County. These sites included:

- Barrens
- Smithfield

- Cub River
- Amalga

10.4.3 Lower Bear River Basin – Summary of Investigation, January 1983

This study examined potential reservoir storage sites in the Lower Bear River Basin (below Bear Lake). This report examined a total of 43 reservoir sites.

10.4.4 Preliminary Site Investigations with Geological and Engineering Evaluations of [Multiple Projects and Studies], May 1985

Potential projects which were identified in previous studies were reviewed. From these studies, 11 reservoir sites and two diversion projects were selected for more detailed geotechnical investigations and preliminary engineering design and cost estimates.

10.4.5 Bear River Drainage – Possible Reservoir Sites Investigation, November 1990

Ten possible sites in the Bear River Drainage were studied, including the following sites:

- Blacksmith's Fork
- Blacksmith's Fork Below Curtis Creek
- Blacksmith's Fork (Lions Hollow)
- Left Hand Fork
- Lower Rock Creek
- Right Fork
- Saddle Creek
- Sheep Creek Off Blacksmith Fork
- Temple Fork
- Upper Rock Creek

10.4.6 Re-Evaluation of the Bear River Reservoir Sites, September 1991

This report presents the results of a review of seven dam sites located on the Bear River.

- Honeyville
- Washakie
- Barrens
- Smithfield
- Avon
- Mill Creek
- Oneida Narrows

10.5 RESERVOIR SITING LIMITATIONS

10.5.1 Bear River Development Act

The Utah legislature passed the Bear River Development Act in 1991. The Act provides the mechanism for DWRe to develop the Project as a state project. The Act mentions potential dam sites at Hyrum, Avon, Mill Creek, Oneida Narrows, North Eden Creek, Washakie, and any other site funded and authorized by the state legislature. Two other sites at Honeyville and Amalga were subsequently removed from further consideration by the legislature due to protests from local groups. The Act defines how the state will be involved in the development and funding of the Project. The Act presently limits further investigation of the Honeyville and Amalga sites.

10.5.2 Location Limitations

Idaho Location. For the purposes of the study of reservoir sites on the Bear River, two limitations were imposed on potential sites related to their location within the Basin. The first is that DWRe does not desire to develop a reservoir in the Basin which is located in Idaho. Building a reservoir in Idaho for use by Utah water users is seen as very difficult politically and so any reservoir site in Idaho was not considered as part of this Project.

Above Bear Lake. Any site above Bear Lake was also not considered. Bear Lake, while a natural lake, is operated as a storage reservoir in the Basin and any new storage above the lake would be subject to water rights within the Basin. Any storage upstream of Bear Lake would be subject to prior storage rights in Bear Lake.

10.5.3 Agency Limitations

It is important to note that many of the previous studies and reports referenced herein included the use of Willard Bay. The Willard Bay Reservoir was constructed by USBR in the 1960s as part of the Weber Basin Project. The current authorized use of Willard Bay is for collection and storage of Weber River and Ogden River water for Weber Basin Project purposes only. Use of Willard Bay for storage of Bear River water would require federal authorization to allow non-project water to be stored in project facilities, and agreement with WBWCD as the project sponsor. Any discussion of the use of Willard Bay in this document is conceptual in nature as no formal discussions between DWRe, USBR, and WBWCD have been initiated. USBR and WBWCD are presently engaged in a Safety of Dams improvement project and a potential minor raise to the dam structure to optimize the storage of Weber and Ogden river water rights. These projects are being constructed solely for the storage of Weber Basin Project water rights from the Weber and Ogden rivers, and are not intended for the storage of Bear River water.

As a result of the foregoing, the study area for the Project storage sites was limited to areas downstream of Bear Lake, in Utah, north of Willard Bay, and as far west in Box Elder County as is feasible for the delivery of water to and from the site.

10.6 PROJECT RESERVOIR DESIGN CRITERIA

10.6.1 Storage Requirements

Bear River water rights that are available for development by the State do not match the Bear River Project participants' pattern of water needs. Most of the available water in the Bear River system occurs in the winter and springtime months, while peak demand for the water users will be during the summer and early fall. Based on historical hydrology, there is frequently no water available to be diverted directly from the Bear River under the State's water rights. This is particularly true during the high demand months of the summer, and in low-runoff years. In certain very dry years, there is no divertible water outside of the months of November through April. Because of this variable supply availability, reservoir storage is required to "firm-up" the water supply to meet the participants' year-round demand patterns.

Utah DWRe has developed a daily time-step computer model of the Bear River water supply called BEARSIM. The BEARSIM model includes long-term, historical records of estimated water availability and streamflow data for the lower Bear River, time series of daily diversions for each major Bear River diversion canal and for the Bear River Migratory Bird Refuge (Refuge), and projected water demands for each of the four project stakeholders. The model incorporates existing and assumed storage reservoirs and conveyance and delivery facilities and operational priorities. DWRe has used the BEARSIM model to simulate the long-term operation of the Bear River Project under many different reservoir storage and water delivery assumptions. Results from these simulation runs provide important input for use in establishing the reservoir storage capacity for the Bear River Project and the capacity of diversion and pipeline conveyance facilities.

Among the many important pieces of information provided by these simulation runs is the conclusion that the Bear River Project cannot develop the full 220,000-acre-feet of reliable water supply without approximately 240,000 acre-feet of storage capacity. This is approximately 80,000 to 90,000 acre-feet more than was previously incorporated into the planning for the Washakie site. This significant deficiency in Project formulation affects the planning of the Bear River Project reservoirs and other facilities. The previous Project planning and formulation (associated with the Washakie reservoir site) results in an average shortage of about 22,000 acre-feet and a maximum year shortage of about 98,000 acre-feet.

In this study, the DWRe's BEARSIM model was initially used to estimate the total storage volume needed to meet the water delivery reliability goal previously established for the Bear River Project. The reliability goal is a maximum one-year supply deficit (or shortage) of not more than 10 percent of any water user's annual demand. Assuming that shortages are shared equally between all four project water users, this would indicate a maximum project-wide shortage of no more than 22,000 acre-feet in any one year.

Preliminary model runs suggest that a minimum active storage of between 220,000 acre-feet and 250,000 acre-feet is necessary to meet the maximum 10 percent shortage criteria. Specific storage requirements will vary somewhat, depending on the location where water is diverted out of the Bear River, and upon the capacity of the diversion and conveyance facilities to refill the reservoir. Reservoir sites with a high diversion and refill capacity (600 cfs or higher) and reservoir sites located farther downstream tend to require slightly less total storage capacity, although piping required to convey water from the storage back upstream to meet Cache County and BRWCD demands may out-weigh any savings on the required storage capacity associated with downstream reservoir locations. Figure 10-2 (Volume II), shows the relationship between storage capacity and total annual shortage for a range of storage reservoir capacities.

The 220,000 acre-feet of annual demand formulated for the Bear River Project is equivalent to an average delivery rate of 303 cfs. Because demands are significantly higher than average in the summer, the total peak project demand is about 660 cfs. For Cache County and BRWCD, the peak delivery capacity is about 180 cfs each. For WBWCD and JVWCD, the peak delivery capacity is about 150 cfs each. During months when no water is available for direct diversion from the Bear River, the delivery system from the reservoir(s) needs to provide this total capacity. During times when the Bear River is capable of directly meeting the peak summer demand, the river diversion facilities need to provide this total capacity, with conveyance to all four upstream delivery points.

Preliminary BEARSIM modeling indicates that reservoir refill capacity requirements are approximately 3 to 4 cfs per 1,000 acre-feet of reservoir storage capacity. This is equivalent to between 650 and 900 cfs for the full 220,000 to 250,000 acre-feet of storage capacity and allows complete refill of one or more empty reservoirs in four or five months. During subsequent review of reservoir combinations, specific BEARSIM modeling was conducted to find the most efficient storage capacity and refill capacity for each combination considered.

10.7 REVIEW OF AVAILABLE RESERVOIR SITES ON THE BEAR RIVER

As part of its scope of services with the DWRe on the Bear River Pipeline Project, BC&A was asked to investigate the Bear River Basin to develop an overall comprehensive list of potential reservoir sites for the Bear River Project. A key component of the Project is storage that would be able to store available water on the Bear River throughout the year for use by the Project in the summer water delivery season. Part of the analysis was to update the Bear River Basin reservoir sites previously studied by DWRe and others. The analysis of these sites as well as the new sites identified as part of this study effort would be completed to the same conceptual level.

Each reservoir site was analyzed on a conceptual basis to determine its acceptability as a storage reservoir for the project. From this comprehensive list, a short list of reservoir sites was developed. Additional work was performed on those short-listed reservoir sites including developing storage/elevation curves and inlet/outlet piping and pumping requirements. Each of those sites was then analyzed for how effectively they could provide a reliable water supply through storage for the overall Bear River Project. A final recommendation was made for an acceptable reservoir or group of reservoirs to be used for storage for the Bear River Project.

10.8 REVIEW OF POTENTIAL RESERVOIR SITES IN THE BEAR RIVER BASIN

Figure 10-3 (Volume II) shows the potential reservoir sites identified for the Bear River Project. Forty five (45) sites were identified through a process of reviewing available storage sites from basin wide mapping and a review of previous studies on the basin. Each of the reservoir sites was analyzed based on the following:

- Physical – Physical properties were estimated for each of the reservoir sties including: pool elevation; reservoir volume and surface area; embankment height, length and volume.
- Water Supply – Water supply to and from the main project were considered including: pipeline size and length; elevation head (for pumping); yield factor and effect on Firm Yield.
- Property – Property consideration we examined including: total number of affected parcels; ownership type; total number of affected acres; and major utility considerations.
- Special Considerations – Special considerations were reviewed including: environmental; political; and construction considerations. Additionally, conveyance to the project and Cache County considerations were evaluated.
- Cost Comparison – A cost comparison for several physical components was performed. Capital costs included the costs for land, pipe to/from the main project, pumps, and embankment. Energy costs included present worth pumping cost both to and from the reservoir. A credit was included for projects where hydro recovery appears to be possible. Special considerations were include for four reservoir sites where additional work would be required that was not depicted in the other costs (i.e. rerouting an interstate or river). The cost comparison does not represent a complete cost estimate of the reservoir, but is a basis for a comparison between reservoirs.

The necessary information was developed for each of the above categories based upon the analysis approach and assumptions that are included in Appendix C, Volume II. The completed data was then reviewed by the project stakeholders, DWRe staff, and the BC&A team to develop a final short listing of reservoir sites to study further.

The data reviewed included:

- Figure 10-4 (Volume II) shows comparable reservoir cost per acre-foot based on the initial analysis of storage on the y-axis with the x-axis representing the approximate east to west location. This figure gives a graphical representation of comparable reservoir costs. It shows which sites are relatively expensive and which sites are relatively inexpensive.
- Tables 10-1 thru 10-7 show:
    - Table 10-1 summarizes the physical information on each dam site.
    - Table 10-2 summarizes water supply information
    - Tables 10-3A and 10-3B summarize property information

- Table 10-4 lists special conditions, if they apply
- Table 10-5 details comparable reservoir costs for several common items
- Table 10-6 summarizes the five summary tables, and uses a color-coding system to show which sites appear to be mostly positive (green), have certain flaws or deficiencies (yellow), or appear to be significantly flawed (red), with respect to each type of information.
- Table 10-7 summarizes the basis of the short listing of the sites

- Maps (A1-A45) showing each individual reservoir site area are included in Appendix A.

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Table 10-1 - Physical

Fig. No.	Name	Study	Volume (ac-ft)	Height (ft)	Crest Length (ft)	Pool Elevation	Embankment Volume (yd^3)	Surface Area (ac.)	On Stream?	County
1	Above Cutler Dam	New	51,000	22	1,580	4,432	170,000	5,270	Yes	Cache
2	Avon	Re-Evaluation	30,000	199	1,800	5,272	6,040,000	400	Yes	Cache
3	Barrens	Cache Valley	101,000	38	57,650	4,443	9,040,000	4,380	No	Cache
4	Beeton	Beeton Prelim.	46,000	32	780	4,275	200,000	1,900	Yes	Box Elder
5	Blacksmith Fork	South Cache	40,000	193	1,460	5,433	5,140,000	460	Yes	Cache
6	Blacksmith Fork (Lions Hollow)	Prelim. Invest	36,000	245	2,590	5,970	7,660,000	410	Yes	Cache Co
7	Blacksmith Fork Below Curtis Creek	Prelim. Invest	24,000	149	1,060	5,609	1,970,000	390	Yes	Cache Co
8	Clarkston Creek	New	196,000	173	15,940	5,058	48,900,000	2,990	Yes	Cache
9	Cub River	Cache Valley	27,000	45	1,610	4,465	700,000	1,500	Yes	Cache
10	Cutler Enlargement (Smithfield)	Prelim. Invest	251,000	46	57,650	4,446	15,620,000	9,990	Yes	Cache
11	Dry Creek	New	99,000	120	890	5,800	290,000	1,050	No	Cache
12	East Fork	New	34,000	233	2,270	5,330	11,860,000	300	Yes	Cache
13	East Promontory	1984 Study?	238,000	19	88,190	4,227	9,410,000	26,070	No	Box Elder
14	Faust Valley	New	251,000	285	4,780	5,165	30,320,000	1,740	No	Box Elder
15	Fielding	New	70,000	70	1,480	4,300	1,110,000	1,700	Yes	Box Elder
16	Forks	Bear River Invest.	40,000	213	1,510	5,185	3,710,000	490	Yes	Cache
17	Honeyville	Re-Evaluation	105,000	42	1,480	4,275	520,000	3,660	Yes	Box Elder
18	Hyrum Enlargement	Bear River Invest.	28,000	119	3,810	4,715	1,380,000	730	Yes	Cache
19	I-84 Dam	New	183,000	170	14,320	4,530	33,640,000	2,530	No	Box Elder
20	Large Bear River Bay	L. Bear Feas.	254,000	7	78,260	4,208	5,190,000	62,410	No	Box Elder
21	Left Hand Fork	Prelim. Invest	18,000	243	1,270	5,927	2,310,000	190	Yes	Cache Co
22	Left Hand Fork Blacksmith Fork	Bear River Drainage	13,000	235	1,070	6,050	3,060,000	130	Yes	Cache Co
23	Lower Rock Creek	Prelim. Invest	22,000	218	840	6,048	2,110,000	320	Yes	Cache Co
24	Mill Creek	Re-Evaluation	23,000	169	1,320	5,747	1,950,000	390	Yes	Cache
25	Paradise	Bear River Invest.	20,000	122	3,710	4,883	2,820,000	540	Yes	Cache
26	Paradise Canyon	New	23,000	436	1,560	5,800	14,860,000	150	No	Cache
27	Portage Canyon	New	71,000	292	4,580	5,020	30,180,000	570	No	Box Elder
28	Public Shooting Grounds	L. Bear Feas.	118,000	20	55,180	4,240	8,480,000	12,740	No	Box Elder
29	Right Fork	Prelim. Invest	6,000	200	850	5,700	2,410,000	70	Yes	Cache Co
30	Rozel Flat #2	L. Bear Feas.	254,000	23	54,160	4,224	9,070,000	15,680	No	Box Elder
31	Saddle Creek	Prelim. Invest	17,000	180	1,000	6,528	1,760,000	300	Yes	Cache Co
32	Salt Wells Flat #1	L. Bear Feas.	133,000	12	62,590	4,210	7,360,000	17,500	No	Box Elder
33	Salt Wells Flat #2	L. Bear Feas.	105,000	24	32,850	4,225	6,160,000	11,370	No	Box Elder
34	Sheep Creek Off Blacksmith Fork	Prelim. Invest	19,000	242	1,140	6,000	3,010,000	230	Yes	Cache Co
35	Small Bear River Bay	L. Bear Feas.	131,000	5	78,260	4,206	2,780,000	62,410	No	Box Elder
36	Smithfield	Cache Valley	58,000	29	1,670	4,440	290,000	5,310	Yes	Cache
37	South Fork	South Cache	11,000	174	910	5,366	1,500,000	180	Yes	Cache Co
38	South Willard	New	58,000	10	27,140	4,230	4,620,000	5,450	No	Weber
39	Temple Fork	Prelim. Invest	40,000	306	1,020	6,167	5,090,000	390	Yes	Cache Co
40	Twin Creek	Bear River Invest.	20,000	165	1,810	6,290	3,240,000	340	Yes	Cache
41	Upper Rock Creek	Prelim. Invest	40,000	243	1,750	6,201	6,360,000	430	Yes	Cache Co
42	Washakie	2009 Study	158,000	56	36,860	4,406	18,083,100	4,970	No	Box Elder
43	West Bay	L. Bear Feas.	90,000	9	390,720	NA*	5,580,000	36,000	No	Box Elder
44	Whites Valley	L. Bear Feas.	170,000	219	1,410	5,260	4,940,000	2,060	No	Box Elder
45	Weber Bay	L. Bear Feas.	124,000	22	52,510	4,225	8,430,000	6,910	No	Weber

Study Abbreviation	Study Name
Bear River Drainage	DWR - BEAR RIVER DRAINAGE – POSSIBLE RESERVOIR SITES INVESTIGATION, Nov 1990
Bear River Invest.	BUREAU OF RECLAMATION, BEAR RIVER INVESTIGATIONS, JUN 1970
Beeton Prelim.	DWR - BEETON DAM AND RESERVOIR PRELIMINARY DESIGN, DEC 1993
Cache Valley	DWR - CACHE VALLEY PRELIMINARY FEASIBILITY STUDY, DEC 1982
L. Bear Feas.	DWR - LOWER BEAR RIVER VALLEY PRELIMINARY FEASIBILITY STUDY, MAY 1982
Prelim. Invest	DWR - PRELIMINARY SITE INVESTIGATIONS WITH GEOLOGICAL AND ENGINEERING EVALUATIONS OF [MULTIPLE PROJECTS AND STUDIES], MAY 1985
Re-Evaluation	DWR - RE-EVALUATION OF THE BEAR RIVER RESERVOIR SITES, SEP 1991
South Cache	DWR - SOUTH CACHE PROJECT, SEP 1976

* The West Bay Expansion Project is an alterantive to the East Promontory Reservoir Project, which is located on the same ground. The West Bay Expansion Project is a series of 15 diked ponds, each pond potentially has a different water surface elevation. There was insufficient information to calculate the surface area and embankment volume from the study

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Table 10-2 - Water Supply

Fig. No.	Name	Source	Conveyance Distance (ft)	Conveyance Capacity (cfs) (cfs)	Conveyance Diameter (in.)	Elev. Head (ft)	Yield Factor	Effect on Firm Yield (ac-ft)
1	Above Cutler Dam	Upper Bear		0	0	22	92%	47,000
2	Avon	Little Bear		0	0	552	40%	12,000
3	Barrens	Pump from above Cutler	7,545	300	90	30	81%	82,000
4	Beeton	Bear River		0	0	0	64%	29,000
5	Blacksmith Fork	Blacksmith Fork	12,733	180	72	720	45%	18,000
6	Blacksmith Fork (Lions Hollow)	Blacksmith Fork	12,733	180	72	1,250	24%	9,000
7	Blacksmith Fork Below Curtis Creek	Blacksmith Fork	12,733	180	72	889	72%	17,000
8	Clarkston Creek	Pump from above Cutler	26,568	480	114	383	57%	112,000
9	Cub River	Cub River		0	0	55	54%	15,000
10	Cutler Enlargement (Smithfield)	Bear River	205	0	108	35	64%	161,000
11	Dry Creek	Pump from Hyrum	56,602	300	90	1,240	32%	32,000
12	East Fork	East Fork Little Bear River		0	0	780	46%	16,000
13	East Promontory	pump from South Bay	71,159	480	114	1	62%	148,000
14	Faust Valley	Pump from below Cutler	77,017	480	114	935	62%	156,000
15	Fielding	Bear River		0	0	0	72%	50,000
16	Forks	Blacksmith Fork	12,733	180	72	478	45%	18,000
17	Honeyville	Bear River		0	0	0	72%	76,000
18	Hyrum Enlargement	Little Bear	12,733	180	72	0	58%	16,000
19	I-84 Dam	Pump from below Cutler	37,927	480	120	252	68%	124,000
20	Large Bear River Bay	Bear River	38,552	480	114	93	62%	157,000
21	Left Hand Fork	Blacksmith Fork	12,733	180	72	1,207	35%	6,000
22	Left Hand Fork Blacksmith Fork	Blacksmith Fork	12,733	180	72	1,330	45%	6,000
23	Lower Rock Creek	Blacksmith Fork	12,733	180	72	1,328	32%	7,000
24	Mill Creek	Blacksmith Fork	12,733	180	72	1,027	30%	7,000
25	Paradise	Little Bear		0	0	163	55%	11,000
26	Paradise Canyon	Pump from Blacksmith	11,389	180	72	1,080	60%	14,000
27	Portage Canyon	Pump from below Cutler	86,109	200	78	650	64%	45,000
28	Public Shooting Grounds	Pump from below Cutler	72,380	400	108	10	64%	76,000
29	Right Fork	Right Fork Loga River		0	0	1,120	90%	5,000
30	Rozel Flat #2	Pump from below Cutler	197,756	480	114	35	62%	157,000
31	Saddle Creek	Blacksmith Fork	12,733	180	72	1,808	35%	6,000
32	Salt Wells Flat #1	Pump from below Cutler	215,748	400	108	20	64%	85,000
33	Salt Wells Flat #2	Pump from below Cutler	219,546	400	108	35	64%	67,000
34	Sheep Creek Off Blacksmith Fork	Blacksmith Fork	12,733	180	72	1,280	34%	6,000
35	Small Bear River Bay	Bear River	38,551	400	108	97	64%	84,000
36	Smithfield	Bear River		0	0	30	66%	38,000
37	South Fork	South Fork Little Bear River		0	0	646	40%	4,000
38	South Willard	Pump from below Cutler	15,953	200	78	35	64%	37,000
39	Temple Fork	Fork off of Logan River		0	0	1,620	77%	31,000
40	Twin Creek	Logan River		0	0	1,710	89%	18,000
41	Upper Rock Creek	Blacksmith Fork	12,733	180	72	1,520	23%	9,000
42	Washakie	Pump from below Cutler	47,580	480	126	711	69%	109,000
43	West Bay	pump from South Bay	77,380	300	90	1	64%	58,000
44	Whites Valley	Pump from below Cutler	83,028	480	120	975	69%	117,000
45	Weber Bay	Pump from below Cutler	34,493	400	108	75	64%	79,000

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Table 10-3A - Property

Fig. No.	Name	Affected Parcels	Ownership in Acres									
			Private	BLM	UDWR	USFS	USFWS	SL&F	SITLA	State Park	Water	Total
1	Above Cutler Dam	222	2455	0	0	0	0	0	0	0	0	2455
2	Avon	10	401	0	0	0	0	0	0	0	0	401
3	Barrens	102	6,539	0	0	0	0	0	0	0	1	6,540
4	Beeton	104	1,904	0	0	0	0	0	0	0	0	1,904
5	Blacksmith Fork	14	87	0	360	14	0	0	0	0	0	461
6	Blacksmith Fork (Lions Hollow)	18	334	0	1	70	0	0	0	0	0	405
7	Blacksmith Fork Below Curtis Creek	6	50	0	341	0	0	0	0	0	0	391
8	Clarkston Creek	115	3,466	0	0	0	0	0	0	0	0	3,466
9	Cub River	107	1,500	0	0	0	0	0	0	0	0	1,500
10	Cutler Enlargement (Smithfield)	287	9,238	0	0	0	0	0	0	0	946	10,184
11	Dry Creek	24	1,060	0	0	0	0	0	0	0	0	1,060
12	East Fork	33	695	0	172	0	0	0	0	0	184	1,051
13	East Promontory	81	13,606	3,706	1,425	0	8,216	571	649	0	0	28,173
14	Faust Valley	27	1,732	9	0	0	0	0	0	0	0	1,741
15	Fielding	79	1,701	0	0	0	0	0	0	0	0	1,701
16	Forks	67	323	0	44	168	0	0	0	0	0	535
17	Honeyville	212	3,655	0	0	0	0	0	0	0	0	3,655
18	Hyrum Enlargement	43	161	0	0	0	0	0	0	564	0	725
19	I-84 Dam	83	2,991	0	0	0	0	0	0	0	0	2,991
20	Large Bear River Bay	54	263	0	0	11,429	0	11,956	131	608	38,866	63,253
21	Left Hand Fork	4	0	0	0	188	0	0	0	0	0	188
22	Left Hand Fork Blacksmith Fork	3	0	0	0	127	0	0	0	0	0	127
23	Lower Rock Creek	8	0	0	322	2	0	0	0	0	0	324
24	Mill Creek	9	376	0	17	0	0	0	0	0	0	393
25	Paradise	74	535	0	0	0	0	0	0	0	0	535
26	Paradise Canyon	7	189	0	0	0	0	0	0	0	0	189
27	Portage Canyon	11	576	0	0	0	0	0	0	0	0	576
28	Public Shooting Grounds	45	10,229	2,262	0	0	0	0	72	0	174	12,737
29	Right Fork	4	0	0	0	70	0	0	0	0	0	70
30	Rozel Flat #2	32	5,185	0	0	0	0	3,559	133	0	6,838	15,715
31	Saddle Creek	10	0	0	0	299	0	0	0	0	0	299
32	Salt Wells Flat #1	17	442	194	0	0	0	5,305	0	0	11,557	17,498
33	Salt Wells Flat #2	45	2,349	4,580	0	0	0	3,569	791	0	83	11,372
34	Sheep Creek Off Blacksmith Fork	11	225	0	1	0	0	0	0	0	0	226
35	Small Bear River Bay	54	263	0	0	11,429	0	11,956	131	608	38,866	63,253
36	Smithfield	297	5,260	0	47	0	0	0	0	0	0	5,307
37	South Fork	3	184	0	0	0	0	0	0	0	0	184
38	South Willard	62	4,050	0	142	0	0	0	0	1,259	0	5,451
39	Temple Fork	5	0	0	0	483	0	0	0	0	0	483
40	Twin Creek	4	0	0	0	0	342	0	0	0	0	342
41	Upper Rock Creek	7	22	0	539	0	0	0	0	0	0	561
42	Washakie	97	4,966	0	0	0	0	0	0	0	0	4,966
43	West Bay	107	13,606	3,706	1,425	0	8,216	571	649	0	0	28,173
44	Whites Valley	22	2,061	0	0	0	0	0	0	0	0	2,061
45	Weber Bay	35	0	0	0	1,643	0	546	178	15	4,107	6,489

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Table 10-3B - Property

Fig. No.	Name	Utility Considerations
1	Above Cutler Dam	Roads & utilities
2	Avon	5 miles county road relocation; 16,000 feet county road, 1 summer home
3	Barrens	4 miles 138KVA transmission line, 160 acres sewage lagoons, 1 mobile home, roads and utilities
4	Beeton	2,400 feet of highway 154, two historic structures, Fielding City waterline, one 46kV and two 12.5kV powerlines
5	Blacksmith Fork	Hardware Ranch, 4 miles county road relocation; Re-evaluation (below Hardware Ranch) says 2,000 feet road relocation, two homes
6	Blacksmith Fork (Lions Hollow)	roads and utilities
7	Blacksmith Fork Below Curtis Creek	roads and utilities
8	Clarkston Creek	
9	Cub River	roads and utilities
10	Cutler Enlargement (Smithfield)	Many private and public utilities, 12,500 feet of 24' diameter tunnel for Little Bear River ($36 M)
11	Dry Creek	Hwy 89
12	East Fork	
13	East Promontory	Refuge
14	Faust Valley	Gas pipeline
15	Fielding	
16	Forks	roads and utilities
17	Honeyville	water supply facilities; two/three highway bridges, 12,000 feet road, six water lines, five 12.5KV power lines, five residences, one church park, two historic structures
18	Hyrum Enlargement	5 homes, state park
19	I-84 Dam	BRWCD Wells potentially affected
20	Large Bear River Bay	Refuge
21	Left Hand Fork	
22	Left Hand Fork Blacksmith Fork	
23	Lower Rock Creek	
24	Mill Creek	Hardware Ranch, 4 miles county road relocation; Re-evaluation (below Hardware Ranch) says 2,000 feet road relocation, two homes
25	Paradise	?
26	Paradise Canyon	
27	Portage Canyon	
28	Public Shooting Grounds	
29	Right Fork	
30	Rozel Flat #2	
31	Saddle Creek	
32	Salt Wells Flat #1	
33	Salt Wells Flat #2	
34	Sheep Creek Off Blacksmith Fork	
35	Small Bear River Bay	Refuge
36	Smithfield	3 roads (unknown length), $4 million power line, 25 acres sewage lagoons; backs water into Idaho
37	South Fork	
38	South Willard	Roads & utilities, state park
39	Temple Fork	
40	Twin Creek	
41	Upper Rock Creek	
42	Washakie	Portions of I15 need to be raised, 2.1 miles State hwy to be raised, 40,000 feet of the UPRR will need to be relocated; 21,000 feet high voltage power line, other utilities, 14 to 25 homes and structures (town of Washakie) would be
43	West Bay	Refuge
44	Whites Valley	
45	Weber Bay	Refuge

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Table 10-4 - Special Considerations

Fig. No.	Name	Enivronmental	Political	Construction	Project Compatability: Work as Part of Project?	Project Compatability: Deliver Water to/from Project?	Project Compatability: Cache County Considerations
1	Above Cutler Dam	Riparian habitat				Yes	Good
2	Avon	3.7 miles Class 3 trout stream, irrigated pasture and cropland				Yes	Good
3	Barrens	2,000 acres irrigated cropland, some lower quality upland game and waterfowl habitat loss, critical winter pheasant habitat, lesser value wetlands	Removed by Legis.			Yes	Good
4	Beeton	Riparian habitat				Yes	Neutral
5	Blacksmith Fork	2 miles Class 1 or 2 trout stream; impact elk migration & Hardware Ranch		Road relocation		Yes	Good
6	Blacksmith Fork (Lions Hollow)	No study				Yes	Small
7	Blacksmith Fork Below Curtis Creek	No study		Road relocation		Yes	Small
8	Clarkston Creek	No study				Yes	Good
9	Cub River	590 acres irrigated cropland, 11 miles Class IV fishery stream, extensive critical upland habitat, valuable wetlands				Yes	Small
10	Cutler Enlargement (Smithfield)	Significant impacts on wetlands, floodplains, irrigated cropland, riparian shrub and woodlands, terrestrial wildlife habitat		Significant issues		Yes	Good
11	Dry Creek	No study		Road & tunnel		Yes	Unclear
12	East Fork	National Forest				Yes	Small
13	East Promontory	24,800 acres alkali mud flats, 304 acres salt marsh, Low value habitat ; Primarily mud flats, some loss of Samphire production	Refuge	Soils		Long conveyance	Neutral
14	Faust Valley	No study		Pipeline relocation		Long conveyance	Neutral
15	Fielding	102 acres irrigated cropland, wetlands (141 wet meadow, 185 semiwet, 34 marsh),, 5 miles Class III stream, upland game habitat				Yes	Neutral
16	Forks	National Forest?		Road relocation		Yes	Good
17	Honeyville	792 acres irrigated cropland, 185 acres non-irrigated (1985 says 4,000 acres prime farmland, 1995 says 1,600), wetlands (1985 says: 227 wet meadow, 749 semiwet, 79 marsh; 1995 says: 1,590acres total, 444 wet meadow, 236 marsh, 152 channel), 25 miles Class III stream (462 acres riverine habitat), upland game habitat (1,771 acres), historic structure; minimal impact to T&E species	Removed by Legis.			Yes	Neutral
18	Hyrum Enlargement	Riparian habitat		Existing dam		Yes	Good
19	I-84 Dam	Agricultural lands	BRWCD			Yes	Neutral
20	Large Bear River Bay	11,000 acres valuable marsh habitat, 38 acres salt marsh, significant loss of wildlife values	Refuge	Soils		Yes	Neutral
21	Left Hand Fork	National Forest?				Yes	Small
22	Left Hand Fork Blacksmith Fork	National Forest?				Yes	Small
23	Lower Rock Creek	National Forest?				Yes	Small
24	Mill Creek	2 miles Class 1 or 2 trout stream; impact elk migration & Hardware Ranch				Yes	Small
25	Paradise	Riparian & agricultural				Yes	Small
26	Paradise Canyon	National Forest?				Yes	Small
27	Portage Canyon	None identified				Long conveyance	Neutral
28	Public Shooting Grounds	140 acres cropland, 643 acres marsh, 197 acres salt marsh, Low and high value habitat		Soils		Long conveyance	Neutral
29	Right Fork	National Forest?				Yes	Small
30	Rozel Flat #2	Low value habitat		Soils		Long conveyance	Neutral
31	Saddle Creek	National Forest?				Yes	Small
32	Salt Wells Flat #1	Low value habitat		Soils		Long conveyance	Neutral
33	Salt Wells Flat #2	Low value habitat		Soils		Long conveyance	Neutral
34	Sheep Creek Off Blacksmith Fork	National Forest?				Yes	Small
35	Small Bear River Bay	11,000 acres valuable marsh habitat, 38 acres salt marsh, significant loss of wildlife values	Refuge	Soils		Yes	Neutral
36	Smithfield	760 acre irrigated cropland, 23 miles of Class IV fishery stream, significant critical riparian/floodplain habitat and wetlands; may back water into Idaho				Yes	Good
37	South Fork	No study				Yes	Small
38	South Willard	Development		Soils		Yes	Neutral
39	Temple Fork	Logan Canyon/National Forest				Yes	Good
40	Twin Creek	Logan Canyon/National Forest				Yes	Good
41	Upper Rock Creek	National Forest?				Yes	Small
42	Washakie	1982 says:492 acres irrigated cropland, 1,037 acres non-irrigated, 3,471 alkali bottom land; 2010 says 4,188 pasture, 574 tilled; 637 acres wetlands; 82,000 feet of channel impacted; raptor and sharp-tailed grouse habitat; very high probability exists for historic cultural resource sites: six historic farmsteads, one, the 1855 to 1856 pioneer fort, could be highly significant, possibility exists that the project area could be considered an important Traditional Cultural Property to local Native American groups; potential fatal flaw		Soils, river relocation		Yes	Neutral
43	West Bay	Refuge; 140 acres cropland, 501 acres salt marsh	Refuge	Soils		Long conveyance	Neutral
44	Whites Valley	1,474 non-irrigated cropland		Road relocation		Long conveyance	Neutral
45	Weber Bay	Excellent marsh habitat	Refuge	Soils		Yes	Neutral

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Table 10-5 - Cost Comparison

Fig. No.	Name	Volume (ac-ft)	Cost (in Millions of Dollars)									Cost/ Acre-Ft
			Capital Costs				Energy Costs			Special Considerations	Net Present Worth	
							Present Worth Energy Costs		Hydro Recovery			
			Land	Pipe	Pump	Embank-ment	To Reservoir	From Reservoir				
1	Above Cutler Dam	51,000	$45.58	$0.00	$0.00	$1.70	$0.00	$0.00			$47.28	$927
2	Avon	30,000	$1.20	$0.00	$0.00	$60.40	$0.00	$0.00			$62	$2,053
3	Barrens	101,000	$113.47	$6.49	$2.29	$90.40	$3.42	$0.00			$216	$2,139
4	Beeton	46,000	$5.20	$9.97	$0.00	$2.00	$0.00	$0.00			$17	$373
5	Blacksmith Fork	40,000	$0.23	$8.56	$0.00	$51.40	$0.00	$0.00			$60	$1,505
6	Blacksmith Fork (Lions Hollow)	36,000	$0.20	$8.56	$0.00	$76.60	$0.00	$0.00			$85	$2,371
7	Blacksmith Fork Below Curtis Creek	24,000	$0.20	$8.56	$0.00	$19.70	$0.00	$0.00			$28	$1,186
8	Clarkston Creek	196,000	$17.33	$35.65	$27.08	$489.00	$42.85	$0.00	-$21.42		$590	$3,013
9	Cub River	27,000	$35.82	$0.00	$0.00	$7.00	$0.00	$0.00			$43	$1,586
10	Cutler Enlargement (Smithfield)	251,000	$47.72	$0.23	$2.67	$156.20	$3.87	$0.00		$50	$261	$1,039
11	Dry Creek	99,000	$0.53	$55.03	$51.46	$2.90	$83.02	$0.88	-$41.51	$30	$182	$1,842
12	East Fork	34,000	$0.54	$0.00	$0.00	$118.60	$0.00	$0.00			$119	$3,504
13	East Promontory	238,000	$42.26	$99.85	$16.47	$94.10	$8.63	$1.94			$263	$1,106
14	Faust Valley	251,000	$3.81	$104.81	$88.80	$303.20	$180.17	$7.99	-$90.08	$10	$609	$2,425
15	Fielding	70,000	$4.02	$4.47	$0.00	$11.10	$0.00	$0.00			$20	$280
16	Forks	40,000	$0.27	$8.56	$0.00	$37.10	$0.00	$0.00			$46	$1,148
17	Honeyville	105,000	$60.14	$9.68	$0.00	$5.20	$0.00	$0.00			$75	$714
18	Hyrum Enlargement	28,000	$4.67	$0.00	$0.00	$13.80	$0.00	$0.00			$18	$660
19	I-84 Dam	183,000	$14.57	$63.03	$33.06	$336.40	$31.09	$1.31	-$15.55		$464	$2,535
20	Large Bear River Bay	254,000	$95.63	$52.72	$15.19	$51.90	$0.00	$4.23	$0.00		$220	$865
21	Left Hand Fork	18,000	$0.09	$8.56	$0.00	$23.10	$0.00	$0.00			$32	$1,764
22	Left Hand Fork Blacksmith Fork	13,000	$0.06	$8.56	$0.00	$30.60	$0.00	$0.00			$39	$3,017
23	Lower Rock Creek	22,000	$0.16	$8.56	$0.00	$21.10	$0.00	$0.00			$30	$1,355
24	Mill Creek	23,000	$0.20	$8.56	$0.00	$19.50	$0.00	$0.00			$28	$1,228
25	Paradise	20,000	$3.15	$0.00	$0.00	$28.20	$0.00	$0.00			$31	$1,568
26	Paradise Canyon	23,000	$0.10	$8.20	$0.00	$148.60	$0.00	$0.00			$157	$6,822
27	Portage Canyon	71,000	$0.86	$68.12	$28.15	$301.80	$35.26	$0.00	-$17.63		$417	$5,867
28	Public Shooting Grounds	118,000	$19.11	$94.03	$21.45	$84.80	$7.59	$0.84			$228	$1,931
29	Right Fork	6,000	$0.04	$0.00	$0.00	$24.10	$0.00	$0.00			$24	$4,023
30	Rozel Flat #2	254,000	$23.57	$263.49	$113.28	$90.70	$91.65	$20.05			$603	$2,373
31	Saddle Creek	17,000	$0.15	$8.56	$0.00	$17.60	$0.00	$0.00			$26	$1,548
32	Salt Wells Flat #1	133,000	$26.25	$264.43	$100.94	$73.60	$72.90	$10.53			$549	$4,125
33	Salt Wells Flat #2	105,000	$17.06	$269.60	$102.54	$61.60	$55.34	$8.79			$515	$4,904
34	Sheep Creek Off Blacksmith Fork	19,000	$0.11	$8.56	$0.00	$30.10	$0.00	$0.00			$39	$2,041
35	Small Bear River Bay	131,000	$95.63	$48.94	$15.57	$27.80	$0.15	$0.66	-$0.07		$189	$1,440
36	Smithfield	58,000	$148.87	$0.00	$0.00	$2.90	$0.00	$0.00			$152	$2,617
37	South Fork	11,000	$0.09	$0.00	$0.00	$15.00	$0.00	$0.00			$15	$1,372
38	South Willard	58,000	$9.72	$11.88	$3.67	$46.20	$0.00	$0.42			$72	$1,239
39	Temple Fork	40,000	$0.24	$0.00	$0.00	$50.90	$0.00	$0.00			$51	$1,279
40	Twin Creek	20,000	$0.17	$0.00	$0.00	$32.40	$0.00	$0.00			$33	$1,629
41	Upper Rock Creek	40,000	$0.28	$8.56	$0.00	$63.60	$0.00	$0.00			$72	$1,811
42	Washakie	158,000	$8.73	$72.15	$19.39	$180.83	$7.14	$1.69		$70	$360	$2,278
43	West Bay	90,000	$14.09	$77.81	$13.13	$55.80	$3.72	$1.12			$166	$1,841
44	Whites Valley	170,000	$3.09	$130.30	$68.54	$49.40	$125.42	$0.00	-$62.71		$314	$1,847
45	Weber Bay	124,000	$14.08	$44.07	$14.04	$84.30	$0.00	$1.83			$158	$1,277

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Table 10-6 - Analysis Summary

		1-Physical	2-Water Supply	3-Property	4-Special Considerations	5-Cost
Fig. No.	Name	Volume (ac-ft)	Yield Factor	Utility Considerations	Special Considerations	$ per ac-ft
1	Above Cutler Dam	51,000	92%	Roads & utilities	Riparian habitat	$ 927
2	Avon	30,000	40%	Roads	Riparian & agriculture	$ 2,053
3	Barrens	101,000	81%	Utilities	Habitat, wetlands, ag.	$ 2,139
4	Beeton	46,000	64%	Utilities	Riparian habitat	$ 373
5	Blacksmith Fork	40,000	45%	Roads and homes	Riparian & Nat. Forest	$ 1,505
6	Blacksmith Fork (Lions Hollow)	36,000	24%	roads and utilities	National Forest	$ 2,371
7	Blacksmith Fork Below Curtis Creek	24,000	72%	roads and utilities	National Forest	$ 1,186
8	Clarkston Creek	196,000	57%		No study	$ 3,013
9	Cub River	27,000	54%	Roads and utilities	Riparian, habitat, forest	$ 1,586
10	Cutler Enlargement (Smithfield)	251,000	64%	Many utilities, Tunnel	Wetlands & habitat	$ 1,039
11	Dry Creek	99,000	32%	Hwy 89	No study	$ 1,842
12	East Fork	34,000	46%		National Forest	$ 3,504
13	East Promontory	238,000	62%		Wetlands & habitat, refuge	$ 1,106
14	Faust Valley	251,000	62%	Gas Pipeline	No study	$ 2,425
15	Fielding	70,000	72%		Wetlands & riparian	$ 280
16	Forks	40,000	45%	roads and utilities	National Forest?	$ 1,148
17	Honeyville	105,000	72%	Many roads & utilities	Riparian, agric, cultural	$ 714
18	Hyrum Enlargement	28,000	58%	Homes & park	Riparian habitat	$ 660
19	I-84 Dam	183,000	68%	BRWCD wells	Agricultural lands	$ 2,535
20	Large Bear River Bay	254,000	62%		Habitat, wetlands, refuge	$ 865
21	Left Hand Fork	18,000	35%		National Forest?	$ 1,764
22	Left Hand Fork Blacksmith Fork	13,000	45%		National Forest?	$ 3,017
23	Lower Rock Creek	22,000	32%		National Forest?	$ 1,355
24	Mill Creek	23,000	30%	Roads & homes	Riparian & forest	$ 1,228
25	Paradise	20,000	55%	?	Riparian & agricultural	$ 1,568
26	Paradise Canyon	23,000	60%		National Forest?	$ 6,822
27	Portage Canyon	71,000	64%		None identified	$ 5,867
28	Public Shooting Grounds	118,000	64%		Wetlands and habitat	$ 1,931
29	Right Fork	6,000	90%		National Forest?	$ 4,023
30	Rozel Flat #2	254,000	62%		Low value habitat	$ 2,373
31	Saddle Creek	17,000	35%		National Forest?	$ 1,548
32	Salt Wells Flat #1	133,000	64%		Low value habitat	$ 4,125
33	Salt Wells Flat #2	105,000	64%		Low value habitat	$ 4,904
34	Sheep Creek Off Blacksmith Fork	19,000	34%		National Forest?	$ 2,041
35	Small Bear River Bay	131,000	64%		Habitat, wetlands, refuge	$ 1,440
36	Smithfield	58,000	66%	Roads & utilities	Riparian, habitat & ag.	$ 2,617
37	South Fork	11,000	40%		No study	$ 1,372
38	South Willard	58,000	64%	Roads & utilities	Development, state park	$ 1,239
39	Temple Fork	40,000	77%		Logan Canyon/Nat. Forest	$ 1,279
40	Twin Creek	20,000	89%		Logan Canyon/Nat. Forest	$ 1,629
41	Upper Rock Creek	40,000	23%		National Forest?	$ 1,811
42	Washakie	158,000	69%	Road,railroad,utilities	Riparian, wetlands, ag.	$ 2,278
43	West Bay	90,000	64%		Refuge, wetlands	$ 1,841
44	Whites Valley	170,000	69%		Agriculture	$ 1,847
45	Weber Bay	124,000	64%		Habitat, refuge	$ 1,277

	1-Physical	2-Water Supply	3-Property	4-Special Considerations	5-Cost
Green	> 40,000	> 50%	None identified	Non identified	< $1,000
Yellow	20 - 40,000	40-50%	Some	Some	$1,000 - 1,500
Red	< 20,000	< 40%	Significant	Significant	> $1,500

Bear River Development Project
Potential Reservoir Sites and Short-Listing Basis

Last Update: 4-17-12

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Fig. No.	Name	Table 10-7 - Short-Listing Basis		
		Summary of Positive Issues influencing Short-list decision	Summary of Negative Issues influencing Short-list decision	Short-list Decision
1	Above Cutler Dam	Good size, excellent yield, good cost	Inundation of riparian habitat requires mitigation	Short-list
2	Avon	None	High cost, small volume, low yield	Do Not Short-list
3	Barrens	Good size and yield	Legislation restricts, high cost, environmental and utility constraints	Do Not Short-list
4	Beeton	No red flags, good volume, yield, and cost.	Fielding is larger and lower cost	Do Not Short-list
5	Blacksmith Fork	None	High impacts to riparian habitat and National Forest; requires re-build of Canyon Rd.	Do Not Short-list
6	Blacksmith Fork (Lions Hollow)	None	High impacts to riparian habitat and National Forest; very low yield; high cost	Do Not Short-list
7	Blacksmith Fork Below Curtis Creek	Good yield, moderate cost	Small site; requires re-build of Canyon Rd	Do Not Short-list
8	Clarkston Creek	Good size	Very high cost due to large embankment.	Do Not Short-list
9	Cub River	None	Small site, moderate yield, impacts, and cost	Short-list
10	Cutler Enlargement (Smithfield)	Large site and relatively low cost	Many utility and habitat impacts; requires long embankment and diversion of Cub River	Do Not Short-list
11	Dry Creek	Good size	Low yield; high pumping cost; requires HWY 89 relocation	Do Not Short-list
12	East Fork	None	Very high cost; requires relocation of Canyon Rd	Do Not Short-list
13	East Promontory	Large site and relatively low cost; low value habitat	Potential impacts to habitat and refuge	Short-list
14	Faust Valley	Large site	High cost due to relatively lond dam requires road and pipeline relocation	Do Not Short-list
15	Fielding	Very low cost and high yield	On-stream	Short-list
16	Forks	Moderate cost	Relatively low yield; riparian impacts; requires re-build of Canyon Rd	Do Not Short-list
17	Honeyville	Relatively low cost and high yield	Restricted by legislation; on-stream	Do Not Short-list
18	Hyrum Enlargement	Relatively low cost; existing site	On-stream, but requires pumping	Use existing info
19	I-84 Dam	Large site; good yield	Infrastructure impacts; relatively high cost due to elevation	Do Not Short-list
20	Large Bear River Bay	Large site, good yield; low cost	Hi habitat and wetland impacts	Do Not Short-list
21	Left Hand Fork	None	Small site, low yield	Do Not Short-list
22	Left Hand Fork Blacksmith Fork	None	Small site, low yield, very high cost	Do Not Short-list
23	Lower Rock Creek	None	Small site, low yield	Do Not Short-list
24	Mill Creek	None	Small site, low yield	Do Not Short-list
25	Paradise	None	Small site, riparian and ag impacts	Do Not Short-list
26	Paradise Canyon	Relative good yield	Small site, very high cost	Do Not Short-list
27	Portage Canyon	Good size and yield	Very high cost	Do Not Short-list
28	Public Shooting Grounds	Good size and yield	Relatively high cost	Do Not Short-list
29	Right Fork	Excellent yield	Small size, very high cost	Do Not Short-list
30	Rozel Flat #2	Good size and yield, low impacts	Relatively high cost	Do Not Short-list
31	Saddle Creek	None	Small size, low yield	Do Not Short-list
32	Salt Wells Flat #1	Good size and yield, low impacts	Relatively high cost	Do Not Short-list
33	Salt Wells Flat #2	Good size and yield, low impacts	Relatively high cost	Do Not Short-list
34	Sheep Creek Off Blacksmith Fork	None	Small size, low yield	Do Not Short-list
35	Small Bear River Bay	Good size and yield	Significant habitat and wetland impacts	Do Not Short-list
36	Smithfield	Good size and yield	Significant riparian and habitat impacts	Do Not Short-list
37	South Fork	None	Small size, low yield	Do Not Short-list
38	South Willard	Good size and yield, relative low cost	Development and state park impacted	Do Not Short-list
39	Temple Fork	Good yield, moderate cost	Logan Canyon potentially impacted	Short-list
40	Twin Creek	High yield	Small site, relatively high cost	Do Not Short-list
41	Upper Rock Creek	None	Low yield; impacts to National Forest	Do Not Short-list
42	Washakie	Good size and yield	High utility and wetland impacts; high cost	Use existing info
43	West Bay	Good size and yield	Impacts to refuge and wetlands	Do Not Short-list
44	Whites Valley	Good size and yield; lower cost than Washakie	Relatively high cost due to elevation	Short-list
45	Weber Bay	Good size and yield, relative low cost	Impacts to refuge and habitat	Short-list

10.8.1 Selection of Storage Sites for Further Analysis

A number of the reservoirs sites that are ranked high on Table 10-5 with respect to comparable costs and other issues summarized in Table 10-6 do not have enough storage to meet a significant portion of the project needs. The vast majority of the reservoir sites do not independently develop all of the needed storage for the project. Therefore, total cost, or cost per acre-foot, cannot be the only selection criteria. A number of the sites have significant environmental or political issues. Also, how each of the storage projects fits into the overall project will also affect the total project costs. The project team felt that the preferred method to develop a short-list was to pick the best one or more reservoirs in certain categories, while covering all of the potential scenarios affecting the overall project. Some categories considered were:

- Best large reservoir site in western Box Elder County
- Best reservoir site in Cache County
- One reservoir that could supply overall project needs
- Reservoir sites with low unit costs for storage
- Best reservoir site on the Bear River
- Best reservoir site near the Great Salt Lake

This resulted in a list of sites that offered the best mix of possible reservoir options for the project as a whole.

10.8.2 Recommendation

On May 4, 2012, the project team met and accepted nine potential reservoir sites for inclusion on a short-list for additional evaluation. The short-listed reservoirs are listed on Table 10-8. Additional work was performed on these nine reservoir sites including developing storage/elevation curves and inlet/outlet piping and pumping requirements. Each of these sites was analyzed for how effectively it could provide reliable water supply storage for the overall Bear River Project. A final recommendation included six reservoirs to be used for storage for the Bear River Project. The rational for this selection is summarized in the attached Table 10-7 based on the analysis completed above and the positive and negative issues of each site.

Table 10-8
Short List of Potential Reservoir Sites

#	Name	Elevation	Volume (AF)		Cost/AF	Characterize	Comparison Cost $M
1	Above Cutler Dam	4,432	51,000	Medium	$927	Difficult environment	$47
2	Cub River	4,465	27,000	Small	$1,586	Cache	$43
3	East Promontory	4,231	238,000	Large	$1,106	Large site	$263
4	Fielding	4,300	70,000	Medium	$280	Least expensive	$20
5	Hyrum Enlargement	4,715	28,000	Small	$660	Cache	$18
6	Temple Fork	6,167	40,000	Small	$1,279	Cache, difficult enviro	$51
7	Washakie	4,406	158,000	Large	$2,278	Most expensive	$360
8	Whites Valley	5,260	170,000	Large	$1,847	Low impact	$314
9	Weber Bay	4,225	124,000	Medium	$1,277	Addl analysis needed	$158

Two of the sites (Hyrum Enlargement and Washakie) have been studied extensively in the past. The other seven sites have been studied to various levels, although some have very little documentation. Each of these nine sites was studied further to determine what sites best met the long term storage needs of the project. For East Promontory, the entire projects storage needs can be met with the one reservoir. For the other reservoir sites, a combination of several reservoirs will be required to meet the needed storage. An analysis of how each of these reservoirs could fit into the overall Bear River Project helped determine the final reservoirs chosen for the project.

10.9 REVIEW OF POSSIBLE RESERVOIR COMBINATIONS TO MEET PROJECT STORAGE REQUIREMENTS

Preliminary hydrologic modeling conducted by DWRe showed that the Project will require approximately 240,000 acre-feet of storage to reliably deliver the full Bear River Project supply of 220,000 acre-feet per year. Because only one of the short-listed sites is capable of storing the full 240,000 acre-feet of water, the development and evaluation of potential combinations of reservoirs is necessary. The following criteria were applied as an aid in the development of a preliminary list of potential combinations of reservoirs. These criteria were also applied in the evaluation of the reservoir combinations.

- Combined storage volume is at least 220,000 acre-feet
- Phasing of site development should be considered
- Sites must supply all three counties
    - Cache County either needs storage in-county, or
    - Supply must be pumped up from Fielding to Cutler
- Potential site development opposition (public, political, environmental) should be considered
- Overall project cost is critically important
- Overall project performance is critically important

These criteria were initially applied in developing the list of reservoir combinations shown in Table 10-9. Each of these combinations is shown diagrammatically in Figures 10-5 thru 10-17 (Volume II). These appeared to be the most cost-effective and storage-effective combinations of sites and are the combinations that the consultant team evaluated further.

Table 10-9
Potential Reservoir Combinations

#	Reservoir Combinations	Total Volume (AF)	Issues
A	1, 4, 9: Above Cutler, Fielding, Weber Bay	245,000	
B	2, 4, 9: Cub River, Fielding, Weber Bay	248,000	
C	4, 5, 9: Fielding, Hyrum Enlargment, Weber Bay	222,000	small volume
D	1, 4, 5, 9: Above Cutler, Fielding, Hyrum Enlargment, Weber Bay	273,000	
E	4, 6, 9: Fielding, Temple Fork, Weber Bay	234,000	
F	3, 5: East Promontory, Hyrum Enlargement	266,000	small in Cache, issues serving north Box Elder
G	2, 3: Cub River, East Promontory	265,000	small in Cache, issues serving north Box Elder
H	4, 8: Fielding, Whites Valley	240,000	nothing in Cache
I	1, 2, 4, 5, 6: Above Cutler, Cub River, Fielding, Hyrum, Temple Fork	216,000	small volume, too many
J	3, 4: East Promontory, Fielding	308,000	nothing in Cache
K	1, 3, 4, 5: Above Cutler, East Promontory, Fielding, Hyrum Enlargment	240,000	reduced East Promontory storage
L	1, 4, 7: Above Cutler, Fielding, Washakie	279,000	most expensive
M	2, 4, 6, 8: Cub River, Fielding, Temple Fork, Whites Valley	257,000	reduced Whites Valley storage

10.10 ANALYSIS OF RESERVOIR COMBINATIONS WITH OVERALL PROJECT

10.10.1 Hydrologic Modeling Results

Each of the thirteen reservoir combinations identified in Table 10-9 were analyzed to estimate how much water they could develop as part of an overall Project. DWRe’s BEARSIM model was used to predict how much water each combination could reliably deliver to the Project and the extent of projected shortages based on the 41-year period of record (1965 – 2005). Table 10-10 shows the average delivery from each reservoir combination and the expected shortages. The maximum shortages shown on Figure 10-18 for the combinations vary from 11 percent for combination C to zero percent for combination L. Table 10-10 also summarizes the hydrologic modeling results.

Table 10-10
Conceptual Review of Reservoir Sites - Summary of Hydrological Analysis

Combination	Storage Capacity	Average Storage	Minimum Storage	Average Delivery	Minimum Delivery	Average Shortage	Maximum Shortage
	(acre-ft)	(acre-ft)	(acre-ft)	(acre-ft)	(acre-ft)		
A	245,000	196,829	26,983	218,839	211,515	0.5%	3.9%
B	247,000	188,023	-	218,319	202,705	0.8%	7.9%
C	222,000	171,450	71	216,899	195,494	1.4%	11.1%
D	273,000	218,484	2,519	219,642	213,729	0.2%	2.9%
E	234,000	182,732	17,195	217,273	202,523	1.2%	7.9%
F	266,000	210,423	71	216,677	203,293	1.5%	7.6%
G	265,000	204,007	-	217,935	205,600	0.9%	6.5%
H	240,000	187,535	-	219,054	202,805	0.4%	7.8%
I	216,000	164,117	-	218,874	205,147	0.5%	6.8%
J	308,000	245,246	-	219,906	217,279	0.0%	1.2%
K	273,000	175,701	2,519	219,642	213,729	0.2%	2.9%
L	279,000	225,541	10,586	220,000	220,000	0.0%	0.0%
M	257,000	184,517	-	218,403	198,984	0.7%	9.6%

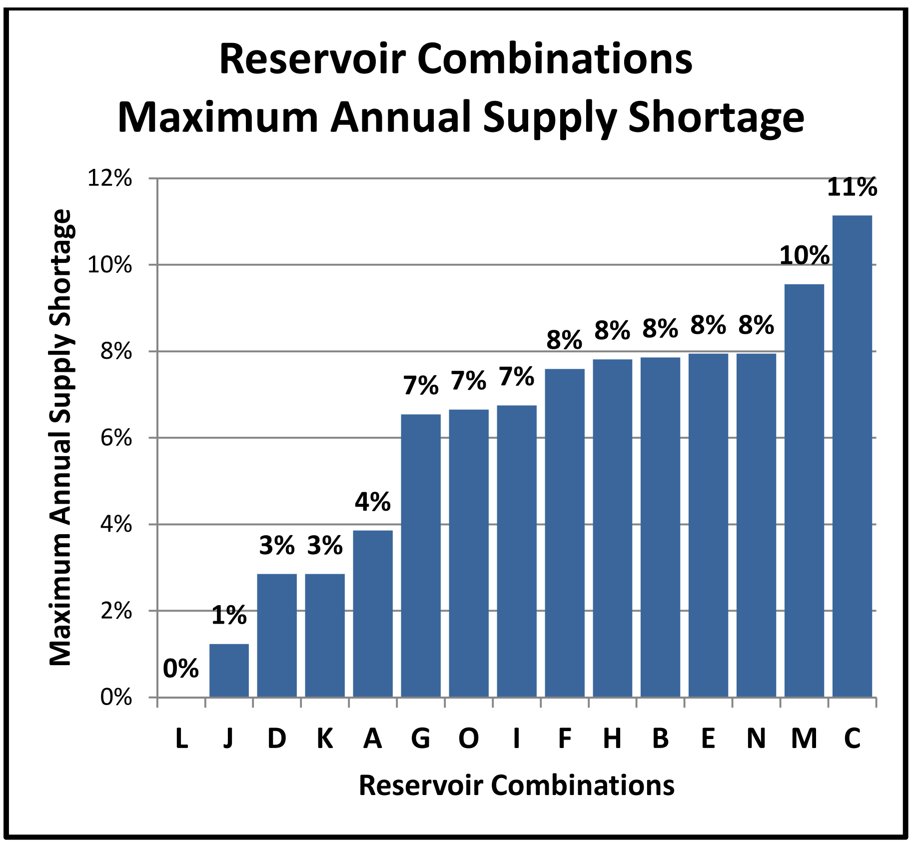


Figure 10-18

10.10.2 Overall Project Requirements

For each of the reservoir combinations Figures 10-19 through 10-30 (Volume II) show how the overall project would conceptually work with storage, piping, and pump stations needed to deliver water from the Project to the stakeholders. A summary table on each map shows projected Project costs for that combination. Figure 10-31 (Volume II) shows water supply developed for the project versus total storage volume of the project features.

10.10.3 Preliminary Cost Analysis

Table 10-11 shows the summary of costs for the thirteen combinations. These costs are not expected to be detailed final cost estimates, but rather a comparison of costs between alternatives for use in comparing the relative costs of different reservoir combinations that can provide storage for the Project[1]. Costs vary from $811 million to $1.323 billion. Figure 10-32 (Volume II) shows the costs of the reservoir combinations plotted from least costly to most costly. The colors of the bars reflect combinations where the major reservoir located below Fielding Reservoir is the same. Combination I includes the least cost reservoirs that add up to the required project volume. This results in a group of five reservoirs in Cache County. While this appears to be the least expensive combination, it is highly unlikely that all of those reservoirs would gain approval as a combination. It appears that those combinations that include Weber Bay are the relatively least expensive feasible combinations. Combinations that include East Promontory are slightly more expensive. Combination H that includes Fielding and Whites Valley has the same range of costs. Combination M, which includes a smaller Whites Valley, Fielding, Cub River, and Temple Fork, is one of the most expensive. Combination L, which includes Washakie, is also one of the most expensive.

10.11 PRELIMINARY ENVIRONMENTAL REVIEW

The nine short-listed reservoir sites included in the 13 combinations underwent preliminary environmental review to identify potential site characteristics that might make development and use impractical or relatively more difficult. Available information was gathered from local, state, and federal sources. A one-day site visit was conducted to understand the environmental setting and identify potentially sensitive environmental resources.

The consultant team gathered publically available information on wildlife habitat; threatened, endangered, and sensitive species occurrences; wetlands and water resources; soils; prime and unique farmlands; and recreational and historic places. A biologist from HDR conducted site visits on September 5-6, 2012, by driving to the inundation areas, making notes of wetlands, habitat types, land use, and social/recreational resources on the aerial maps, and taking photos. Public roads provided access to the majority of the inundation areas. Where access was restricted, the team observed the area from a short distance away.

[1] One of the potentially most significant costs that are not included in Table 10-10 is for environmental mitigation, and particularly mitigation associated with the filling of wetlands. Additional detailed review of environmental mitigation costs is recommended.

Bear River Development Project
Potential Reservoir Sites and Analysis Results

Last Update: 11/28/12

Bowen Collins & Associates, Inc. CONSULTING ENGINEERS HDR

DRAFT

Table 10-11

Combination Cost Comparison (in Millions of Dollars)*

Item #	Description	Combo A	Combo B	Combo C	Combo D	Combo E	Combo F	Combo G	Combo H	Combo I	Combo J	Combo K	Combo L	Combo M
	Reservoir Site and Facitility	**$268.0**	**$278.2**	**$251.4**	**$290.4**	**$305.6**	**$350.4**	**$366.2**	**$410.1**	**$245.2**	**$358.6**	**$385.9**	**$485.2**	**$533.7**
8	Above Cutler Dam	$47.3			$47.3					$47.3		$47.3	$47.3	
9	Cub River		$42.8					$42.8		$42.8				$42.8
10	East Promontory						$323.3	$323.3			$319.3	$273.3		
11	Fielding	$36.7	$38.3	$38.3	$38.3	$38.3			$39.3	$31.1	$39.3	$38.3	$38.3	$38.3
12	Hyrum Enlargement			$27.0	$27.0		$27.0			$27.0		$27.0		
13	Temple Fork					$97.0				$97.0				$97.0
14	Washakie												$399.6	
15	Weber Bay	$184.1	$197.0	$186.0	$177.8	$170.3								
16	Whites Valley								$370.8					$355.5
	Bear River Pipeline Construction Costs	**$346.0**	**$365.3**	**$365.3**	**$365.3**	**$365.3**	**$356.1**	**$356.1**	**$300.6**	**$281.6**	**$376.5**	**$372.5**	**$374.9**	**$297.0**
1	North Box Elder Co. Reach	$192.4	$202.8	$202.8	$202.8	$202.8	$105.6	$105.6	$64.5	$136.5	$164.6	$155.6	$202.8	$61.0
2	Elwood to Brigham City	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$95.5	$0.0	$0.0	$0.0	$0.0	$95.5
3	East Promontory to Brigham City	$0.0	$0.0	$0.0	$0.0	$0.0	$47.2	$47.2	$0.0	$0.0	$44.8	$44.8	$0.0	$0.0
4	South Box Elder Co. Reach	$70.4	$79.3	$79.3	$79.3	$79.3	$98.2	$98.2	$57.5	$71.1	$93.2	$98.2	$98.2	$57.5
5	Weber Co. Reach	$83.1	$83.1	$83.1	$83.1	$83.1	$73.9	$73.9	$83.1	$73.9	$73.9	$73.9	$73.9	$83.1
6	Honeyville Diversion Pump Station						$31.2	$31.2						
	Cache County Project Facilities	**$23.6**	**$28.2**	**$28.2**	**$0.0**	**$28.2**	**$28.2**	**$28.2**	**$28.2**	**$0.0**	**$28.2**	**$0.0**	**$0.0**	**$28.2**
7	Collinston Connection	$23.6	$28.2	$28.2		$28.2	$28.2	$28.2	$28.2		$28.2			$28.2
	Running Subtotal:	**$637.6**	**$671.6**	**$644.8**	**$655.7**	**$699.0**	**$734.7**	**$750.5**	**$738.9**	**$526.8**	**$763.2**	**$758.5**	**$860.2**	**$858.9**
	Mobilization/Field Oversight Expenses	**$63.8**	**$67.2**	**$64.5**	**$65.6**	**$69.9**	**$73.5**	**$75.0**	**$73.9**	**$52.7**	**$76.3**	**$75.8**	**$86.0**	**$85.9**
17	Contractor General Conditions (Prime) - 10%	$63.76	$67.2	$64.5	$65.6	$69.9	$73.5	$75.0	$73.9	$52.7	$76.3	$75.8	$86.0	$85.9
	Running Subtotal:	**$701.3**	**$738.8**	**$709.3**	**$721.2**	**$768.9**	**$808.2**	**$825.5**	**$812.8**	**$579.4**	**$839.6**	**$834.3**	**$946.2**	**$944.7**
	Project Administration & Management	**$280.5**	**$295.5**	**$283.7**	**$288.5**	**$307.6**	**$323.3**	**$330.2**	**$325.1**	**$231.8**	**$335.8**	**$333.7**	**$378.5**	**$377.9**
18	Legal & Admin - 10%	$70.13	$73.9	$70.9	$72.1	$76.9	$80.8	$82.6	$81.3	$57.9	$84.0	$83.4	$94.6	$94.5
19	Engineering - 5%	$35.1	$36.9	$35.5	$36.1	$38.4	$40.4	$41.3	$40.6	$29.0	$42.0	$41.7	$47.3	$47.2
20	Scope Contingency/Market Conditions - 25%	$175.3	$184.7	$177.3	$180.3	$192.2	$202.0	$206.4	$203.2	$144.9	$209.9	$208.6	$236.5	$236.2
	Bear River Pipeline Project Grand Total:	**$982**	**$1,034**	**$993**	**$1,010**	**$1,076**	**$1,131**	**$1,156**	**$1,138**	**$811**	**$1,175**	**$1,168**	**$1,325**	**$1,323**

***Costs represent comparison values only**

10.11.1 Wetlands

The consultant team used publically available National Wetland Inventory (NWI) mapping to determine the acres of wetlands within the inundation areas of each reservoir. NWI mapping was imported into a Geographic Information System (GIS), along with the inundation boundaries of each proposed reservoir. The total acreages of NWI mapped wetlands within each inundation boundary were calculated and are presented in Table 10-14. NWI maps were then reviewed to briefly summarize the types of wetlands in each area. During the field visit, the consultant team observed any obvious features that would significantly change the acreages of wetlands, such as new urban or industrial development.

10.11.2 Wildlife Habitat

The consultant team gathered information on mapped wildlife habitats from the Utah Division of Wildlife Resources (UDWR) online at the Utah GIS Portal website (**http://gis.utah.gov/data/**). The UDWR provides habitat acreages and value (critical, substantial) for mostly game species and some conservation species. The acreage of habitats and the value within each reservoir inundation area are presented in Table 10-14. The consultant team visited each reservoir site to confirm and characterize the habitats within each inundation area.

10.11.3 Threatened, Endangered, and Sensitive Species Occurrences

The Utah Conservation Data Center (UCDC) maintains a database and records observations of state sensitive and federally listed wildlife species compiled from a range of state and federal agencies, universities, museums, and non-profit organizations. The consultant team requested location information from the UCDC on recorded occurrences of state sensitive and federally listed wildlife species within one mile of each reservoir site, provided in GIS format. These records include raptors and other migratory birds protected under the Migratory Bird Treaty Act. Exact locations of species observations are not provided by UCDC, but rather a one-mile "buffered" location, meaning the actual location could be anywhere within one mile of the location given. In addition, the consultant team used information from the Utah Conservation Data Center (**dwrcdc.nr.utah.gov/ucdc**) to generate a list of state sensitive and federally listed wildlife species that could occur within the study area. Sensitive or federally-listed species that could be present in Box Elder and Cache Counties and could use the habitats within the study area are shown in Table 10-12 and Table 10-13, respectively. The team prepared maps including aerial maps and location records for raptors and other special-status species provided by UCDC. During the field visits, the consultant team looked for any obvious and recent changes that would substantially change the likelihood of a listed or sensitive species to use the area. The number of observations provided by UCDC within each inundation area is provided in Table 10-14.

10.11.4 Farmlands and Soils

The consultant team consulted the Natural Resources Conservation Service (NRCS) soil survey and classification to identify unique and prime farmland soils within each reservoir inundation area. The soil maps and data were imported into a GIS so that acres of each type of classified farmland soil could be calculated. These quantities area presented in Table 10-14.

10.11.5 Social and Recreational Resources

Formal surveys for social and recreational resources were not conducted. During the on-line searches and site visits, the consultant team looked for obvious resources such as parks, trailheads, churches, schools, and historic markers. Publically available maps were reviewed to see if additional social and recreational resources were located within or near the inundation boundaries of each reservoir. These resources are listed in Table 10-14.

Table 10-12
Special Status Species that Could Inhabit the Box Elder County Study Areas

Common Name	Scientific Name	Status*
Box Elder County		
AMERICAN WHITE PELICAN	PELECANUS ERYTHRORHYNCHOS	SPC
BALD EAGLE	HALIAEETUS LEUCOCEPHALUS	SPC
BLUEHEAD SUCKER	CATOSTOMUS DISCOBOLUS	CS
BOBOLINK	DOLICHONYX ORYZIVORUS	SPC
BONNEVILLE CUTTHROAT TROUT	ONCORHYNCHUS CLARKII UTAH	CS
BURROWING OWL	ATHENE CUNICULARIA	SPC
CALIFORNIA FLOATER	ANODONTA CALIFORNIENSIS	SPC
DESERET MOUNTAINSNAIL	OREOHELIX PERIPHERICA	SPC
FERRUGINOUS HAWK	BUTEO REGALIS	SPC
GRASSHOPPER SPARROW	AMMODRAMUS SAVANNARUM	SPC
GRAY WOLF	CANIS LUPUS	E
GREAT PLAINS TOAD	BUFO COGNATUS	SPC
GREATER SAGE-GROUSE	CENTROCERCUS UROPHASIANUS	C
JUNE SUCKER	CHASMISTES LIORUS	E
KIT FOX	VULPES MACROTIS	SPC
LAHONTAN CUTTHROAT TROUT	ONCORHYNCHUS CLARKII HENSHAWI	T
LEAST CHUB	IOTICHTHYS PHLEGETHONTIS	C, CS
LEWIS'S WOODPECKER	MELANERPES LEWIS	SPC
LONG-BILLED CURLEW	NUMENIUS AMERICANUS	SPC
LYRATE MOUNTAINSNAIL	OREOHELIX HAYDENI	SPC
MOUNTAIN PLOVER	CHARADRIUS MONTANUS	SPC
NORTHERN GOSHAWK	ACCIPITER GENTILIS	CS
NORTHWEST BONNEVILLE PYRG	PYRGULOPSIS VARIEGATA	SPC
PREBLE'S SHREW	SOREX PREBLEI	SPC
PYGMY RABBIT	BRACHYLAGUS IDAHOENSIS	SPC
SHARP-TAILED GROUSE	TYMPANUCHUS PHASIANELLUS	SPC
SHORT-EARED OWL	ASIO FLAMMEUS	SPC
TOWNSEND'S BIG-EARED BAT	CORYNORHINUS TOWNSENDII	SPC
UTAH PHYSA	PHYSELLA UTAHENSIS	SPC
WESTERN PEARLSHELL	MARGARITIFERA FALCATA	SPC
WESTERN TOAD	BUFO BOREAS	SPC
YELLOW-BILLED CUCKOO	COCCYZUS AMERICANUS	C
YELLOWSTONE CUTTHROAT TROUT	ONCORHYNCHUS CLARKII BOUVIERI	SPC

*SPC = Wildlife species of Concern; CS = Species managed under a Conservation Agreement; E = Federally listed as under the Endangered Species Act (ESA) as endangered; T = Federally listed under the ESA as threatened; C = Candidate for federal listing under ESA. Source: Utah Conservation Data Center website at http://dwrcdc.nr.utah.gov/ucdc/ViewReports/sscounty.pdf.

Table 10-13
Special Status Species that Could Inhabit the Cache County Study Areas

Common Name	Scientific Name	Status*
Cache County		
AMERICAN WHITE PELICAN	PELECANUS ERYTHRORHYNCHOS	SPC
BALD EAGLE	HALIAEETUS LEUCOCEPHALUS	SPC
BLACK SWIFT	CYPSELOIDES NIGER	SPC
BLUEHEAD SUCKER	CATOSTOMUS DISCOBOLUS	CS
BOBOLINK	DOLICHONYX ORYZIVORUS	SPC
BONNEVILLE CUTTHROAT TROUT	ONCORHYNCHUS CLARKII UTAH	CS
BROWN (GRIZZLY) BEAR	URSUS ARCTOS	T - Extirpated
BURROWING OWL	ATHENE CUNICULARIA	SPC
CALIFORNIA FLOATER	ANODONTA CALIFORNIENSIS	SPC
CANADA LYNX	LYNX CANADENSIS	T
DESERET MOUNTAINSNAIL	OREOHELIX PERIPHERICA	SPC
FERRUGINOUS HAWK	BUTEO REGALIS	SPC
FRINGED MYOTIS	MYOTIS THYSANODES	SPC
GRASSHOPPER SPARROW	AMMODRAMUS SAVANNARUM	SPC
GREAT PLAINS TOAD	BUFO COGNATUS	SPC
GREATER SAGE-GROUSE	CENTROCERCUS UROPHASIANUS	C
LEWIS'S WOODPECKER	MELANERPES LEWIS	SPC
LONG-BILLED CURLEW	NUMENIUS AMERICANUS	SPC
LYRATE MOUNTAINSNAIL	OREOHELIX HAYDENI	SPC
NORTHERN GOSHAWK	ACCIPITER GENTILIS	CS
PYGMY RABBIT	BRACHYLAGUS IDAHOENSIS	SPC
SHARP-TAILED GROUSE	TYMPANUCHUS PHASIANELLUS	SPC
SHORT-EARED OWL	ASIO FLAMMEUS	SPC
THREE-TOED WOODPECKER	PICOIDES TRIDACTYLUS	SPC
TOWNSEND'S BIG-EARED BAT	CORYNORHINUS TOWNSENDII	SPC
WESTERN RED BAT	LASIURUS BLOSSEVILLII	SPC
WESTERN TOAD	BUFO BOREAS	SPC
YELLOW-BILLED CUCKOO	COCCYZUS AMERICANUS	C

*SPC = Wildlife species of Concern; CS = Species managed under a Conservation Agreement; T = Federally listed under the ESA as threatened; C = Candidate for federal listing under ESA. Source: Utah Conservation Data Center website at http://dwrcdc.nr.utah.gov/ucdc/ViewReports/sscounty.pdf.

Table 10-14 summarizes the results of the preliminary environmental review looking at wetland acres affected, wildlife habitat value, the number of TES (threatened, endangered, and sensitive) species, acres of farmland affected, social resources, and the potential cost for environmental mitigation based on typical wetland and farmland mitigation costs. As can be seen from the table, three reservoirs would appear to inundate large areas of wetlands and have the most potential for very large environmental mitigation costs: Above Cutler Dam, East Promontory, and Weber Bay.

Table 10-14
Conceptual Review of Reservoir Sites - Summary of Environmental Review

Reservoir Site Name	Inundation Area (acres)	Wetlands (acres)	Wildlife Habitat Value	Number of TES Species	Number of TES Records	Prime or Unique Farmlands (acres)	Social Resources Present	Environmental Mitigation Comparison Cost* ($M)
Above Cutler Dam	4,250	2,535	M	11	24	1,898	Bird watching, fishing area	136
Cub River	1,500	297	M	3	6	775	Limited bird watching, fishing	19
East Promontory	28,170	25,533	H	6	8	4	Limited. Adjacent to	1,277
Fielding	1,700	790	H	6	10	848	Limited.	44
Hyrum Enlargement	730	542/120 (see text)	H	5	9	80	Fishing, boating, camping area	28
Temple Fork	480	1	VH	3	14	0	Trailheads, camping area	0
Washakie	4,970	288	M	2	2	278	Limited	16
Whites Valley	2,060	4	H	5	9	80	Limited. Adjacent to	1
Weber Bay	6,900	6,841	VH	4	9	70	Bird watching, hunting	342

* Comparison Mitigation cost assumed at $50,000 per acre of wetlands and $5,000 per acre of prime farmlands. A more typical wetlands mitigation cost is $100,000 or more per acre, but inventory acreage may be exagerated on certain sites. It is also possible that UDWRe would not have to mitigate 100% of these impacts if it can be shown that the reservoirs could be operated to maintain some of the wetlands or that the operations would only change, possible improve, the existing wetlands function.

Environmental mitigation requirements for the construction of Bear River Project storage (and possibly for the diversion of 220,000 acre-feet of water out of the Bear River) are likely to be complicated. The US Army Corps of Engineers (USACE) rules and procedures in place at the time that project permitting is completed will dictate how impacts are mitigated and how much compensatory wetland mitigation is required. The general guidance is that the selected project must be the least environmentally damaging practical alternative. Beyond that, current procedures frequently require replacement of similar or higher value wetland functions, within the same watershed, using similar types of wetlands, with a high likelihood of success. Mitigation ratios, whereby more wetland acreage must be created than is being lost or degraded by the project can be as low as 1 to 1, or as high as 10 to 1. As part of a subsequent study effort, DWRe is planning to examine the environmental issues at each reservoir (and for the project as a whole) more closely to more accurately determine the possible environmental mitigation approach and expected costs.

10.12 RESERVOIR SITES ELIMINATED FROM FURTHER CONSIDERATION

10.12.1 East Promontory

East Promontory functions similarly to Weber Bay as it provides storage in the lower portion of Box Elder County. The pumping costs to and from the reservoir in addition to the large pipeline require makes it a less cost-effective solution. There are also environmental concerns with this location as noted above.

10.12.2 Washakie

It was estimated that Washakie would be the most expensive reservoir to construct. Its high cost, location, environmental impacts, and long term pumping requirements make it one of the least desirable locations for Project storage.

10.12.3 Hyrum Enlargement

The Hyrum Enlargement site is most likely to face substantial local opposition, as it has in the past. The local political climate for this option, combined with its smaller storage volume, makes it less desirable than the other Cache County reservoir options. Due to these issues, it will not be advanced as a recommended reservoir site.

10.13 RECOMMENDED RESERVOIR SITES FOR PROJECT

10.13.1 Final Recommended Reservoirs for Project Consideration

Based on the analysis of the potential reservoir sites discussed in the sections above, and considering all of the potential combinations and issues related to each reservoir site, the following recommendations are made for Project storage. These six reservoirs are recommended for further consideration to meet Project storage requirements. Precise locations and site attributes are preliminary and subject to adjustment during further review. Adjustments in response to geotechnical, archaeological, and land ownership considerations, or to minimize environmental impacts or mitigation costs, are likely.

Fielding Reservoir. Fielding Reservoir appears to be the best reservoir combination of low unit cost and available storage. It is also located in Box Elder County and could be used as a reservoir to supply the county's future water needs. There are limited environmental issues and being on the main stem of the River, it requires no pumping to fill. At 70,000 acre-feet, it only develops about a third of the Project's needed storage, but the reservoir has a very low unit cost. In fact, it is the reservoir site with the lowest per acre-foot cost of any site studied.

Weber Bay. Weber Bay is part of the reservoir combinations for the Project that appears to have the least overall cost for the Project as a whole. The reservoir would be located adjacent to the existing Willard Bay Reservoir. Located at the southern end of the Project it could provide storage for WBWCD and JVWCD for their combined 100,000 acre-foot allotment of Project water supply. WBWCD has extensive history with Willard Bay construction and rehabilitation;

design and construction issues would be similar at Weber Bay. One issue is the amount of wetlands that would be affected by the inundation. Costs for mitigating this impact will need to be determined in a subsequent phase of the Project study effort.

Whites Valley. Whites Valley reservoir is located just north of I-84 between Bothwell and Howell. Whites Valley reservoir could be a viable alternative to Weber Bay if Weber Bay cannot be permitted or built. The site is an excellent dam site with very little embankment required. The land on which the reservoir would be placed is mostly farmland and appears to have very few environmental issues. The issue with the reservoir is that there is a large pump lift and its relative distance from the Bear River to the reservoir site makes the energy costs at this site expensive. Some of the energy used in pumping water to the site can be recovered through use of hydropower facilities when deliveries are made. The site provides advantages to BRWCD because it is in the recharge zone for some of their major supply wells and can readily serve Box Elder County.

Temple Fork. Temple Fork is located on the upper Logan River in Logan Canyon. It could provide off stream storage of approximately 50,000 acre feet for the Project. Being located in the upper part of the watershed in Cache County, the water supply could be used to supplement supplies in Cache County and provide higher quality water to the county. There will most likely be opposition to building a dam in Logan Canyon but the site is a viable alternative for storage in Cache County.

Cub River. Cub River reservoir would store approximately 27,000 acre feet of water. It would be located on the Cub River just above its confluence with the Bear River. One of its challenges is that is has a relatively low yield factor, because of the small size and low inflow. The inundation footprint of the reservoir would also impact riparian habitat and wetlands along the river.

Above Cutler Dam. The reservoir would store approximately 51,000 acre feet of water from the Bear River, being located on the main stem of the river. The dam would be located just above Cutler Reservoir as the name implies and would back water up some distance north along the Bear River. The reservoir has a relatively low unit cost and could serve to deliver Cache County its water from the Project. Potential issues include the mitigation of riparian habitat along the river, and disruption to roadways east and west in the county (these would have to be relocated or bridged). The reservoir would also require substantial ROW purchases because of the high number of private parcels impacted by the anticipated inundation area.

10.13.2 Recommended Reservoir Combinations

Some combination of these six reservoirs is recommended to be used to develop the storage needed for the Project. Based on the analysis, the following general recommendations are made to determine what reservoirs and in what combination to use.

- Fielding should be part of the final reservoir combination because of its low unit cost, location, and apparent lack of any major site development issues.
- Above Cutler Dam could be a replacement for Fielding if issues there cannot be resolved. Above Cutler Dam serves the same function as Fielding, though not as cost-effectively.

- Weber Bay should be part of the final reservoir combination as the lower reservoir site in the system because of lower costs and the ability to meet WBWCD/JVWCD supply needs.
- Whites Valley could be a replacement for Weber Bay if issues there cannot be resolved. It is an excellent dam site that appears to have limited environmental or political issues. It also meets Project storage requirements when combined with Fielding and a reservoir site in Cache County.
- Temple Fork and Cub River. It would benefit Cache County to have a reservoir located in the county to supply their water needs. Otherwise the Project water would have to be pumped back up to Cache County or exchanges would have to be made with downstream water users. Either of these reservoirs could supply some or all of that storage. It is recommended that these be considered as alternatives for storage in Cache County.

10.14 RECOMMENDED RESERVOIR COMBINATION FOR PROJECT

Based on the recommended reservoir sites for the Project and the location/volume requirements of the storage, it is recommended that Combinations B and M (Figures 10-20 and 10-30 [Volume II], respectively) be advanced for further study. Combination B includes the recommended reservoirs of Fielding, Weber Bay and Cub River (one of the recommended Cache County reservoirs), for a total storage of 247,000 acre-feet. Combination M includes the recommended reservoirs of Fielding, Whites Valley, Cub River, and Temple Fork (two of the recommended Cache County reservoirs) for a total storage of 257,000 acre-feet. The final reservoir combination developed for the project will be using these reservoirs and their possible combinations and will be determined with the further investigations and study of the next phases of the Project.

10.15 INITIAL REAL ESTATE REVIEW

HDR completed a Real Estate review of the six short-listed reservoir sites to determine the land value and ownership information of potentially impacted parcels associated with each site. This review included the development of the expected take area acreage, the current land use, and the expected price to acquire the land that would be purchased or otherwise obtained by DWRe.

HDR's Real Estate Services team began with publically available GIS tax parcel data from both Box Elder and Weber Counties; obtained from the counties in December 2012 and January of 2013; respectively. This data included the property boundaries, size, ownership, and current land use for parcels within the county. The six short-listed reservoir site footprints were overlaid on the property boundaries in a GIS analysis that determined the projected "Take Area Acres" of each property for each site alternative. The current land use categories of each of the potentially impacted properties were generalized into the following categories: Agricultural, Commercial, Open Space, Residential, and Vacant. Local research was conducted based on sales comparables in the areas to determine an average price per acre for each land use category. This value was then multiplied by each potentially impacted property's projected "Take Area Acres" to determine the estimated ROW cost for each property in each site footprint. The estimated ROW costs were then summed for each reservoir site to determine the final estimated ROW cost for each site.

In conclusion, the Real Estate review estimated the total land value of two of the Short-Listed sites; Whites Valley and Temple Fork, to be less than $1 million each and one of the sites; Above Cutler Dam, to be valued at almost $40 million. See Table 10-15 for a complete summary of the review.

Table 10-15
Real Estate Review of Estimated Land Value
for Six Short-Listed Sites

#	Name	# Potentially Impacted Properties	Estimated ROW Costs
1	Above Cutler Dam	385	$39,802,182
2	Cub River	106	$12,367,875
4	Fielding	78	$5,804,513
6	Temple Fork	5	$994,461
8	Whites Valley	22	$840,874
9	Weber Bay	35	$3,361,500

11.0 BEAR RIVER PROJECT

11.1 OVERALL PROJECT DESCRIPTION

The Bear River Project will develop water as part of the implementation of the Bear River Water Development Act. Water will be diverted from the Bear River and delivered to Box Elder, Cache, Weber, Davis, and Salt Lake Counties. The Project will develop up to 220,000 acre-feet of Utah's water rights on the Bear River, for the communities in the service areas of the BRWCD, Cache County, WBWCD, and JVWCD. Formulation of the Project has been going on for more than 40 years. The main components of the Project (use of surplus Bear River flow, use of reservoir storage to make supply reliable, diversion above areas of water quality degradation, and delivery to meet both the Wasatch Front and local water needs) have been consistently part of the Project.

11.2 MAJOR PROJECT FACILITIES

The Project as currently envisioned includes reservoir storage and conveyance facilities necessary to deliver water from the Bear River to the three participating water agencies and Cache County and are shown on Figure 11-1 (Volume II). New reservoir storage will be at the sites identified for further study in Chapter 10. Water will be diverted into these reservoirs in the winter and spring months and delivered to the three water districts and Cache County during their peak summer demand months. Water will be diverted from the Bear River and pumped/stored. A pipeline from the reservoir(s) will deliver water through Box Elder and Weber Counties to the proposed West Haven WTP. From the West Haven WTP south, WBWCD and JVWCD are planning a project consisting of the WTP, a finished water storage reservoir, and pump stations to deliver the water following treatment to Weber, Davis, and Salt Lake Counties. Figure 11-1 (Volume II), shows the major facilities of the overall Project, including the Washakie Reservoir alternative, removed from further consideration after the analysis of project storage requirements, as well as the remaining potential reservoir locations discussed in Chapter 10.

11.2.1 Bear River Project Facilities

The Bear River project includes:

- Storage
- Diversion Facility
- Pipelines to the West Haven WTP
- Cache County Facilities (intake pump stations and pipelines)

These facilities are the focus of the Bear River Project study. Concept level design for these facilities (with the exception of the Cache County facilities) is contained in this report. A preliminary concept layout for the Cache County facilities is described in Chapter 7, Section 7.6.

11.2.2 Washakie Reservoir

The Washakie Reservoir is an off-steam storage facility planned to be located in Malad Valley south of the Idaho and Utah border. The reservoir is planned to store 160,000 acre-feet of Bear River water. The *Washakie Reservoir Project Preliminary Engineering and Design Report* was completed by CH2M HILL for DWRe in February 2010. The 2010 report indicated that the Washakie site is technically feasible for a new reservoir and provided preliminary design information with geology, geotechnical, hydrology, facilities, water quality, environmental, and cultural considerations. The 2010 report also provided conceptual cost information that was used as discussed in Chapter 12. After completion of the pipeline routing study as part of this report, it was determined that Washakie Reservoir, because of its high cost, would not be studied further as a reservoir site for the Project. As a result, DWRe requested further analysis of reservoir sites for the Project that was discussed in Chapter 10.

11.2.3 Recommended Reservoir Sites for Further Study

Based on the recommended reservoir sites for the Project and the location/volume requirements of the storage, it is recommended that the reservoirs of Fielding, Weber Bay, Cub River, Whites Valley, and Temple Fork be considered for further analysis. The final reservoir combination developed for the project will be using these reservoirs and their possible combinations and will be determined with the further investigations and study of the next phases of the Project.

11.2.4 West Haven WTP

The West Haven WTP is planned to treat up to 300 cfs (approximately 193.9 MGD) of Project water. The treated water will be delivered to WBWCD and JVWCD for use in Weber, Davis, and Salt Lake Counties. A preliminary plant site layout was developed by Carollo in 1998. The WTP will also require an on-site raw water storage reservoir to operate efficiently. A raw water reservoir size of 307 acre-ft (100 MG) has been assumed for cost estimating purposes in Chapter 12. This size will provide storage for approximately 50% of the maximum daily treatment capacity of the proposed WTP.

11.2.5 Wasatch Front Regional Water Project Finished Water Transmission Pipeline from West Haven WTP to WBWCD and JVWCD

This pipeline is proposed to convey treated water from the West Haven WTP to approximately 2100 South and Bangerter Highway in Salt Lake County, where it will connect to the Jordan Aqueduct Reach No. 3 pipeline. In 1997, Boyle Engineering Corporation completed a preliminary study titled the Bear *River Pipeline Alignment Study*. A preliminary alignment for the finished water pipeline, pump stations, and a finished water reservoir were part of the study. In 2005, BC&A completed the *Wasatch Front Regional Water Project Reservoir Site Selection and Alignment Study* for WBWCD. The study evaluated and recommended a location for the reservoir and pipeline alignments into and out of the reservoir from the proposed transmission pipeline alignment proposed in the 1997 study. Since that time, WBWCD has selected a reservoir site near the proposed pipeline alignment.

11.2.6 Wasatch Front Regional Water Project 100 MG Reservoir

A finished water reservoir is required to help regulate pressure, equalize pumping and treatment rates, uphold reliability of water supply, and improve the operational flexibility and efficiency of the finished water pipeline. The finished water reservoir is sized at 100 MG based on providing storage for approximately 50% of the maximum daily flow of the proposed finished water transmission pipeline. *Technical Memorandum No. 1 for the Wasatch Front Regional Water Project* was prepared for WBWCD by BC&A in October 2001. This memorandum evaluated potential reservoir sites and recommended a reservoir site in Layton, Utah. The *Wasatch Front Regional Water Project Reservoir Site Selection and Alignment Study* for WBWCD reconfirmed the recommended reservoir site (BC&A, 2005). A subsequent technical memorandum entitled *100 MG Reservoir Site Evaluation* (BC&A, September 2006) for WBWCD evaluated an alternate reservoir site located west of I-15 near 200 South and 700 West in Clearfield, Utah. The memo indicated that the alternate site was equally suitable for the reservoir. WBWCD has purchased the land in Clearfield and this site is the planned location for the 100 MG reservoir as shown on Figure 11-1 (Volume II).

11.2 PROJECT SUMMARY

The Bear River Project is extensive and complex extending from Cache County through Box Elder, Weber, Davis, and Salt Lake Counties. Previous studies have evaluated various components of the Project but have not included an overall synopsis of the entire Project. This chapter reflects the current understanding of plans for the Project.

12.0 PROJECT CONCEPTUAL COSTS

This chapter presents the results of the conceptual-level cost estimates for the Bear River Project. As discussed in Chapter 11, the Bear River Pipeline is one of many facilities required for the Bear River Project. The pipelines costs based on the original Washakie Reservoir site are presented in this chapter. Three alternative total Project costs are presented in this chapter as well. These include the overall Project costs for the original Washakie alternative, Project costs for reservoir alternative B, and Project costs for reservoir alternative M both described in chapter 10 of this report. In addition, costs from previous studies on other Project facilities south of the West Haven Water Treatment Plant to deliver water to WBWCD and JVWCD were updated and are summarized in this chapter to provide an overall Bear River Project conceptual cost for those agencies. Environmental mitigation costs are not included in these totals.

12.1 COST ESTIMATING

The conceptual costs presented in this chapter are considered a combination of Class 5 and Class 4 estimates for planning purposes by the Association for the Advancement of Cost Engineering—International (AACE). The class estimates are defined as follows:

> **Class 5.** This estimate is prepared based on limited information, where little more than proposed facility type, its location, and the capacity and operating characteristics are known. This class of estimate includes, but is not limited to, market studies, assessment of viability, evaluation of alternate schemes, project screening, location and evaluation of resource needs and budgeting, and long-range capital planning. Examples of estimating methods used would be cost/capacity curves and factors, scale-up factors, and parametric modeling techniques. Little time is expended in the development of this estimate. The typical expected accuracy range for this class estimate is -20 to -50 percent on the low side and +30 to +50 percent on the high side.
>
> **Class 4.** This estimate is prepared based on information where the preliminary engineering is from 1 to 5 percent complete. Examples of estimating methods used would include equipment and system process factors, scale-up factors, and parametric and modeling techniques. This estimate requires more time expended in its development. The typical expected accuracy range for this class estimate is -15 to -30 percent on the low side and +20 to +50 percent on the high side.

12.2 BEAR RIVER PIPELINE PROJECT COSTS

Tables 12-1, 12-2, and 12-3 detail total Project costs for the original Washakie alternative, for reservoir alternative B, and for reservoir alternative M both described in chapter 10 of this report. These costs include the major pipeline facilities as discussed in Chapter 7 and outlined in Chapter 11. The development of these unit costs is detailed in the *Bear River Pipeline and Pump Station Unit Cost Technical Memorandum* (Carollo, BC&A, 2010), which is included in the Volume I Appendix, Part II. These costs are considered a Class 4 estimate. Costs for Cache County facilities are classified as a Class 5 estimate, as limited information was available. Costs for the Bear River Pipeline project facilities will be shared between Cache County, BRWCD, WBWCD, and JVWCD.

12.3 BEAR RIVER PROJECT COSTS

The Bear River Project costs represent the conceptual costs for the entire Project. These costs include the Bear River Pipeline project costs needed to deliver water to and from the different reservoir combinations, and additional major facilities as discussed in Chapter 11. These costs were obtained from a combination of previous studies and reports. Costs for the Washakie Reservoir were obtained from the *Washakie Reservoir Project Preliminary Engineering and Design Report (CH2M HILL, February 2010)*. Costs for the finished water transmission pipeline and 100 MG reservoir were obtained from the *Wasatch Front Regional Water Project Reservoir Site Selection and Alignment Study* for WBWCD (BC&A, February 2005). The 2005 study referenced the *River Pipeline Alignment Study* (Boyle, 1997) for the finished water pipeline alignment and provided updated costs for the pipeline and 100 MG finished water reservoir. The cost allocation between WBWCD and JVWCD for these facilities was also identified in this report. Costs for Washakie Reservoir, finished water pipeline, and 100 MG finished water reservoir are considered Class 4 estimates.

All costs were adjusted to the March 2010 Engineering News Record Index (ENR), 20-cities cost indexing system value of 8600 to be consistent with Bear River Pipeline project costs in this report. Facilities located upstream of the proposed West Haven WTP will be cost shared between Cache County, BRWCD, WBWCD, and JVWCD. The West Haven WTP and facilities located downstream of the WTP will be cost shared between WBWCD and JVWCD. Table 12-4 shows total project costs for each of these alternatives including costs for WBWCD and JVWCD for facilities to deliver the water south to these agencies from the West Haven Water Treatment Plant.

12.4 COST SUMMARY

Table 12-5 details the costs for the overall Bear River Project for the three Project alternatives by component by Work Group Participant. This table also shows total capital costs per acre-foot of water developed by the Project based on the Bear River Compact. Total capital costs per acre-feet vary from $5,545 for Cache County and BRWCD to $12,678 for JVWCD depending on the alternative. Annual costs per acre-foot based on a thirty-year financing at five percent interest vary from $361 per acre-foot to $825 per acre-foot depending on the alternative.

Table 12-1
State of Utah
Division of Water Resources
Bear River Project Cost-Washakie Alternative
Bear River Pipeline Concept Report
Opinion of Probable Construction Costs
20 Cities ENR Index = 8600 - March 2010

Item #	Description	Quantity	UOM	Unit Price	Total Price	Comments/Assumptions
				Bear River Pipeline Project Grand Total:	**$ 1,606,290,000**	
	Bear River Pipeline Construction Costs				**$408,086,000**	
1	Supply Reach - 126" Diam	47,590	LF	$1,533	$72,956,000	Pipeline costs include pipe materials, coatings/linings,
2	Collinston Reach I - 102" Diam	6,340	LF	$1,122	$7,114,000	installation, est ROW acquisition, surface restoration,
3	Collinston Reach II - 108" Diam	6,340	LF	$1,209	$7,666,000	utilities relocation, and general pipeline
4	North Box Elder Co. Reach - 114" Diam	123,230	LF	$1,445	$178,068,000	appurtenances as shown in the conceptual
5	South Box Elder Co. Reach - 90" Diam	45,750	LF	$1,203	$55,038,000	plan/profile sheets and as outlined in Chapter 6 of the
6	Weber Co. Reach - 90" Diam	70,470	LF	$1,177	$82,944,000	Report.
7	Collinston Valve Vault	1	LS	$1,900,000	$1,900,000	
8	Metering Vaults	3	EA	$800,000	$2,400,000	
	Bear River Project Pump Stations				**$99,600,000**	
1	Washakie Pump Station	24,000	HP	$1,500	$36,000,000	660 cfs pumped from Washakie Reservoir
2	Collinston Diversion & Pump Station I	14,000	HP	$1,800	$25,200,000	Lower head pump station - 400 cfs to Washakie Res
2	Collinston Diversion & Pump Station II	24,000	HP	$1,600	$38,400,000	Higher head pump station - 480 cfs to South
	Cache County Project Facilities				**$115,239,000**	See Chapter 7 for details on Cache County Facilities
1	72" Pipeline to Cutler Reservoir	24,728	LF	$704	$17,409,000	From Collinston Diversion (from Washakie Res)
2	30" Pipeline to Newton Reservoir	23,660	LF	$209	$4,945,000	From a Pump Station at Cutler Reservoir
3	Newton Reservoir Pipeline Pump Station	2,600	HP	$3,000	$7,800,000	Cost per HP derived from Cost Memorandum
4	48" Pipeline to 8th Ward Canal	59,747	LF	$473	$28,231,000	From a Pump Station at Cutler Reservoir
5	8th Ward Canal Pipeline Pump Station	2,900	HP	$2,900	$8,410,000	Cost per HP derived from Cost Memorandum
6	42" Pipeline to Hyrum Reservoir	92,570	LF	$325	$30,067,000	From a Pump Station at Cutler Reservoir
7	Hyrum Reservoir Pipeline Pump Station	3,900	HP	$2,700	$10,530,000	Cost per HP derived from Cost Memorandum
8	24" Pipeline to Richmond Irr. Company	13,150	LF	$201	$2,647,000	From a Pump Station at Cutler Reservoir
9	Richmond Pipeline Pump Station	1,300	HP	$4,000	$5,200,000	Cost per HP derived from Cost Memorandum
				Running Subtotal:	**$622,925,000**	
	Mobilization/Field Oversight Expenses				**$62,293,000**	
1	Contractor General Conditions (Prime)	1	LS	10%	$62,293,000	
				Running Subtotal:	**$685,220,000**	
	Project Administration & Management				**$277,520,000**	
1	Legal & Admin	1	ls	10%	$68,520,000	
2	Engineering	1	ls	5%	$37,690,000	
4	Scope Contingency/Market Conditions	1	ls	25%	$171,310,000	
	Reservoirs				**$643,550,000**	
1	Washakie	1	LS	$ 567,940,000	$567,940,000	Costs Developed in Feb 2010 Washakie Report
2	Other Site	1	LS	$ 75,610,000	$75,610,000	From 1991 Honeyville Reservoir Site Study
				Bear River Pipeline Project Grand Total:	**$1,606,290,000**	Total Estimated Constr Costs w/ Contingency

AACE International CLASS 4 Cost Estimate. This estimate is prepared based on information where the preliminary engineering is from 1 to 5 percent complete. Examples of estimating methods used would include equipment and system process factors, scale-up factors, and parametric and modeling techniques. This estimate requires more time expended in its development. The typical expected accuracy range for this class estimate is -15 to -30 percent on the low side and +20 to +50 percent on the high side.

Table 12-2
State of Utah
Division of Water Resources
Bear River Project Cost-Reservoir Combination B
Bear River Pipeline Concept Report
Opinion of Probable Construction Costs
20 Cities ENR Index = 8600 - March 2010

Item #	Description	Quantity	UOM	Unit Price	Total Price	Comments/Assumptions
	Bear River Project Grand Total:				**$ 1,219,830,000**	
	Bear River Pipeline Construction Costs				**$367,736,000**	
1	North Box Elder Co. Reach - 150" Diam	94,480	LF	$2,147	$202,849,000	Pipeline costs include pipe materials,
2	South Box Elder Co. Reach - 150" Diam	36,950	LF	$2,147	$79,332,000	coatings/linings, installation, est ROW acquisition,
3	Weber Co. Reach - 90" Diam	79,270	LF	$1,049	$83,155,000	surface restoration, utilities relocation, and general
4	Metering Vaults	3	EA	$800,000	$2,400,000	
	Reservoirs (including pump stations)				**$306,300,000**	
1	Cub River	1	LS	$42,800,000	$42,800,000	
2	Fielding	1	LS	$38,300,000	$38,300,000	
3	Weber Bay	1	LS	$197,000,000	$197,000,000	
4	Collinston Connection	1	LS	$28,200,000	$28,200,000	
	Cache County Project Facilities				**$115,239,000**	See Chapter 7 for details on Cache County Facilities
1	72" Pipeline to Cutler Reservoir	24,728	LF	$704	$17,409,000	From Collinston Diversion (from Washakie Res)
2	30" Pipeline to Newton Reservoir	23,660	LF	$209	$4,945,000	From a Pump Station at Cutler Reservoir
3	Newton Reservoir Pipeline Pump Station	2,600	HP	$3,000	$7,800,000	Cost per HP derived from Cost Memorandum
4	48" Pipeline to 8th Ward Canal	59,747	LF	$473	$28,231,000	From a Pump Station at Cutler Reservoir
5	8th Ward Canal Pipeline Pump Station	2,900	HP	$2,900	$8,410,000	Cost per HP derived from Cost Memorandum
6	42" Pipeline to Hyrum Reservoir	92,570	LF	$325	$30,067,000	From a Pump Station at Cutler Reservoir
7	Hyrum Reservoir Pipeline Pump Station	3,900	HP	$2,700	$10,530,000	Cost per HP derived from Cost Memorandum
8	24" Pipeline to Richmond Irr. Company	13,150	LF	$201	$2,647,000	From a Pump Station at Cutler Reservoir
9	Richmond Pipeline Pump Station	1,300	HP	$4,000	$5,200,000	Cost per HP derived from Cost Memorandum
				Running Subtotal:	**$789,275,000**	
	Mobilization/Field Oversight Expenses				**$78,928,000**	
1	Contractor General Conditions (Prime)	1	LS	10%	$78,928,000	
				Running Subtotal:	**$868,210,000**	
	Project Administration & Management				**$351,620,000**	
1	Legal & Admin	1	ls	10%	$86,820,000	
2	Engineering	1	ls	5%	$47,750,000	
4	Scope Contingency/Market Conditions	1	ls	25%	$217,050,000	
	Bear River Project Grand Total:				**$1,219,830,000**	Total Estimated Constr Costs w/ Contingency

AACE International CLASS 4 Cost Estimate. This estimate is prepared based on information where the preliminary engineering is from 1 to 5 percent complete. Examples of estimating methods used would include equipment and system process factors, scale-up factors, and parametric and modeling techniques. This estimate requires more time expended in its development. The typical expected accuracy range for this class estimate is -15 to -30 percent on the low side and +20 to +50 percent on the high side.

Table 12-3
State of Utah
Division of Water Resources
Bear River Project Cost-Reservoir Combination M
Bear River Pipeline Concept Report
Opinion of Probable Construction Costs
20 Cities ENR Index = 8600 - March 2010

Item #	Description	Quantity	UOM	Unit Price	Total Price	Comments/Assumptions
				Bear River Project Grand Total:	**$ 1,359,300,000**	
	Bear River Pipeline Construction Costs				**$299,474,000**	
1	North Box Elder Co. Reach - 150" Diam	28,400	LF	$2,147	$60,975,000	Pipeline costs include pipe materials, coatings/linings,
	Elwood to Brigham City - 114" Diam	66,080	LF	$1,445	$95,486,000	installation, est ROW acquisition, surface restoration,
2	South Box Elder Co. Reach - 120" Diam	36,950	LF	$1,555	$57,458,000	utilities relocation, and general pipeline
3	Weber Co. Reach - 90" Diam	79,270	LF	$1,049	$83,155,000	appurtenances as shown in the conceptual
4	Metering Vaults	3	EA	$800,000	$2,400,000	
	Reservoirs (including pump stations)				**$464,800,000**	
1	Cub River	1	LS	$42,800,000	$42,800,000	
2	Fielding	1	LS	$38,300,000	$38,300,000	
3	Whites Valley	1	LS	$355,500,000	$355,500,000	
4	Colliston Connection	1	LS	$28,200,000	$28,200,000	
	Cache County Project Facilities				**$115,239,000**	See Chapter 7 for details on Cache County Facilities
1	72" Pipeline to Cutler Reservoir	24,728	LF	$704	$17,409,000	From Collinston Diversion (from Washakie Res)
2	30" Pipeline to Newton Reservoir	23,660	LF	$209	$4,945,000	From a Pump Station at Cutler Reservoir
3	Newton Reservoir Pipeline Pump Station	2,600	HP	$3,000	$7,800,000	Cost per HP derived from Cost Memorandum
4	48" Pipeline to 8th Ward Canal	59,747	LF	$473	$28,231,000	From a Pump Station at Cutler Reservoir
5	8th Ward Canal Pipeline Pump Station	2,900	HP	$2,900	$8,410,000	Cost per HP derived from Cost Memorandum
6	42" Pipeline to Hyrum Reservoir	92,570	LF	$325	$30,067,000	From a Pump Station at Cutler Reservoir
7	Hyrum Reservoir Pipeline Pump Station	3,900	HP	$2,700	$10,530,000	Cost per HP derived from Cost Memorandum
8	24" Pipeline to Richmond Irr. Company	13,150	LF	$201	$2,647,000	From a Pump Station at Cutler Reservoir
9	Richmond Pipeline Pump Station	1,300	HP	$4,000	$5,200,000	Cost per HP derived from Cost Memorandum
				Running Subtotal:	**$879,513,000**	
	Mobilization/Field Oversight Expenses				**$87,952,000**	
1	Contractor General Conditions (Prime)	1	LS	10%	$87,952,000	
				Running Subtotal:	**$967,470,000**	
	Project Administration & Management				**$391,830,000**	
1	Legal & Admin	1	ls	10%	$96,750,000	
2	Engineering	1	ls	5%	$53,210,000	
4	Scope Contingency/Market Conditions	1	ls	25%	$241,870,000	
				Bear River Project Grand Total:	**$1,359,300,000**	Total Estimated Constr Costs w/ Contingency

AACE International CLASS 4 Cost Estimate. This estimate is prepared based on information where the preliminary engineering is from 1 to 5 percent complete. Examples of estimating methods used would include equipment and system process factors, scale-up factors, and parametric and modeling techniques. This estimate requires more time expended in its development. The typical expected accuracy range for this class estimate is -15 to -30 percent on the low side and +20 to +50 percent on the high side.

Table 12-4
State of Utah
Division of Water Resources
Overall Bear River Project Cost
Bear River Pipeline Concept Report
Opinion of Probable Construction Costs
20 Cities ENR Index = 8600 - March 2010

	Bear River Overall Project Grand Total:	Washakie	Combination B	Combination M	
Item #	Description	Total Price			Comments/Assumptions
1	Bear River Project Construction Costs	$1,606,290,000	$1,219,830,000	$1,359,300,000	See Tables 12-1,12-2,12-3
2	West Haven WTP	$246,250,000	$246,250,000	$246,250,000	$1.25 per gallon for 197 MGD
3	Pipeline to WBWCD & JVWCD	$137,360,000	$137,360,000	$137,360,000	From WBWCD WFR Water Project Report 2005
4	Finished Water Reservoir & Pump Station	$59,540,000	$59,540,000	$59,540,000	From WBWCD WFR Water Project Report 2005
		$2,049,440,000	$1,662,980,000	$1,802,450,000	

Notes:
1. Combination M costs include present worth costs and revenues from pumping and hydropower recovery.

Cost Item Notes:

2 Estimated cost based on and assumed cost per million gallons to treat ($/mgd). No conceptual design has been performed for this project. AACE International Class 5 Cost Estimate

3 & 4 Finished Water Pipeline, Reservoir, and Pump Station costs from Reservoir Site Selection and Alignment Study, by BC&A, for WBWCD, Feb 2005. Costs are derived from the highest cost alternative presented in the Report, Appendix Table A-3

AACE International CLASS 5 Cost Estimate. This estimate is prepared based on limited information, where little more than proposed facility type, its location, and the capacity and operating characteristics are known. This class of estimate includes, but is not limited to, market studies, assessment of viability, evaluation of alternate schemes, project screening, location and evaluation of resource needs and budgeting, and long-range capital planning. Examples of estimating methods used would be cost/capacity curves and factors, scale-up factors, and parametric modeling techniques. Little time is expended in the development of this estimate. The typical expected accuracy range for this class estimate is -20 to -50 percent on the low side and +30 to +50 percent on the high side.

AACE International CLASS 4 Cost Estimate. This estimate is prepared based on information where the preliminary engineering is from 1 to 5 percent complete. Examples of estimating methods used would include equipment and system process factors, scale-up factors, and parametric and modeling techniques. This estimate requires more time expended in its development. The typical expected accuracy range for this class estimate is -15 to -30 percent on the low side and +20 to +50 percent on the high side.

Table 12-5
State of Utah
Division of Water Resources
Overall Bear River Project Water Costs
Bear River Pipeline Concept Report

		Project Costs						Overall Costs			$ Per Ac-Ft			Annual Payment Amortized 5% for 30 years			Annual Cost $/Ac-Ft		
Stakeholder	Project Water Right (Ac-Ft)	Washakie	Combination B	Combination M	West Haven WTP	Finished Water Pipeline to WBWCD/ JVWCD	Finished Water Reservoir and Pump Station	Total-Washakie	Total-Combination B	Total-Combination M	Total-Washakie	Total-Combination B	Total-Combination M	Total-Washakie	Total-Combination B	Total-Combination M	Annual Cost $/Ac-Ft	Annual Cost $/Ac-Ft	Annual Cost $/Ac-Ft
		$ 1,606,290,000	$ 1,219,830,000	$ 1,359,300,000	$ 246,250,000	$ 137,360,000	$ 59,540,000	$ 2,049,440,000	$ 1,662,980,000	$ 1,802,450,000									
Cache County	60,000	$ 438,079,091	$ 332,680,909	$ 370,718,182	$ -			$ 438,079,091	$ 332,680,909	$ 370,718,182	$ 7,301	$ 5,545	$ 6,179	($28,497,674)	($21,641,371)	($24,115,750)	$ 475	$ 361	$ 402
Bear River Water Conservancy District	60,000	$ 438,079,091	$ 332,680,909	$ 370,718,182	$ -			$ 438,079,091	$ 332,680,909	$ 370,718,182	$ 7,301	$ 5,545	$ 6,179	($28,497,674)	($21,641,371)	($24,115,750)	$ 475	$ 361	$ 402
Weber Basin Water Conservancy District	50,000	$ 365,065,909	$ 277,234,091	$ 308,931,818	$ 123,125,000	$ 35,713,600	$ 15,480,400	$ 539,384,909	$ 451,553,091	$ 483,250,818	$ 10,788	$ 9,031	$ 9,665	($35,087,762)	($29,374,177)	($31,436,159)	$ 702	$ 587	$ 629
Jordan Valley Water Conservancy District	50,000	$ 365,065,909	$ 277,234,091	$ 308,931,818	$ 123,125,000	$ 101,646,400	$ 44,059,600	$ 633,896,909	$ 546,065,091	$ 577,762,818	$ 12,678	$ 10,921	$ 11,555	($41,235,904)	($35,522,318)	($37,584,300)	$ 825	$ 710	$ 752
Total	220,000	$ 1,606,290,000	$ 1,219,830,000	$ 1,359,300,000	$ 246,250,000	$ 137,360,000	$ 59,540,000	$ 2,049,440,000	$ 1,662,980,000	$ 1,802,450,000				($133,319,013)	($108,179,236)	($117,251,959)			

Notes:

1. Additional storage costs based on Final Report on the Re-Evaluation of Bear River Reservoir Sites, by CH2MHILL for DWRe September 1991, escalated to March 2010 using ENR construction cost index. Estimated cost based on 117,000 acre-ft Honeyville Reservoir.
2. Finished water pipeline, reservoir, and pump station cost breakdown between WBWCD and JVWCD is based on the February 2004 Cost Allocation Study for the Wasatch Front Regional Water Project, Table 4-1, page 4-2, 26% WBWCD and 74% JVWCD.
3. From Washakie Reservoir Project Preliminary Engineering and Design Report, by CH2MHILL, for DWRe, February 2010, Chapter 9, Table 9-5, costs for reservoir only.

13.0 PROJECT IMPLEMENTATION

13.1 PROJECT SCHEDULE

The overall Bear River Project includes facilities as described in Chapter 11 to develop a water right of 220,000 acre-feet. Previous water demand studies indicate Bear River Project water will be needed by 2035 as discussed in Chapter 4. The enormity of the Project in terms of real estate acquisition, environmental requirements, design and construction, and overall costs makes it essential to begin soon in order to guarantee water is available by 2035. Table 13-1 shows the proposed development schedule for the Bear River Project. Real estate acquisition should begin immediately. Environmental studies and permit processes should begin by 2014. Design should begin by 2021 to allow three years to complete. Construction should begin by 2025 with five years allowed to construct a project of this size. This schedule will allow Bear River Project water to be delivered up to five years before its forecasted need. This should allow for any delays at any stage of the project to occur and still meet the 2035 deadline.

13.2 ENVIRONMENTAL COMPLIANCE PLAN

Implementing the Bear River Project, including storage reservoirs, pump stations, and pipelines, will require environmental permitting and agency coordination. State-level permits include but are not limited to stream alteration permits, floodplain development permits, and, for construction, Utah Pollutant Discharge Elimination System (UPDES) permits for stormwater runoff and groundwater discharges as well as fugitive-dust-control plans. Federal agency involvement is not fully defined at this time. The Project will likely require a U.S. Army Corps of Engineers (USACE) authorization under Section 404 of the Clean Water Act (CWA) for a river diversion and because of potential significant impacts to wetlands and other waters of the U.S.

This section presents the required components of USACE's CWA Section 404 permitting process, the processes' required compliance with other federal regulations, and an approximate timeline for the environmental compliance efforts needed to permit the project. Note that some of the major steps overlap.

Section 404 permit authorization by USACE requires compliance with several other federal statutes. These include the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), and the National Historic Preservation Act (NHPA). It is anticipated that the USACE will require an Environmental Impact Statement (EIS) for NEPA compliance. Section 7 of the ESA requires USACE to consider the effects of their actions (such as permit authorization) on threatened and endangered species (TES) in the form of a Biological Assessment. Lastly, the National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of their actions on cultural resources and to protect them; requiring cultural resource surveys of all potential alignments.

The major steps of the environmental process, with approximate conservative timelines to achieve project completion by 2030, are summarized below:

1. Baseline Studies and Modeling – 2013 to 2015
2. 404 Permit Application preparation, and USACE processing – 2015 to 2017
3. National Environmental Policy Act Compliance – 2017 to 2021
4. Wetland Mitigation Site Development – 2020 to 2024.

Table 13-1
Proposed Bear River Project Schedule

Task Name	Year																								
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Real Estate Acquisition																									
Government Parcels																									
Private Parcels																									
NEPA Process																									
Wetland Mitigation Site Development																									
NEPA Compliance																									
404 Permit application and USACE processing																									
Baseline studies and monitoring																									
Design and Construction (Project completed five years before estimated need)																									
Construction Funding																									
Design (Three year design process)																									
Bidding (One year bidding period for major project packages)																									
Construction Begins (Five year construction period, major project)																									
***Project Water Supply Needed**																									

*Coincides with JVWCD and WBWCD studies

13.2.1 Baseline Studies

Baseline environmental surveys are needed to characterize the existing environmental resources that might be affected by project construction and operation. Studies should be started as soon as the project is being defined. These baseline studies include (at a minimum) a waters of the U.S. (wetlands) delineation, threatened and endangered species studies, environmental resource surveys, cultural resource surveys, baseline hydrologic and hydraulic modeling of groundwater and surface water, floodplains, and baseline water quality monitoring studies. Water quality studies have already been started but might need to be revised, as the project scope is more clearly defined.

Wetland Delineation and Functional Assessment. USACE will require a boundary delineation of the wetlands, and an ordinary high water mark (OHWM) delineation of streams, ditches, and canals and other waters of the U.S. in the project study area[1] to determine the direct and indirect impacts to wetlands and other waters of the U.S. (ponds, rivers, streams, springs, canals, and ditches). A required part of this process is developing and performing a wetland functional assessment (33 Code of Federal Regulations [CFR] §332.5), which is a way to determine the ability for a wetland to perform its ecological and hydrological functions. The critical steps for a complete delineation are:

- **Field Delineation and Functional Assessment Methodologies** – The first step is to develop and propose a wetland functional assessment methodology that will be used along with USACE delineation methods. The USACE may invite other state and federal agencies to participate in developing this methodology to ensure their concurrence with the methods that will be used for this large project.
- **Data Collection, Delineation Field Work, and Functional Assessment** – A wetland delineation, of all potential project alternative corridors and storage sites, should to begin in April and will need to be completed by the end of September of the same year. Data necessary for functional assessment will be determined during interagency coordination, but generally include an assessment of hydrology, plant communities, and level of disturbance or pollution.
- **Waters of the U.S. Delineation Report –** A draft wetland delineation report will be submitted to the USACE for review. USACE comments on the draft report will be addressed and a final report will be prepared and submitted. The delineation report and functional assessment will provide the baseline wetlands and waters of the U.S. information to evaluate potential impacts from the proposed project and alternatives and define appropriate mitigation. Proposed mitigation will be defined in terms of both total acreage of wetland impacts for each wetland type and waters of the U.S.

[1] The project study area will be defined during multi-agency scoping and coordination meetings held early in the process. The project study area will be much larger than the area needed for construction.

Threatened and Endangered Species and Wildlife Habitat Assessment. Disclosing impacts from the project for NEPA compliance will require wildlife habitat assessments. In addition, threatened and endangered species studies will be required for compliance with the ESA. The required time-intensive steps are:

- **Development of Wildlife Habitat Methodology** – Because the NEPA process does not have any standardized methods, the Project Team will need to develop an assessment methodology. The assessment methodology should seek to balance the desires of resource agencies and the amount of effort required for data collection within a potentially large study area.
- **Collection of Wildlife Habitat Data** – The fieldwork for the wildlife habitat evaluation should begin as soon as possible after the analysis methodology is accepted. Certain TES have narrow survey windows, many as narrow as one month per year.
- **Production of Wildlife Habitat Technical Report** – The information in the technical report will be used to analyze and compare the expected impacts of the project alternatives to wildlife and wildlife habitat. This analysis is required as part of the NEPA process.
- **Biological Assessment –** Given the potential for impacts to TES habitat, consultation under Section 7 of the Endangered Species Act (50 CFR §402) will also be required. Because the project will be considered a "major construction activity," a biological assessment (BA) will be necessary. The BA should be started early, even before the NEPA process formally begins, as it will require substantial research and analysis. If the BA finds that the project is "likely to adversely affect/modify" or "may adversely affect/modify" a listed species or its designated critical habitat, then the consultation process becomes "formal." If the BA finds that the project will have "no effect" or is "not likely to adversely affect/modify" any listed species or their habitat, the consultation process remains "informal." The USACE would initiate formal consultation as soon as the BA determines that a "may affect" situation exists. However, at this time, there are no federally listed threatened or endangered species occurrences within the project area and consultation should remain informal.

Cultural Resources Assessment. Section 106 of the National Historic Preservation Act (1966) and USACE's policies for evaluating permit applications (33 CFR §320.4) require that the applicant (DWRe) analyze impacts to areas that have recognized historic, cultural, or scenic values as well as conservation areas and recreation areas. Therefore, surveys for prehistoric resources, historic properties, cultural resources, and other resources will need to be done to evaluate the expected impacts of the project facilities. The necessary steps in this process are:

- **Database Search and Tribal Contact** – The first step is to search the Utah Division of State History's database for information about cultural and historic sites and to coordinate with the State Historic Preservation Officer (SHPO) and other cultural resource agencies.
- **Collection of Cultural/Historic Properties Data** – Research that was conducted for the pipeline alternatives evaluation found that few past surveys have been done in the study area. Therefore, intensive "pedestrian" (walk-through) surveys for archaeological sites

would likely be needed. Reconnaissance-level surveys would also need to be conducted for historic properties.

- **Report Production** – A cultural resources report would be produced using the results of the database search and the pedestrian or reconnaissance-level surveys.
- **Negotiation of Programmatic Agreement** – As described in Chapter 8, a programmatic agreement would be negotiated with the SHPO to describe documentation requirements for affected sites.

Hydrologic and Hydraulic Modeling. Constructing the Project facilities will temporarily affect the movement of water through river channels and wetlands. The operation of the project will deplete flow in the lower Bear River, the U.S. Fish and Wildlife Service's Bear River Migratory Bird Refuge (Refuge), and the Great Salt Lake. The depletions will be significant, particularly in low-water years, and could affect other resources including water quality, wetlands, sediment transport, fish and wildlife habitat, and recreation.

For this reason, hydraulic, hydrologic, and water quality modeling will be necessary. This modeling will include research into and modeling of existing conditions and the likely changes within the Bear River and its floodplain, the Refuge, and the Great Salt Lake's Bear River Bay. The results of this modeling will help define the direct and indirect effects of the future operation of the project on riparian areas, wetlands, and wildlife habitat. The primary steps in this modeling are:

- **Data Gathering** – The wetlands delineation data, National Wetlands Inventory (NWI) data, stream gauge data, baseline hydrology models, and other data sources will be used to estimate the direct and indirect effects of the project, primarily the effect of removing 220,000 acre-feet from the Bear River channel and the associated lake shore areas.
- **Modeling** – The data gathered in the previous step will be used to model both the hydraulic effects on the river channel and the hydrological effects on wetlands in the Bear River delta.
- **Results –** The water quality data collection and modeling will be used to analyze indirect effects to wetlands and wildlife habitat and to facilitate the CWA Section 401 water quality certification from the Utah Division of Water Quality.

13.2.2 USACE 404 Permit Application Process

The 404-permit process for this Project will be complex and will need extensive coordination with USACE. The process will likely require additional data gathering to refine the baseline studies or to generate additional information as other reasonably foreseeable federal action are defined.

Basic Permit Application Steps. The anticipated permit application steps are the following:

- **Develop a Draft Purpose and Need** – The DWRe and project team members must clearly define the need for the Project. The analysis of the need should include whether non–Bear River water development alternatives can satisfy the future water demands. USACE and the public will want to know whether other water resources can be developed and whether expanded conservation measures can reduce demand to eliminate some or all of the need for the Project. We understand that planning studies have been completed by the JVWCD and WBWCD. The DWRe should encourage Box Elder County and Cache County to complete detailed studies as well.

- **Start USACE Pre-application Process** – The application process starts with a pre-application meeting(s) with USACE (33 CFR §325.1[b]). These activities will kick off the environmental compliance effort. USACE's goal will be to receive concurrence on the data collection and impact analysis methodologies used for the resources mentioned in Chapter 8. To achieve this goal, USACE will likely invite other affected agencies to an initial or follow-up meeting(s) to discuss the elements of the project, the required scope of the analysis, and the roles and responsibilities of the stakeholders—the DWRe as the applicant, USACE, and any identified cooperating agencies.
- **Refine Alternatives** – After more-detailed environmental resource surveys are completed, the project alternatives should be refined. USACE will presume there is a pipeline alternative that avoids wetland impacts. Therefore, the DWRe will need to show how avoidance alternatives are not "practicable." The data in this report will be important for showing the corridor selection process. According to the CWA Section 404(b)(1) guidelines, USACE can only permit a "least environmentally damaging practicable alternative" (LEDPA). The following is from 40 CFR §230.10(a):

  404(b)(1) Guidelines *– No discharge of dredged or fill material (to jurisdictional waters of the United States) shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.*

  "Practicable" *– An alternative is considered practicable if it is available and capable of being completed after considering cost, existing technology, and logistics in light of the overall project purpose (40 CFR 230.10[a][1]).*
- **Perform Initial Impact Assessments** – After refining the alternatives to avoid or minimize environmental impacts, the Project Team will assess the impacts of alternatives as a way to compare the alternatives and perhaps limit the number of alternatives that require detailed analysis in the permit application or subsequent NEPA evaluation. Initial impact data would need to be included in the permit application along with a detailed project description.
- **Submit Department of the Army Permit Application (under Section 404 of CWA) –** A draft 404 permit application will be submitted to USACE. USACE has 15 days to evaluate the completeness of the application. Impact mitigation concepts, even if only conceptual in nature, should be developed during the permit application process.
- **Gather Additional Data and Prepare Application –** Because of the scale of this project and the anticipated elevated level of public and agency interest, the DWRe should plan on a period of time when USACE will require additional data collection and reporting. USACE's decision to issue a permit will be based on an evaluation of the probable impacts, including cumulative impacts, of the Project on factors that are of interest to the public. USACE's decision will reflect concerns for protecting or using important

resources, and it will try to balance benefits against reasonably foreseeable detriments. All factors that could be relevant to the project will be considered, including its cumulative effects. Table 13-2 lists the typical categories of public-interest review factors.

Table 13-2
Public-Interest Factors

Physical Characteristics	Biological Characteristics	Human-Use Characteristics
Substrate	Special aquatic sites (for example, the Refuge)	Water supplies
Water quality	Wildlife habitat (aquatic and terrestrial)	Recreational and commercial fisheries and recreation
Flood-control functions	TES habitat	Parks, national and historic monuments, and wilderness areas
Storm, wave, and erosion buffers	Biological availability of contaminants in dredge or fill material	Economics
Currents, circulation, or drainage patterns; erosion and accretion patterns		Energy consumption or generation
Aquifer recharge		Farmland
Base flows		Mineral needs
Mixing zones		Consideration of private property (including environmental justice populations)

- **Submit Final 404 Permit Application and Issue Public Notice –** Once the application is considered complete, USACE is required to issue a public notice (33 CFR §325.3) and solicit comments to support its permit decision. During this process, USACE will determine whether to issue a permit, issue a permit with modifications or conditions, or reject the permit application. During this stage, USACE will also evaluate the need to prepare an environmental document pursuant to NEPA. Under NEPA, if USACE determines that a proposed project is a major federal action with a potential to affect the quality of the human environment significantly, an Environmental Impact Statement (EIS) would be required. The need for an EIS is likely.

Considerations for Project Phasing. Project phasing could be an important consideration with regard to the specific action that is proposed in a permit application. If certain aspects of the Bear River development project are needed earlier, and can stand alone, it might be possible to permit them separately. However, USACE will evaluate the "independent utility" of any proposed action included in a permit application.

Independent utility *is a test to determine what constitutes a single and complete project in the USACE's regulatory program. A project is considered to have independent utility if it would be* *constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.*

13.2.3 NEPA Compliance

NEPA is a statutory framework that provides supplemental legal authority, disclosure of environmental information, intergovernmental coordination, and an opportunity for public input on any project where a federal agency is connected, whether as a funding agency or other authority (42 United States Code [USC] 4322; 40 CFR 1500.1). Assuming an EIS is required, the major steps in the NEPA process are:

- **Notice of Intent and NEPA Scoping –** A Notice of Intent would be published in the *Federal Register* and in local publications. This Notice of Intent would start the public and agency scoping process. The scoping process solicits comments on the important issues that should be addressed in the EIS. Comments will be collected, organized, and published so that USACE and the cooperating agencies can determine the scope of analysis in the EIS.
- **Data on Affected Environment for EIS –** After the scoping period, additional data gathering will likely be needed to define fully the affected environment and the Project's effects on the resources identified during scoping. A typical approach is to prepare resource-specific technical memoranda with the specific methodologies, data, and analysis.
- **Draft EIS –** The data previously gathered and captured in technical memoranda will be used to prepare the Draft EIS. The Draft EIS will be published and made available for review and comment by the agencies and the public. While the Draft EIS is out for public review, a public meeting is typically held in which the project team is available to answer questions and collect formal comments on the Draft EIS.
- **Final EIS –** This step includes collecting, organizing, and responding to agency and public comments on the Draft EIS. USACE will determine the need for additional analysis and revisions that might be necessary before a Final EIS is published. Once the Final EIS is published, the public and agencies will have another opportunity to comment. USACE will prepare a response to any additional substantive comments received that were not addressed in the Final EIS.
- **USACE Decision Document –** Once USACE has reviewed the Final EIS, received public comments, and responded to any substantive comments (if any), it will produce a decision document that will accompany the issuance of the 404 permit.

13.2.4 Mitigation for Wetland Impacts

Compensatory mitigation involves actions taken to offset unavoidable impacts to wetlands, streams, and other aquatic resources that are authorized by Clean Water Act Section 404 permits. Such impacts are likely to occur for this Project. Three commonly used means of mitigation are location-specific mitigation, mitigation banking, and in-lieu fee mitigation. Current regulatory guidance issued by USACE and EPA suggests that, for a single, large project, developing a mitigation bank with funds to back its development is the preferred method since it provides the greatest opportunity for success as well as being the most ecologically beneficial option (33 CFR §332). Wetland banking creates a contiguous wetland complex (and wildlife habitat) in a single location that is easier to develop and monitor, as opposed to several smaller mitigation sites. Because this bank will be financially backed by the DWRe, wetland impact credits can be deducted at certain milestones through development, see Table 13-3. This will allow concurrent project and mitigation development and phased project construction. All stages described below will be coordinated with USACE as well as other state and local agencies that make up an Interagency Review Team (IRT).

Initial Steps for Developing Mitigation. The initial steps to develop a mitigation approach are as follows:

- **Develop Mitigation Concepts** – Potential mitigation concepts should be developed in advance of the permit application and NEPA processes. During this step, several potential mitigation sites that are feasible to acquire should be identified and studied to determine which would have the greatest chance of success. These data will be presented to the IRT when pre-application consulting is initiated.
- **Develop Mitigation Bank Prospectus** – USACE, as part of the 404 permitting process, requires that a mitigation bank prospectus be developed in coordination with the IRT. This document will describe the mitigation bank objectives, mitigation needs (wetland and wildlife habitat types), site suitability, and other details.
- **Secure Mitigation Property** – The DWRe should try to identify and secure mitigation property during the 404 permitting process, but some of the properties must be secured before the DWRe can receive any wetland credits.
- **Develop Mitigation Banking Instrument** – Once there is consensus on the mitigation prospectus, work will begin to develop a mitigation-banking instrument (MBI). Included in these negotiations will be USACE, EPA, the U.S. Fish and Wildlife Service, and others. During this process, negotiations will occur to determine the proper credit/impact ratios as well as the milestones for releasing the credits.

An impact credit deduction example in Table 13-3 provides a *conceptual* schedule of credit deductions for different timing of actual wetland impacts based on mitigation development milestones.

Table 13-3
Impact Credit Deduction Example

Milestone	Deductions (acres)	Impacts (acres)
MBI signed	3	1
Property acquired	2	1
Construction completed	1.5	1
Monitoring period	1.25	1
Mitigation complete	1	1

Follow-On Steps for Implementing Mitigation. The follow-on steps to develop a mitigation approach are as follows:

- **Mitigation Design Plans** – Final mitigation design plans and construction specifications will be developed.
- **Contractor Bidding and Procurement** – Developing contract documents and procuring a contractor will begin once the mitigation planning is complete. Projected operations will likely include grading, construction of diversion structures, and required planting.
- **Site Construction and Planting** – Depending on the site conditions and seasonal considerations, the actual construction is expected to span one construction season. It will be important to finish construction of the site in the fall so that seeds can germinate. Experienced staff should oversee the construction of the mitigation bank to ensure that plans and specifications are followed. Staff should also be available to assess construction progress and make design decisions in the field specific site conditions are recognized.
- **Monitoring and Progress Reporting** – After construction is complete, the mitigation plan and MBI will require site monitoring and yearly reporting to USACE. Expected monitoring and maintenance periods can be three to five years depending on the MBI and will likely require staff to assess wetlands, habitat suitability, weed-control effectiveness, threatened and endangered species using the area, water quality, and other factors. Formal written reporting will be required annually.
- **Release of Mitigation Credits** – After the required establishment periods and when the success criteria for the site are met, the DWRe will begin consultation with USACE so that USACE can release a large part of the mitigation credits related to establishing the mitigation site.
- **Final Monitoring Period** – Once all of the MBI conditions are met and the required maintenance periods end, USACE will release all remaining wetland credits. Typically, the banking instrument must include guarantees that the site will be maintained into perpetuity. This long-term maintenance might require a commitment from the applicant, an endowment to provide operating funds, or an agreement with a third party.

13.2.5 Task Timing and Relationships

The scheduling of the inter-related steps required to plan and permit a project of this size is complex and detailed. A preliminary approach to schedule development was prepared for estimating when DWRe will need to begin the critical phases of the Project, and the approximate total amount of time that will be required to complete the Project. This preliminary schedule uses a Gantt chart to display the timing and relationship between many of the most significant elements of project development. A Gantt chart showing details of the recommended timeline is included in Volume II Appendix, Part 3, and summarized in Table 13-1. The following notes are important to consider in understanding this schedule.

- Note that some of the Gantt chart task bars are shown in red as a visual aid to help the reader check that they fall within a seasonal window in which surveys need to be conducted.

- Durations are not necessarily the total time or effort needed to complete the tasks; durations indicate the timeframes within which the tasks occur.
- Schedule contingency time has been included after the NEPA process. This assumes two years to defend the decision document and two years to prepare a supplemental document, if needed. Note that, for supplemental NEPA, USACE would likely have to re-evaluate all resources, not just areas determined to be deficient (in the court's view).
- The DWRe might be allowed to proceed with wetland impact mitigation prior to final environmental decision-making. However, the DWRe would have to weigh the risks of more lengthy challenges against the cost to purchase property and construct the mitigation site. Mitigation ratios could be improved if the site is "complete".
- The schedule assumes that the design effort would start before all challenges are defended (in about 2021). Proceeding with Project design prior to resolving all legal and permitting challenges is associated with a greater degree of risk than there would be if DWRe did not begin design until about 2023.

13.2.6 Risk-Mitigation Strategies

For large, potentially contentious projects such as this one, a risk-mitigation strategy should be developed to reduce the risk of litigation. Strategies for risk mitigation include:

- **Agency and Public Involvement** – To avoid unexpected, adverse reactions to expected Project impacts, the DWRe should involve as many agencies and interest groups as practically possible in the planning stages so that these groups have input early on and feel that they are a part of the process.
- **Joint Project Purpose –** The Honeyville Dam and Reservoir Environmental Evaluation Report (Biowest, 1995) identified, as a specific project purpose, storing water for both municipal use (50,000 acre-feet) and use within the Refuge (50,000 acre-feet) to maintain wetland habitats late in the season. This joint action might have benefitted the Refuge to such an extent that the U.S. Fish and Wildlife Service was considering joining the State as a project sponsor and was comparing the benefits to the Refuge against the impact of the reservoir site. This strategy could be used to gain acceptance by resource agencies, and, if the benefits are significant, the public might accept the beneficial project results. Identifying and evaluating other potential project benefits to recreation, fish and wildlife, or other resources is critically important to the project development process and should occur as soon as possible.
- **Control the NEPA Process –** USACE will select a third party, independent of the DWRe, to prepare the actual NEPA document. Therefore, the DWRe should conduct all of the preliminary studies to help control the data gathering efforts and have its experts provide analysis conclusions. The DWRe should retain as much control over the process as possible to control the potential requests for multi-year, detailed studies of every environmental resources and should try to control the geographical extents of the analyses.

13.3 REAL ESTATE ACQUISITION PLAN

The purpose of the Real Estate Acquisition Plan is to recommend actions and options for future project planning, phasing, and protection of linear property pathways within the recommended alignment study corridor. Using the results of the Pipeline Real Estate Analysis, this section presents various coordination strategies for public and private entities, recommends approaches to establishing early agreements with key landowners, and integrates the Right-of-Way needs of the Project into the overall development plan and expected schedule. Recommendations are presented in two phases; Phase 1: Initial Agreements to be completed first, followed by Phase Two: Property Acquisition.

13.3.1 Phase 1: Initial Agreements

Public agency coordination is very important to protecting the proposed Bear River alignment for future construction. An effective initial public agency coordination process will help protect the alignment corridor, and make the subsequent property acquisition phase much easier. The Bear River Pipeline real estate representative in public agency discussions should be familiar with the sensitive issues surrounding the Bear River Pipeline alignment history and process, benefits to the region, public agency negotiations, and Right-of-Way (ROW) and property issues. In deliberations, this representative should communicate the real estate priorities of the DWRe, outline the alignment selection process, review affected properties, and discuss and document concerns and preferences expressed by agencies and jurisdictions. Staff level and elected official discussions are anticipated. The goal of early discourse with public agencies is the development of a general agreement document such as a Memorandum of Understanding (MOU). A MOU would document mutual understanding of corridor preservation requirements for the Bear River Pipeline Project in a multi-lateral agreement between public agencies and Bear River Project participating agencies. Agreements that are more specific may require refined design data and detailed construction timing information.

Agency Coordination Recommendations

A. **UDOT/State of Utah:** Siting utility corridors and alignments along existing ROW is generally considered to result in fewer conflicts and less impact to property than carving out an entirely new path. The Bear River Pipeline alignment options for established ROWs are predominately associated with roadways. Reaching an agreement with the Utah Department of Transportation (UDOT) regarding potential shared use of some portions of their ROW is of primary importance in validating and protecting the alignment location for future refinement and design. Knowledge of the usable area available in UDOT ROW, whether for temporary construction use or for pipe placement, will help to define the private property impacts and acquisition areas needed. Engaging in discussions with UDOT is recommended as soon as possible.

   The UDOT Chief Land Surveyor described the process for initiating discussions regarding use of their property in the general terms that follow. UDOT will evaluate the potentially impacted roadways individually. The UDOT designation of "No Access Lines" (NA Lines) or "Limited Access Lines" (LA Lines) on their ROW will impact how shared use might be evaluated and potentially granted. UDOT generally owns property for transportation purposes and protects that use through the NA Lines or LA Lines. In these areas, use may be possible, although it will require detailed evaluation by UDOT and a permit or Vested Rights Agreement. UDOT also owns property outside the NA Lines or LA Lines. Use of these areas may be possible for utility corridors, and obtaining the rights to such use may be through the conveyance of fee or easement interests. The UDOT Chief Land Surveyor recommended that DWRe meet with UDOT to present the proposed alignment corridor and review their evaluation process. UDOT attendees at this meeting should include representatives of Region 1, representatives of the UDOT Right of Way Director's Offices, State Permit Officer's Office, Chief Land Surveyor's Office and possibly the Utility Engineer. Based on UDOT's input after the initial meeting, ROW maps can be evaluated more closely to determine where the NA Lines and LA Lines are located within their ownership. This information will provide guidance for all parties in their further assessment of the specific location of the Bear River Pipeline alignment and in the development of a MOU for preservation of the proposed corridor.

Because the UDOT corridors are the predominant pathways followed by the Pipeline alignment, agreement with UDOT on basic issues is recommended as the first step. Areas of agreement prior to discussions with other property owners include identifying which side of the ROW is preferred, identifying the width and type of ROW use being considered in specific areas and examining where the alignment might need to deviate from the proposed path due to UDOT conflicts. Discussions with other agencies or private parties should remain general in nature until the UDOT evaluations and issues have been considered.

B. Federal: Federal property is not a large part of the proposed Bear River Pipeline alignment corridor and there are few anticipated impacts. Some of the impacted properties appear unavoidable since the federal ownership extends on both sides of the proposed alignment corridor. Those impacts are generally along I-15 near US 91.

Because of the review time that federal processes often require and the inability to compel the use of federal property, evaluation of potential impacts to federal property is a priority that should be focused on once the alignment is set and impacts are certain.

C. County Jurisdictions (Box Elder, Weber): Box Elder County and Weber County should be approached and kept informed as Project elements and impacts are defined. It is our recommendation that combined county and city meetings be scheduled to provide the impacted and interested jurisdictions with an overview of the Project, updates on timing, and details regarding alignment refinement.

D. City Jurisdictions: Bear River City, Corinne, Farr West, Marriot-Slaterville, Perry, Tremonton, Willard, Plain City, Pleasant View City and West Haven City should be approached and kept informed as Project elements and impacts are defined.

The General Manager of the BRWCD and Assistant General Manager of WBWCD confirmed that having separate meetings for each county would be best. These meetings would be coordinated with the Public Involvement Plan, described in the Volume I Appendix, Part 4. The Box Elder County meeting might include the county commissioners and representatives as well as mayors and councils for the affected cities in Box Elder County. The Weber County meeting might be similarly composed and, with adequate lead-time for placement on the agenda, could take place at a quarterly joint city/county meeting. Phone invitations as well as letter invitations are encouraged in order to gain good attendance. These meetings could provide general Project updates and opportunities to schedule individual jurisdiction meetings to discuss specific impacts. The individual meetings are opportunities to seek written support for preservation of the alignment corridor and to discuss possible agreement terms and timeframes.

Canal Company and Water District Coordination Recommendations. Coordination with canal companies and water districts should be conducted as separate meetings and contacts related to Project impacts to properties and facilities. Discussions could include the exploration of possible joint use benefits. Below is a list of known canal and water agencies with interests in the proposed Bear River Pipeline alignment corridor:

- Bear River Canal Company
- Bear River Water Conservancy District
- Jordan Valley Water Conservancy District
- Weber Basin Water Conservancy District
- Pineview Water Users
- Plain City Irrigation Company
- South Slaterville Irrigation Company
- Wilson Irrigation Company
- Hooper Irrigation Company

13.3.2 Phase 2: Private Property Agreements

Prior to acquisition of private property, it is recommended that support and commitment for specific alignment locations be obtained from UDOT and other impacted jurisdictions. When these agreements are more clearly defined and private property implications of alignment elements are more certain, it is recommended that the private property assessment be revisited. Priority of acquisition may need to be adjusted based on new information.

Railroad Company Coordination. Coordination with railroad companies should be conducted as separate meetings and contacts related to Project impacts to railroad ROW. It is anticipated that railroads will protect their active rail ROW and will allow crossings pending engineering detail and scrutiny, but will be reluctant to consider parallel-shared use beyond possible temporary construction uses. Below is a list of known railroad companies with interests in the proposed alignment corridor:

- Union Pacific
- Southern Pacific
- Utah Transit Authority

Coordination Regarding Private Properties. Private properties will be impacted by the Bear River Pipeline and associated facilities. Much of the impact will be in the form of temporary use of property during construction. It is anticipated that this use of property will be defined and secured using Temporary Construction Easements (TCEs) that will be negotiated with property owners when the alignment's specific needs are more certain. Some private property rights will need to be acquired for the pipeline and associated facility permanent placement. The specific properties affected, and the extent of the impact, remains to be determined and will be impacted by UDOT and Jurisdictional agreements that will become clearer as initial design is accomplished. The type of permanent rights secured for waterline projects is usually either an easement or a fee simple interest. The cost difference for an easement acquisition for the proposed use is not anticipated to be much different from the acquisition of a fee simple interest. The rights secured and the flexibility in use of the property is much greater with a fee simple ownership interest. For these reasons, a fee simple interest is recommended for the permanent property rights needed. The real estate definitions of the types of interest discussed in this section are presented below.

- **Temporary Construction Easement**: A right granted to a person, company or agency authorizing specific temporary use of the owner's land. Specific activities and terms of agreement are defined in the TCE document.
- **Easement**: A right, privilege or interest limited to a specific use or control purpose which one party has in the land of another party and which runs with the land and is not a personal right of an individual.
- **Fee Simple**: A complete, unencumbered ownership right in a piece of property.

The specific properties that might be impacted, based on current limited information, have been considered and their acquisition priority has been evaluated based on property type and potential for impact to the study corridor (see Chapter 9). As previously stated, prior to acquisition of private property, it is recommended that support and commitment for the alignment be obtained from UDOT and other impacted jurisdictions. Priority of acquisitions may need to be adjusted based on new information and UDOT and jurisdictional agreements that clarify impacts to private property. At that time, it is recommended that the private property priority assessment be revisited and prioritized. Below is a list of private property types in order of general acquisition priority, as seen at this time:

1. Commercial/Industrial
2. Residential
3. Agricultural

13.3.3 Implementation Overview

It is recommended that all property acquisition work follow the State of Utah and federal regulations for property acquired with federal funds. Although use of federal funds for the Bear River Project is not currently planned, following this process will insure that property acquisition process will not disqualify current or future phases of the project from receipt of federal funds, should they become available and should Project planning change.

Agency agreement negotiations may be aided by the use of real estate consultants in conjunction with staff. Consultants who are familiar with UDOT and other corridor legal descriptions and title issues will be able to characterize encumbrances so that the parties can evaluate impacts clearly. Consultant inclusion in negotiations with agencies may streamline the identification of major issues and concerns and may bring past experience to finding solutions.

Strategic acquisition of priority parcels as well as all other property acquisitions should be accomplished by persons experienced in federal and State of Utah regulations for acquisitions and relocations. Scheduled assessments of property priority, cost and availability are strongly recommended. Experienced State of Utah staff available for the assessment and acquisition/relocation work may be limited. A consultant team may be retained for specific, periodic property prioritization reviews, and for the accomplishment of strategic acquisition work, using additional task orders.

13.3.4 Summary of Real Estate Plan

It is recommended that property acquisition be approached in the two-phase method outlined above. Initial work to reach agreements with UDOT and other agencies is seen as the first step to property protection of the proposed alignment corridor. Once agreements are in place, a clearer understanding of the alignment corridor can be established. Next, it is recommended that the prioritization of acquisitions based on the expected impacts to those properties be reassessed. This can be accomplished by using the methods described in Chapter 9 "Pipeline ROW Analysis" as well as other methods. Expected acquisition costs can be adjusted using current assessed values and market value data and applied to an overall project plan at that time.

Project coordination will be critical throughout the planning, design, and implementation of the Bear River Pipeline project. Real estate impacts and input should be considered and communicated to all members of the Project Team. The land/parcels database developed in this Concept Study can assist with identifying area owners and detailed tracking of processes such as public outreach; right of entry agreements for surveys; and environmental, permitting, and overall project scheduling. It is recommended that real property representatives participate in public meetings and in the review of documents and project communications to the public regarding project impacts to property.

13.4 PUBLIC INVOLVEMENT

13.4.1 Why Is Public Involvement Important?

Effective public involvement can improve decision-making by providing the public with opportunities to express their views before a final decision is made. It allows people from a variety of backgrounds and interests to participate in decisions that will affect their community. An agency can use public involvement to inform and educate citizens, and help them understand why specific actions are necessary and should be considered. Additionally, public involvement can inform the agency about individual or community opinions that they may otherwise overlook by only considering a limited number of perspectives. If used effectively, public involvement can reduce the negative conflicts that often occur between the affected community and the agency thereby creating a dynamic that promotes consensus, shared understanding, and collaboration.

13.4.2 Why Have A Public Involvement Plan (PIP)?

Public involvement is an organized effort to structure communication between an agency (local, state or federal) or organization that is responsible for making a decision, and the public that may be affected by the decision. There are many levels of public involvement, including, but not limited to, information dissemination, situations in which the public receives information about a decision but is not asked for comment, and empowering the public to develop and ultimately approve a decision.

Many different methods are used at various levels of public involvement. Some examples of these methods include community meetings, surveys, focus groups, press releases, public comments, open houses, web sites, ongoing advisory groups and many other means that allow for the exchange of ideas. The PIP will describe many of these methods in more detail.

Having a strong PIP and implementing the actions in the PIP may help DWRe overcome some of the past controversy/opposition many communities have expressed over the Bear River Pipeline project. Because this is a long-term project, DWRe will need to reevaluate and update the PIP as the project progresses.

13.4.3 What Is In The PIP?

The Bear River Pipeline PIP outlines the major public participation objectives for the project and offers various methods for involving different types of publics throughout the life of the project. The PIP also offers key messages that DWRe should use consistently when dealing with the community. Importantly, the PIP offers a general timeline for implementing these methods. The full PIP is included in the Volume I Appendix, Part 4.

13.5 PROJECT PHASING

The overall Bear River Project is a very large and expensive project. The DWRe has considered possible ways to phase the Project to allow for delivery of water from the Project without full Project development and resulting costs. While it is assumed that the water supplies from the Project will be needed in 2035 as discussed above, the water users may require water supplies from the Project without full implementation of the Project. A three step phasing plan to develop the Bear River water could be as follows:

13.5.1 Phase 1-Interim Supplies for Bear River Water Conservancy District (BRWCD) or Cache County

The overall Bear River Project builds facilities to service either BRWCD or Cache County as the need arises. These facilities are constructed to be compatible with the long term plan for overall Project facilities. BRWCD can be served by a pump station on the Bear River in Box Elder County. Water rights are leased or bought by BRWCD or Cache County (independent of the Project) to supply a reliable water supply during this phase of the Project. Deliveries can be made to Cache County through exchange to direct diversions from the Bear River. No additional storage on the Bear River is constructed at this time. Phase 2 of the Project is not constructed until BRWCD, Cache County, WBWCD, or JVWCD need additional water supply from the Project.

13.5.2 Phase 2-Initial Project Storage and Pipeline

A reservoir is built and the storage develops an additional water supply for the Project. Water is released from storage to the Bear River. A pipeline from a diversion on the Bear River is built to convey water from the Bear River to the West Haven WTP. Project water supply is delivered to all Project participants through the BRWCD pump station(s), river diversions for Cache County, and deliveries to the West Haven WTP for WBWCD and JVWCD. With the additional water supply developed by the storage, diversions can occur to WBWCD, JVWCD, as well as supplementing flows to BRWCD and Cache County. The full water right of the Project of 220,000 acre-feet is not yet developed.

13.5.3 Phase 3-Additional Reservoir Storage

Additional reservoir storage is developed for the Project. The additional storage will allow for full development of the water rights needed for full Project development. Water rights obtained in Phase 1 of the Project can convert back to their water right holders or BRWCD/Cache County can acquire them permanently for use in their counties. Project water supply is delivered to all Project participants through the BRWCD pump station(s), river diversions for Cache County, and deliveries to the West Haven WTP for WBWCD and JVWCD.

VOLUME I APPENDIX

Part 1 – Bear River Pipeline and Pump Station Unit Cost Technical Memorandum
Part 2 – Cache County Ultimate Development Water Demand Study
Part 3 – Box Elder Ultimate Development Water Demand Study
Part 4 – Public Involvement Plan
Part 5 – Public Involvement Brochure
Part 6 – Stakeholder List and Meeting Notes
Part 7 – Chapter 8 Photos

PART 1 – BEAR RIVER PIPELINE AND PUMP STATION UNIT COST TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM

Date: December 8, 2010

To: Eric Millis, State of Utah Division of Water Resources

From: Thayne Clark, BC&A; Duane Jensen, Carollo

Subject: Bear River Pipeline and Pump Station Unit Costs

Job No.: 233-09-01

Purpose

The purpose of this memorandum is to establish the pipeline and pump station unit costs for the proposed Bear River Pipeline and associated pump stations. The pipeline project will divert water from the Bear River and deliver it to a proposed water treatment plant (WTP) in West Haven, Weber County. The pipeline will also provide water to multiple agencies at various points along its alignment. The proposed pipeline and pump station unit costs will be used primarily for the route selection analysis, pipe/pump optimization and for the development of the conceptual project cost estimates.

1.0 PIPELINE UNIT COST ESTIMATION

Data Sources

The pipeline unit costs are based on contractor bid cost breakdowns from 43 water pipeline projects that have been bid within the past twenty-two years (See Table 1). These projects range in size from 36-inch to 126-inches in diameter and are located throughout the Western United States, with twenty of them located in Utah. The projects varied in the quantities and types of vault structures, valves, connections, other special structures, and construction methods.

Because these pipelines were constructed over a twenty-two year period and construction costs have increased over this period, each pipeline construction cost was first adjusted to March 2010 construction costs using the Engineering News Record Index (ENR), 20-cities cost indexing system (value of 8600). A plot of the pipeline diameter versus construction cost of these projects is found in Figure 1.

Procedure

The ideal conditions in which to construct a major pipeline include furnishing and installing the pipeline in open country where there are minimal interfering utilities and easy excavation, without rock or groundwater. The cost to install a pipeline of a given diameter and material in these ideal conditions can be considered a baseline cost. To determine the baseline cost of the Bear River Pipeline, comparisons were made to the baseline costs of the projects referenced in Table-1. The project installation conditions identified that could occur along the alignments being considered for the Bear River Pipeline are similar to conditions that occurred along many of these pipelines. As the construction conditions observed in these projects included a variety of special circumstances, cost factors were used to normalize each project's actual cost to an equivalent baseline cost.

In most cases the installation factors were estimated by examining the conditions that occurred on each of the pipeline projects, then adjusting the factors that apply to those conditions to obtain the cost of a pipeline with the ideal, baseline condition. From this data the cost curve was calculated using regression analysis to obtain the estimating cost for the Bear River Pipeline. The effects of this adjustment can be observed by the difference in the spreads of cost for various sizes from the raw cost, adjusted to 2010 construction cost shown in Figure 1, to the calculated baseline costs shown in Figure 2. The factors for various field conditions used to adjust to baseline cost are listed in Table 2. The adjusted baseline unit costs based on pipe diameter are found in Table 3.

An iterative process was performed to empirically determine the cost factors based on similar projects. The results of this process are summarized in Table 2.

Table 2
Pipeline Normalization Factors

Summary of Normalization Factors		
Multiply the baseline cost, or Normalized Pipeline Cost (NPC), by the Factors listed to obtain the cost of the installed pipeline for local conditions (APC)		
If The Pipeline is Installed In the Following:		
Urban Factor (RF)		**Factors**
Open Country or Unpaved Roadway		1.00
a.	Narrow R.O.W	1.30
b.	State Highway	1.20
c.	Paved Collector or City Street	1.10
d.	Paved Rural Roadway	1.08
Now add the Utility Adjustment Cost. The resulting summation is the Adjusted Urban Rating.		
Utility Factor (UF)		
	No Utility Factors	0.00
p.	Rural Utilities	0.15
q.	High Density Utilities	0.30
Then multiply this product by the number below for groundwater		
Groundwater Condition (GW)		
	No Groundwater	1.00
e.	Stagnant Groundwater in Clays	1.20
f.	Flowing Groundwater in Sands and Gravels	1.80
Then multiply this product by the number below for Steepness Factor		
Steepness Factor (SF)		
	Grades are 25% and below	1.00
g.	Grades are 25% or more	1.40
Then multiply this product by the number below for Special Conditions		
Special Conditions (SC)		
	No special Conditions	1.00
h.	Ditch Crossing (Crossing, plus 50 Feet)	1.10
0	Small Canal Crossing (Crossing, plus 50 Feet.)	1.30
j.	Large Canal Open Cut (Crossing, plus 100 ft.)	1.80
k.	River Crossing Open Cut (Crossing, plus 100 ft.)	2.00
l.	Large Canal Crossing (Tunneled) (Crossing plus, 100 ft.)	2.80
m.	River Crossing (Tunneled) (Crossing Plus, 100 Ft.)	2.90
n.	Freeway Crossing (Tunneled), (ROW Lines, Plus 100 Ft.)	3.00
o.	Railroad Crossing (Tunneled), (ROW, Plus 100 Ft.)	3.00

Table 3 summarizes the average baseline cost data when normalization factors from Table 1 are applied to similar projects.

Table 3
Average Open Field Cost of Large Diameter Pipelines at ENR of 8600

Pipe Dia. (inches)	Installed $/Linear Foot
36	220
42	290
48	355
54	425
60	495
66	570
72	635
78	710
84	780
90	860
96	935
102	1,020
108	1,100
114	1,185
120	1,275
126	1,370
132	1,465
144	1,670

Two past pipeline projects that are plotted on Figures 1 and 2 came in considerably below the cost curve and were not used in establishing the average cost for pressure pipeline. These include the 96-inch Taylor Pipeline Project constructed in 1988 by the Central Utah Water Conservancy District and the recently bid Provo Reservoir Canal Enclosure Project (PRCEP) for the Provo River Water Users Association. Both of these pipelines were canal replacement projects in wide open areas, with little or no groundwater. In the case of the PRCEP, the pipe is being placed in the existing canal, which will allow its installation with little excavation. The Bear River

Pipeline will most likely not be placed within an open canal, so these two projects were not included in calculating the base pipe cost for this study.

Some costs, such as ditch and canal crossings were estimated based on adjustments of data to reflect the extra effort to deal with the conditions of groundwater, and other factors that might occur at the time of installation as well as the cost of restoring the ditch or canal after crossing. The cost adjustment factors for large canals, rivers, freeways and railroads were determined based on tunneling beneath them. As long as significant rock is not encountered, tunneling can be accomplished beneath these facilities on nearly a ninety-degree angle to the crossing using pressure balanced tunneling equipment. Because of the large size of the pipeline, earth removal from the tunnel can be accomplished using small equipment as opposed to ore carts that are necessary in tunnels of smaller diameter. A local tunnel consultant was consulted in estimating these factors.

Engineers at Bowen, Collins and Associates helped verify the values for the cost factors by calculating the difference in costs of various construction scenarios based on contractor estimated costs from recently bid projects. These calculations can be found in the Appendix to Chapter 6 in the Bear River Pipeline Concept Report.

To estimate the cost for various alternative routes for Bear River Pipeline project, the above factors were used to give a more accurate installed cost for various sections of the pipeline. To estimate the installed cost of a given pipe size, the adjusted urban rating factor was determined by multiplying the urban rating factor by the utility rating factor. This product was then multiplied by any other construction factors. This total construction cost factor was then multiplied by the baseline cost to determine the estimated actual cost of the pipeline.

For example, if new 120-inch pipeline were to be constructed in a paved collector street within stagnant ground water conditions where rural utilities were located, the estimated installed cost per foot would be:

> (1.10, the factor for Paved connector + 0.15, the addition factor for rural utilities) X (1.20, the factor for stagnant groundwater) X ($1275, the Base Cost for 120-inch pipe) = $1912.

This method applies to typical trench or tunnel type pipe installations. The pipeline costs presented in this memorandum will be used throughout the Bear River Pipeline Concept Report.

2.0 PUMP STATION UNIT COST ESTIMATION

Data Sources

The pump station costs are based on general cost estimating guidelines set forth by Robert L. Sanks, *Pumping Station Design, Second Edition, Chapter 29* and Southern Nevada Water Authority (SNWA). Other data used in generating the pump station costs estimates came from contractor bid cost breakdowns from 11 smaller pump station projects. These projects varied in size from 300 horsepower (hp) to 2,800 hp. The cost estimates from each of the projects and from the estimating guidelines were all normalized relative to total cost per horsepower of the pump station.

It should be noted that there is limited data on large pump stations above 20,000 horsepower, so the costing guidelines from SNWA and Sanks were utilized more heavily for estimation of unit cost at larger horsepower ranges.

Data Evaluation

The compiled pump station costs were based upon the following assumptions:

- Total cost of installed pump station facility including the building, electrical and controls, associated mechanical, valves, and piping and all other appurtenances required for a finished water pumping station

- Total installed horsepower

- March 2010 ENR value of 8600.

The bid tabulations for each of the 11 projects and the cost estimating guidelines were combined graphically in Figure 3 to show a general trend in pump station cost per hp.

Results

The results of the pump station cost estimation evaluation show that the cost per hp varies greatly with respect to the size of the pumping facility. As shown in Figure 3, the smaller the pump station horsepower, the greater the unit cost of the pump station.

Pump station cost per horsepower can vary based on the complexity of the pumping station and its associated functions. To account for this variation in cost, a band of cost per horsepower was created that defines the minimum and maximum cost per hp for the full range of pump station sizes that this project may include.

The pump station unit cost for pump stations larger than 10,000 horsepower approaches between $1,500/hp to $2,000/hp on the higher end. For the purposes of this study, it is recommended that the pump station unit costs fall within this range depending on size and complexity of the pump station facility. Generally intake pump stations will fall within the upper end of this range, while standard pump stations would fall into the lower end of this range.

Table 1
Pipeline Projects Used to Develop Cost Curve

Pipe Diam (in)	Date of Bid	ENR	Project Name	Designed By	Total Project Length (miles)	Pipe & Installation Cost ($/LF)	Pipe & Installation in 2010 Costs ($/Lf)	Project Description
36	Jun-02	6532	36-Cheyenne Board of Public Utilities, WY	Black & Veatch	12.0	$133	$175	Open Terrain
42	Jun-02	6532	42-Contra Costa Water District, CA (a,c)	CH2MHill/MWH	20.0	$376	$495	80% Restricted ROW in canal with canal improvements - 15% in open terrain - 5% in low urban roadways
48	Oct-00	6259	48-El Paso Water Utilities-Canutillo I, TX	Carollo	3.0	$222	$305	Open
48	Jun-00	6238	48-Llano & Mark, Santa Rosa, CA	CH2MHill	8.0	$327	$451	Low urban area --200psi
48	~~Ukn~~		~~Windsor, Santa Rosa, CA~~	~~CH2MHill~~	~~7.0~~	~~$345~~		Low urban area --200psi Not Used, Insuffcant Data
48	~~Ukn~~		~~Mid South, Santa Rosa, CA~~	~~CH2MHill~~		~~$343~~		Low urban area --200psi Not Used, Insuffcant Data
48	Apr-99	6010	48-Weber Basin WCD Sandridge, UT	Bowen Collins & Associates	1.8	$347	$497	Low urban area - Residential Streets
48	Jun-02	6532	48-Jordan Valley WCD 15000 So., UT	Boyle	4.3	$166	$219	Medium urban, some open terrain
48	Nov-06	7910	48-Jordan Valley WCD 11800 So., UT (c,q)	Bowen & Collins	3.0	$499	$543	City Collector, Utilities, Traffic Paving
48	Jun-99	6039	48-Ute Water, CO	CDM	3.2	$250	$356	Medium urban, some open terrain
54	Jun-99	6039	54-Ute Water, CO	CDM	5.6	$275	$392	Medium urban, some open terrain
54	Apr-96	5550	54-El Paso Public Utilities, Canutillo III, TX	Carollo	1.7	$217	$336	
60	Apr-01	6286	60-El Paso Public Utilities, Canutillo Upper Valley, TX	Carollo	4.0	$373	$511	Open along Freeway
60	Mar-99	5986	60-Folsom E2A, Sacramento, CA (a,b,p)	Carollo	2.5	$758	$1,089	Narrow construction zone, one street crossing, heavy parallel traffic, commercial driveways, difficult ground conditions, pavement replacement, some utility relocation and utilities
60	Jul-95	5484	60-SNWA West Valley Lateral, NV (p)	Carollo	2.5	$370	$580	In Las Vegas
60	Dec-04	8165	60-MWDSLS POMA. Open Sections, UT (p)	CH2M-Hill	7.9	$563	$593	Not in Pavement, Canal and future Roadway , Minor Utilities
60	Dec-04	8165	60-MWDSLS POMA Paved Streets, UT (c,q)	CH2M-Hill	3.3	$697	$734	Paved City Streets, Utilities, Traffic
60	Dec-04	8165	60-MWDSLS POMA Relations St., UT (a,c,p)	CH2M-Hill	0.4	$818	$862	Very Narrow, Residential Street, Utilities, Deep, minor GW.
60	Jul-95	5484	60-SNWA North Valley Lateral, NV (b,q)	Parsons	2.0	$565	$886	In Las Vegas
60	May-09	8574	60-CUWCD - Spanish Fork - Mapleton, UT (e,p)	CUWCD	3.8	$668	$670	US 6 Traffic, Rock, narrow, High Pressure
60	Jul-09	8566	60-CUWCD - Spanish Fork - Springville, UT (a,c,f,q)	CUWCD	2.9	$1,870	$1,877	City Traffic, High Density Utilities, Flowing GW, City Street
60	Sep-08	8407	60-PRWUA Penstock Pipe, UT (f,g)	CUWCD	0.7	$1,332	$1,363	Open, 1/2 half is Steep,
66	Aug-00	6233	66-Board of Water Works, CO	Black & Veatch	5.0	$401	$553	
66	Aug-00	6233	66-Board of Water Works, CO	Black & Veatch	5.0	$410	$566	67" Weighted Pipe
66	ENR 1-97	5751	66-Quail Creek, UT	Boyle Bear River Report	9.0	$380	$568	Open Terrain
66	Jan-82	3726	66-Salt Lake City LCCC, UT	Carollo	1.1	$245	$565	
72	Jan-82	3726	72-Salt Lake City LCCC, UT	Carollo	0.6	$270	$623	Bench Const. Some Rock
72	Aug-00	6233	72-Board of Water Works, CO	Black & Veatch	5.0	$443	$612	
72	Sep-08	8407	72-PRWUA Siphon, UT (f,g)	Bowen & Collins	0.7	$1,399	$1,431	Open, 1/2 half is Steep,
72	ENR 1-97	5751	72-Las Vegas Pipeline, NV	Boyle Bear River Report	7.0	$390	$584	Open Terrain
78	Aug-00	6233	78-Board of Water Works, CO	Black & Veatch	5.0	$479	$661	76" Weighted Pipe
84	Dec-04	8165	84-MWDSLS, POMA Open, UT	CH2M-Hill	1.1	$815	$858	Open,
84	Dec-04	8165	84-MWDSLS, POMA Paved, UT (d)	CH2M-Hill	1.5	$872	$918	Paving Rep. W retrouting traffic
90	Aug-94	5433	90-Bradshaw 3. Sacramento, CA	Carollo	1.0	$549	$869	Open construction zone, one street crossing, no parallel traffic ideal ground condition, no driveways.
90	Dec-93	5439	90-LA County San, CA	Carollo	0.9	$687	$1,086	City Streets w/ Traffic Control
96	April-88	4571	96-CUWCD Duchesne Taylor, UT *	Horrocks/Carollo	2.5	$373	$702	Canal Replacement, open country, (Not Used in Regression)
96	ENR 1-97	5751	96-CUWCD - Diamond Fork, UT	Boyle	7.0	$676	$1,010	Open Terrain - high groundwater
96	Oct-08	8623	96-CUWCD-Spanish Fork Canyon Rh2, UT (a,b,p)	CUWCD	2.7	$1,929	$1,924	US 6 Traffic, Rock, narrow, High Pressure, city water line in area, Whitaker Const.
96	May-09	8574	96-CUWCD-Spanish Fork Canyon, Rh3, UT (a,b)	CUWCD	2.1	$1,376	$1,380	US 6 Traffic, Rock, narrow, High Pressure. Ames
108	Jul-94	5409	108-Bradshaw 4. Sacramento, CA, (p)	Carollo	1.0	$799	$1,271	Open construction zone, 3 street crossing, no parallel traffic, ideal ground condition, pipe jacked under hwy 99, no driveways
108	Jun-98	5895	So. Nev Water Auth.	Carollo/B&V	7.8	$443	$646	Not Used in regression analysis, Data is questionable. Very, very low
108	Oct-98	5986	108-Bradshaw 5B, Sacramento, CA (c,p)	Carollo	1.0	$1,086	$1,560	Narrow construction zone, many street crossing, heavy parallel traffic, commercial driveways, many private driveways, developed neighborhoods, pavement replacement, significant
108	Jan-07	7903	108 CUWCD - Spanish Fork Canyon, UT (a,b.e)	CUWCD	2.3	$1,995	$2,171	Incudes one Vault, some Rock, on Highway 6
114	May-00	6299	114-Bradshaw 1&2, Sacramento, CA (p)	Carollo	1.0	$1,032	$1,409	Open construction area, 3 structures, one street crossing, no traffic, ideal ground conditions, significant dewatering will be
120	Mar-91	4926	120-OCSD, I-9, CA (p)	Carollo	3.4	$862	$1,505	Tight area, Bike Trail distruptions. Two street crossing. W/ Tunnels
120	Mar-10	8600	120-PRCEP Seg. o *	CH2M-Hill	0.3	$1,256	$1,256	Open, west of I-15, (Not used in regression analysis)
126	Mar-10	8600	126-PRCEP Segs.'a, h & j *	CH2M-Hill	1.2	$1,446	$1,447	Along 800 N., Orem, Pressure Siphons (Not used in anal.)
126	Mar-10	8600	126-PRCEP Seg.'b-g,I,k,l & n *	CH2M-Hill	17.6	$1,171	$1,167	Bench Areas, Not used in Regression analysis

FIGURE 2

carollo Engineers...Working Wonders With Water™

Bowen Collins & Associates, Inc. CONSULTING ENGINEERS

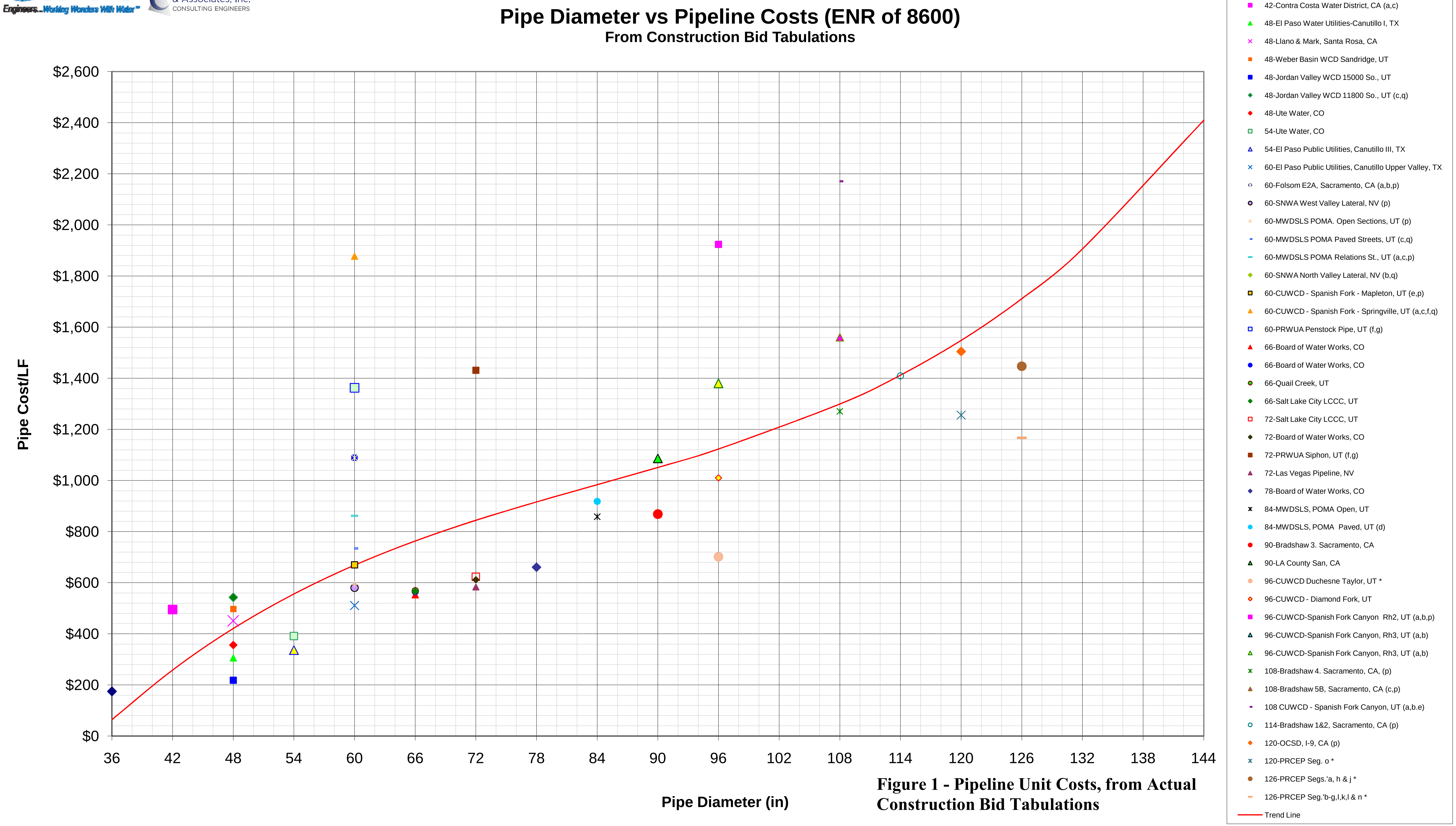
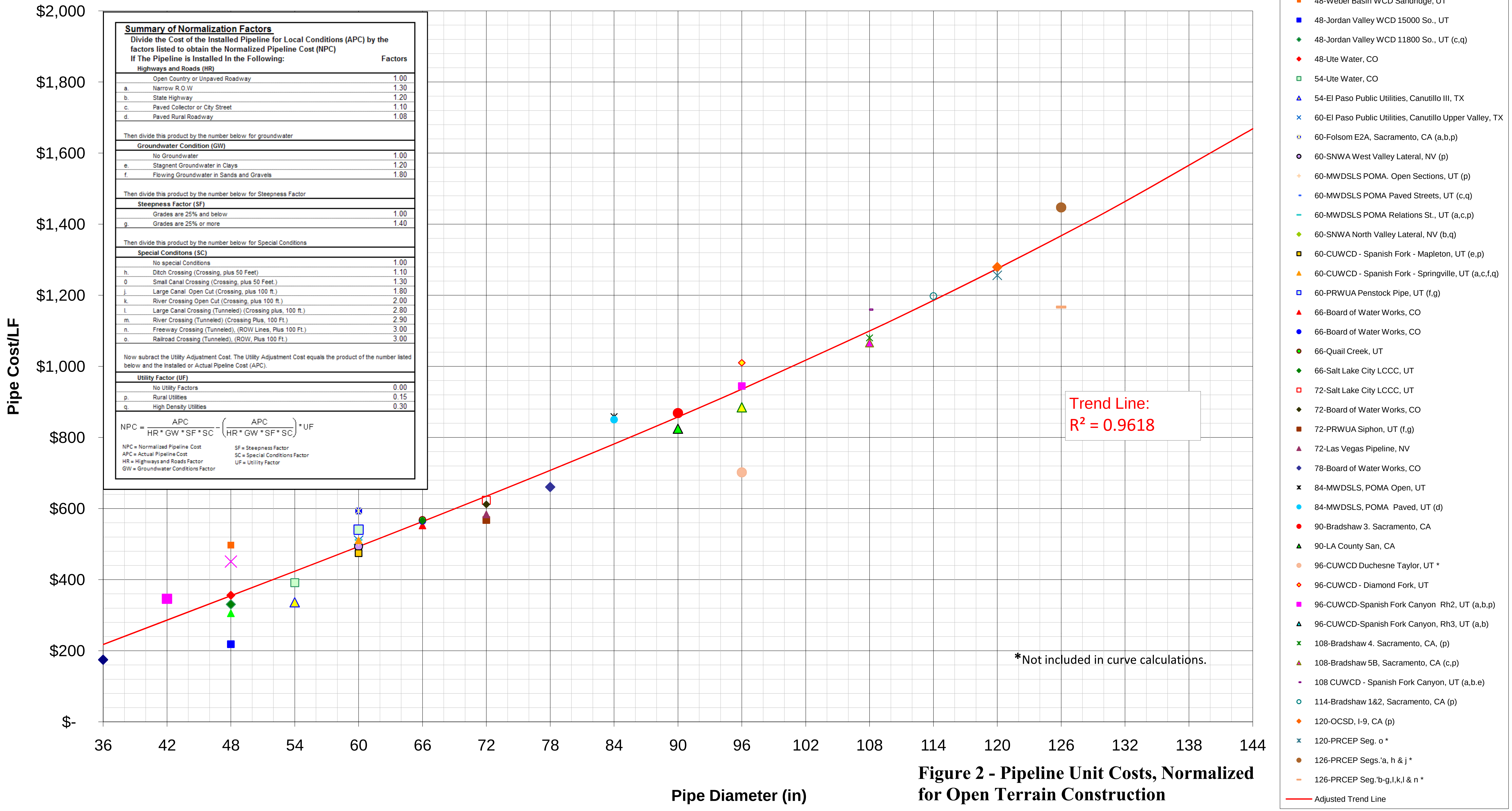


Figure 1 - Pipeline Unit Costs, from Actual Construction Bid Tabulations

Pipe Diameter vs Pipeline Costs (ENR of 8,600)

Normalized to Open Country Trench Installation



Summary of Normalization Factors

Divide the Cost of the Installed Pipeline for Local Conditions (APC) by the factors listed to obtain the Normalized Pipeline Cost (NPC)

If The Pipeline is Installed In the Following:		Factors
Highways and Roads (HR)		
	Open Country or Unpaved Roadway	1.00
a.	Narrow R.O.W	1.30
b.	State Highway	1.20
c.	Paved Collector or City Street	1.10
d.	Paved Rural Roadway	1.08
Then divide this product by the number below for groundwater		
Groundwater Condition (GW)		
	No Groundwater	1.00
e.	Stagnent Groundwater in Clays	1.20
f.	Flowing Groundwater in Sands and Gravels	1.80
Then divide this product by the number below for Steepness Factor		
Steepness Factor (SF)		
	Grades are 25% and below	1.00
g.	Grades are 25% or more	1.40
Then divide this product by the number below for Special Conditions		
Special Conditons (SC)		
	No special Conditions	1.00
h.	Ditch Crossing (Crossing, plus 50 Feet)	1.10
0	Small Canal Crossing (Crossing, plus 50 Feet.)	1.30
j.	Large Canal Open Cut (Crossing, plus 100 ft.)	1.80
k.	River Crossing Open Cut (Crossing, plus 100 ft.)	2.00
l.	Large Canal Crossing (Tunneled) (Crossing plus, 100 ft.)	2.80
m.	River Crossing (Tunneled) (Crossing Plus, 100 Ft.)	2.90
n.	Freeway Crossing (Tunneled), (ROW Lines, Plus 100 Ft.)	3.00
o.	Railroad Crossing (Tunneled), (ROW, Plus 100 Ft.)	3.00
Now subract the Utility Adjustment Cost. The Utility Adjustment Cost equals the product of the number listed below and the Installed or Actual Pipeline Cost (APC).		
Utility Factor (UF)		
	No Utility Factors	0.00
p.	Rural Utilities	0.15
q.	High Density Utilities	0.30

$$NPC = \frac{APC}{HR * GW * SF * SC} - \left(\frac{APC}{HR * GW * SF * SC}\right) * UF$$

NPC = Normalized Pipeline Cost
APC = Actual Pipeline Cost
HR = Highways and Roads Factor
GW = Groundwater Conditions Factor
SF = Steepness Factor
SC = Special Conditions Factor
UF = Utility Factor

Figure 2 - Pipeline Unit Costs, Normalized for Open Terrain Construction

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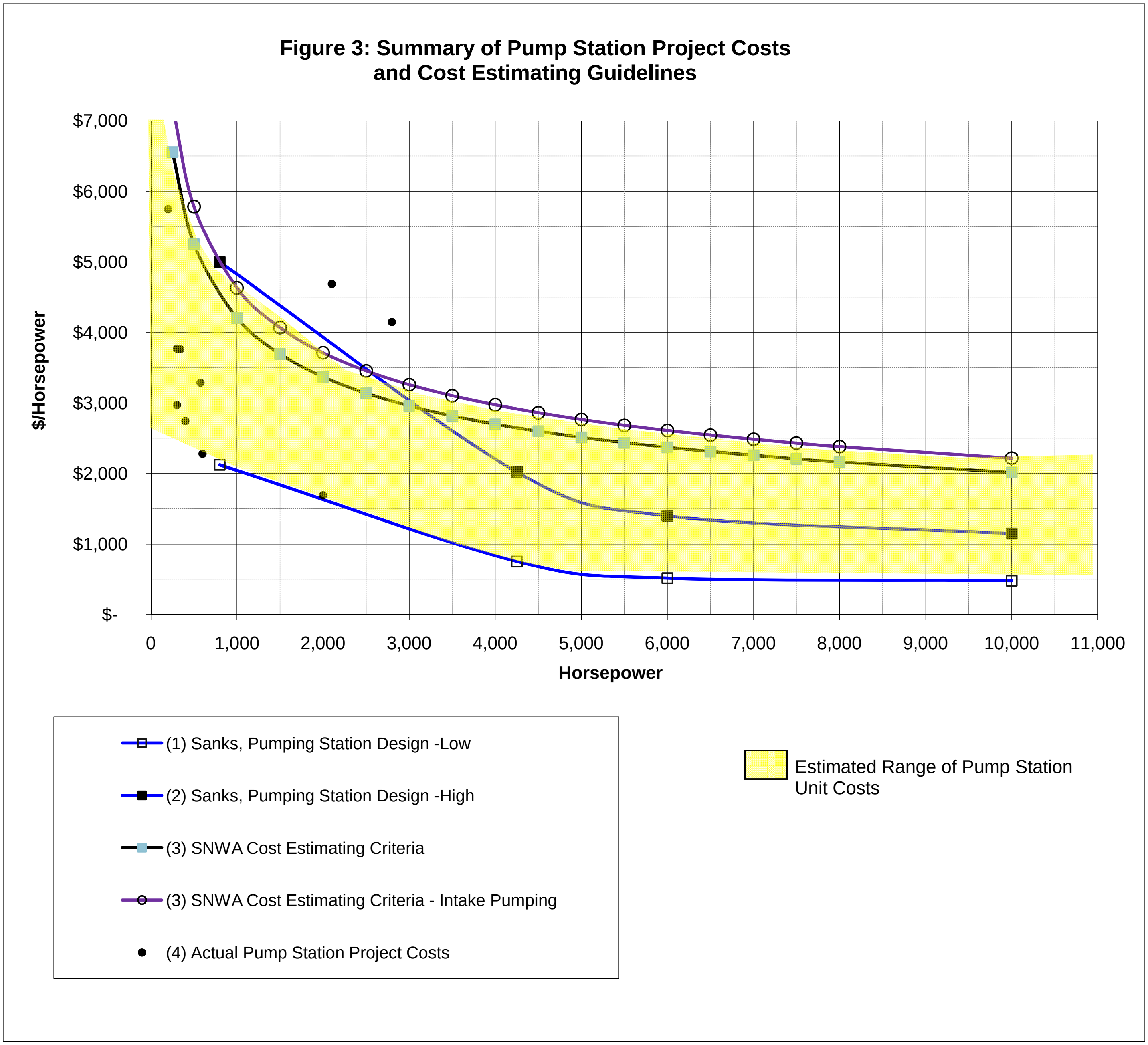


Notes:

(1) From Robert Sanks "Pumping Station Design," Chapter 29 - based on low-end cost curve for service water pumping stations - costs based on pump station peak flow rate
(2) From Sanks "Pump Station Design," Costs Chapter - based on high-end cost curve for service water pumping stations - costs based on pump station peak flow rate
(3) From SNWA pump station cost estimating equation based on pump station peak HP
(4) From cost comparison of various pump station projects

All pump station costs include the installation of the pumps and pumping facilities including the building, piping, all mechanical, and electrical/controls.

This cost evaluation was performed to obtain conceptual level costs per horsepower for water pumping stations. The costs represented on this figure only represent conceptual costs and should be used with discretion.

PART 2 – CACHE COUNTY ULTIMATE DEVELOPMENT WATER DEMAND STUDY

TECHNICAL MEMORANDUM - DRAFT

DATE: July 7, 2010

TO: Bob Fotheringham, Cache County

FROM: Thayne Clark, P.E. and Keith Larson, P.E.
Bowen, Collins & Associates
154 East 14000 South
Draper, Utah 84020

COPIES: Michael Collins (BC&A)
Marisa Egbert (Division of Water Resources)
File

PROJECT: Bear River Pipeline Concept Report Project

SUBJECT: Cache County Ultimate Development Water Demand Study

Introduction

As part of the Bear River Pipeline Concept Report, Bowen Collins & Associates (BC&A) prepared an estimate of projected ultimate water demands in Cache County (County). The purpose of this estimate is to provide the County with an ultimate water demand for assumed future build-out conditions. The following sections of this memorandum summarize the results of this ultimate water demand estimate.

Developable Area

Cache Valley, which is bounded on the west by the Wellsville Mountains and on the east by the Bear River Mountains, is largely an agricultural community with most development along the east side of the valley near Logan, Utah. The existing Cache County population was approximately 111,841 in 2008 according to the Utah Governor's Office of Planning and Budget (GOPB). The GOPB has projected that the Cache Valley population will reach 331,594 by the year 2060 (annual growth rate of 2.2%). Because most of the County is largely agricultural, there is considerable potential for additional development and population growth beyond the year 2060. To estimate the potential for growth beyond 2060, BC&A examined the ultimate developable area in the County.

The likely developable area of the County to be used for the purpose of this evaluation is shown in Figure 1, which largely encompasses Cache Valley. The following assumptions were used to outline developable areas in Cache County:

- Areas with steep slopes - Any areas with slopes exceeding 30 percent were considered undevelopable. In some cases, slopes less than 30 percent were also considered undevelopable if they occurred in areas that did not have access from other developable lands or were too small to support development.
- Flood Plains – Areas within flood plains, including associated wetland areas (as estimated visually from aerial photography), were considered undevelopable.

The total developable area shown in Figure 1 is approximately 151,000 acres, all located within Cache Valley.

Water Demand

Because much of Cache County is currently undeveloped, estimating total water demand at build-out is highly dependent on the assumed build-out densities for the County. For the purposes of this study, it has been assumed that Cache County will eventually be developed at similar densities to those observed in the more developed areas of the Wasatch Back. BC&A has completed a number of supply and demand studies in recent years for large wholesale water providers in Utah. Based on this work, BC&A has developed estimates of total water demand on a per acre basis, based on average expected densities at ultimate development. Table 1 includes the results of these estimates provided to the water districts, represented as total annual municipal and industrial (M&I) water demand in acre-ft per gross developable area.

Table 1
Projected M&I Annual Water Demand for Large Water Districts

Water District	Projected Annual Demand (acre-ft/acre)
Weber Basin Water Conservancy District - Wasatch Back Service Area	1.98
Weber Basin Water Conservancy District - Wasatch Front Service Area	2.8
Metropolitan Water District of Salt Lake & Sandy	2.6
Jordan Valley Water Conservancy District	2.52

Expected annual demand at ultimate development ranges from about 2.0 to 2.8 acre-ft per gross developable acre. The lower end of this range is associated primarily with development on the Wasatch Back where lower population densities and greater open space are expected. More urban areas along the Wasatch Front all have demands closer to the higher end of the range.

Based on the developable area in Cache County, this suggests that the ultimate water demand in Cache County will fall within the ranges summarized in Table 2.

Table 2
Projected M&I Water Demand for Cache County at Ultimate Development

Demand Range	Water Demand (acre-ft/yr)
Lower Density[1]	302,000
Higher Density[2]	423,000

[1] 2.0 acre/ft per gross developable acre
[2] 2.8 acre/ft per gross developable acre

Envision Cache Valley

The Envision Cache Valley Final Report was recently released in February 2010. This report documents a broad public planning process that outlines the preferred development pattern that Cache Valley residents would like to see occur in Cache Valley as the population continues to grow. The report defines development patterns preferred by most participants in the planning process that outlined a few goals pertinent to future water demands in Cache Valley:

- Water Quality – Cache Valley has abundant sources of water as a result of its proximity to the Bear River Mountains and plentiful groundwater supplies. Planning should safeguard water resources by keeping growth away from major riparian corridors to protect public safety and preserve water resources to support birds, fish, deer, elk, and other wildlife.
- Working Farms & Ranches – Cache Valley is one of the most productive agricultural areas in Utah and working farms and ranches were identified as an important aspect of life in Cache Valley. Planning should help preserve working farms to foster security and self sufficiency in the valley and in the State of Utah.
- Growth Patterns – City ordinances and codes should promote: town centers, cluster developments, infill and redevelopment. Planning should encourage growth patterns that preserve the individuality of each of the Cache Valley communities to prevent cities from growing into a single conglomerate which would be the likely scenario under current development patterns (over the last 10-years).

Compared to typical development practices, the Envision Cache Valley goals may affect water demands in Cache Valley in a few different ways:

- Residential Water Demand – The Cache County Water Policy Board performed a study in 2003 to identify the effects of urbanization on water rights and water demands ("Development of a GIS model to evaluate the impact of urbanization on water rights and water demands for the City of Nibley, Utah"). One conclusion of this study was that higher density residential development (6000 square-foot lots or 7.2 lots/acre) resulted in approximately the same water demands as agricultural water demands. At lower densities, residential development reduced total water demands. At densities higher than

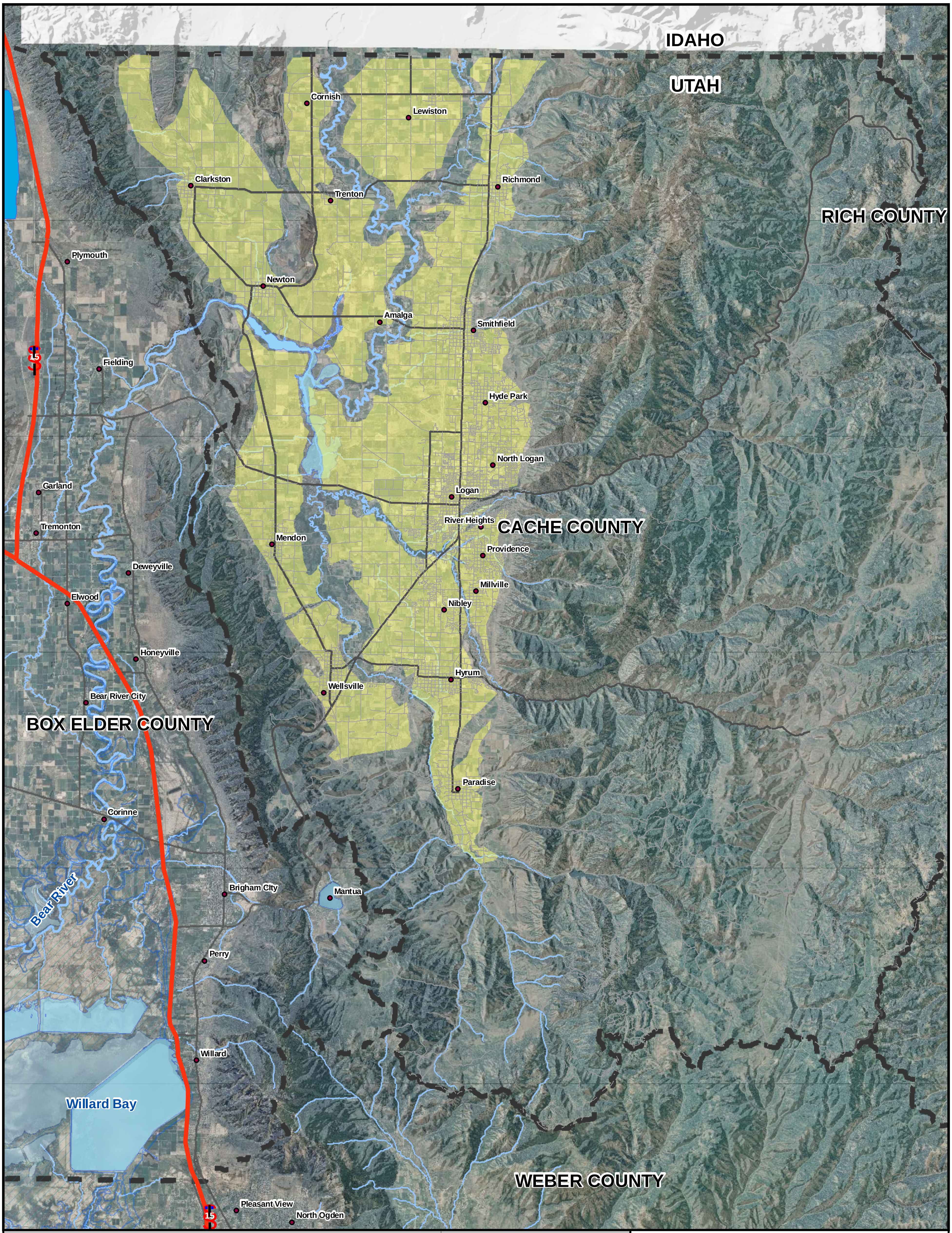
7.2 lots/acre, it would be expected that residential water demands would be higher than for agricultural uses. Because Envision Cache Valley seeks to encourage cluster type developments with higher densities, very little decrease in water demand should be expected from converting irrigated agricultural land to residential land use.

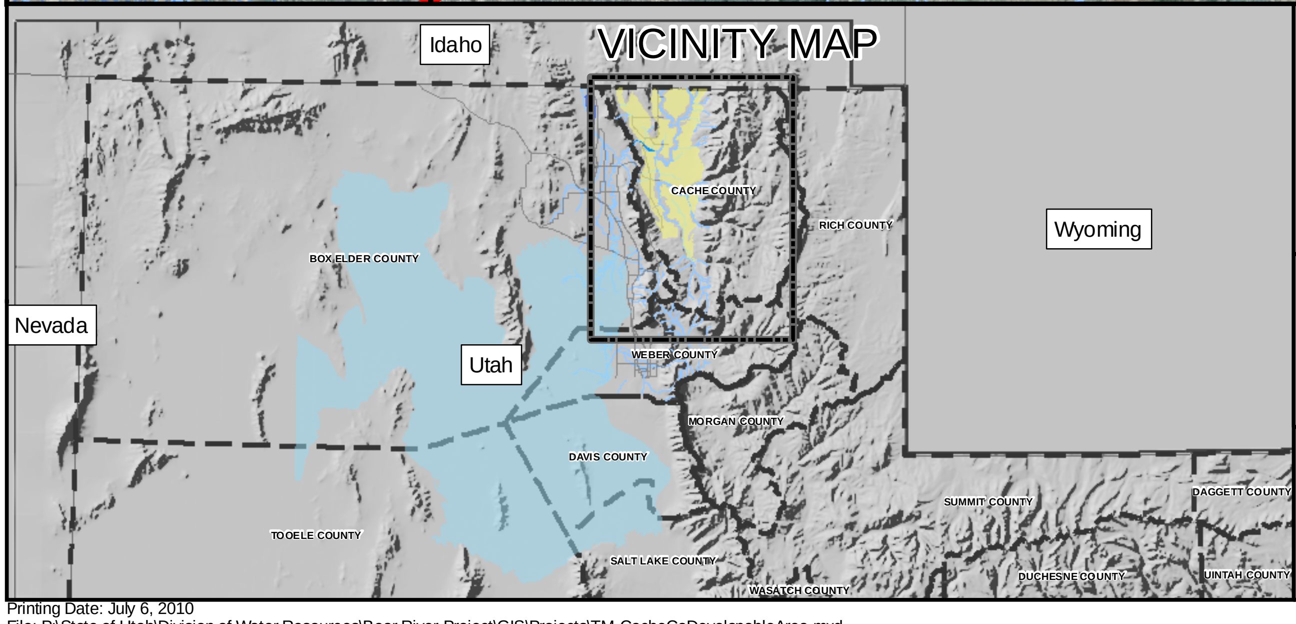
- Irrigated Agricultural Area – Cache Valley has approximately 112,450 acres of irrigated agricultural land. Some of this land may be within the boundaries of existing flood plains. While some reduction in irrigated agricultural land is expected as development occurs, the goals of Envision Cache Valley seek to preserve farms and ranches and the associated irrigated land. Development of irrigated agricultural areas will likely have minimal effect on total water demands.
- Non-Irrigated Agricultural Area – Cache Valley has approximately 66,701 acres of non-irrigated agricultural land, though some of this land may be within the boundaries of existing flood plains and/or along areas with steeper slopes. The development of non-irrigated agricultural area will lead to much higher water demands per acre than for existing conditions under the Envision Cache Valley planning standards.

Conclusions

Because Cache Valley hopes to preserve (and even expand) its farms and ranches by following the guidelines established in Envision Cache Valley, irrigation water demands will remain relatively constant while indoor water demands from population growth will continue to rise. Total water demands are therefore expected to be on the higher end of the water demands shown in Table 2 or around 423,000 acre-ft/year at ultimate development.

Unlike other areas along the Wasatch Front, much of this demand will continue to be for irrigation rather than for municipal purposes. Further study is recommended since this estimate of future water demands does not take into the account the complex interaction of future development trends and the desire for agricultural preservation in Cache Valley and how it will affect future water demands.





LEGEND

Developable Area

County Boundaries

2

0 2 4 8

Miles

Figure 1 - Cache County Developable Area

Bear River Pipeline Concept Report

State of Utah
Division of Water Resources

Bowen Collins & Associates, Inc.
CONSULTING ENGINEERS

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PART 3 – BOX ELDER ULTIMATE DEVELOPMENT WATER DEMAND STUDY

Bowen Collins & Associates, Inc.
CONSULTING ENGINEERS

TECHNICAL MEMORANDUM - DRAFT

DATE: June 29, 2010

TO: Voneene Jorgensen, Bear River Water Conservancy District

FROM: Thayne Clark, P.E. and Keith Larson, P.E.
Bowen, Collins & Associates
154 East 14000 South
Draper, Utah 84020

COPIES: Michael Collins (BC&A)
Marisa Egbert (Division of Water Resources)
File

PROJECT: Bear River Pipeline Concept Report Project

SUBJECT: Box Elder County Ultimate Development Water Demand Study

Introduction

As part of the Bear River Pipeline Concept Report, Bowen Collins & Associates (BC&A) prepared an estimate of projected ultimate water demands in Box Elder County (County). The purpose of this estimate is to provide Bear River Water Conservancy District with an ultimate water demand for an assumed future build-out condition in the County. The following sections of this memorandum summarize the results of this ultimate water demand estimate.

Developable Area

Box Elder County currently has a population of approximately 50,000 according to current estimates. Most of the County population (97%) lives within the Bear River valley. This valley is bounded to the west by the West Hills and to the east by the Clarkston Mountain Range. According to the Governor's Office of Planning and Budget (GOPB), the County population will grow to approximately 127,000 by the year 2060 (annual growth rate of approximately 1.8%). Furthermore, because most of the County is largely agricultural, there is considerable potential for additional development and population growth beyond the year 2060. To estimate the potential for growth beyond 2060, BC&A examined the ultimate developable area in the County.

The likely developable area of the County to be used for the purpose of this evaluation is shown in Figure 1. The following assumptions were used to outline developable areas in Box Elder County:

- Great Salt Lake high water elevations – Any areas falling within the high water elevation (4,216 ft msl) were considered undevelopable.
- Potential wetlands or marshlands – Any areas around the Great Salt Lake that are designated as wetlands were considered undevelopable.
- Areas with steep slopes - Any areas with slopes exceeding 30 percent were considered undevelopable. In some cases, slopes less than 30 percent were also considered undevelopable if they occurred in areas that did not have access from other developable lands or were too small to support development.
- Flood Plains – Areas within flood plains (as estimated visually from aerial photography) were considered undevelopable.
- West of the West Hills (Samaria Mountains) – Although there is a substantial amount of land in Box Elder County west of the West Hills that could be developed, it has been assumed that limited water rights and access to major road corridors will restrict potential growth. In this vicinity of the County, only areas that are currently being used for agricultural or other purposes uses were identified as future developable areas.

The developable area within the County to be served by the Bear River system is essentially limited to the Bear River Valley, because of topographical barriers to the west. The areas beyond the Bear River Valley are unlikely to be served Bear River water since doing so would require extensive pumping and transmission costs.

Figure 1 illustrates the likely developable areas within the County to be served by the Bear River system (in yellow), and the developable areas not served by the Bear River system to the west (in green). The total developable area likely served by the Bear River system is 149,000 acres, with an additional 84,000 acres most likely served by other water sources to the west.

Water Demand

Because much of Box Elder County is currently undeveloped, estimating total water demand at build-out is highly dependent on the assumed build-out densities for the County. For the purposes of this study, it has been assumed that Box Elder County will eventually be developed at similar densities to those observed in the more developed areas of the Wasatch Front. BC&A has completed a number of supply and demand studies in recent years for large wholesale water providers in Utah. Based on this work, BC&A has developed estimates of total water demand on a per acre basis, based on average expected densities at ultimate development. Table 1 includes the results of these estimates provided to the water districts, represented as total annual municipal and industrial (M&I) water demand in acre-ft per gross developable area.

Table 1
Projected M&I Annual Water Demand for Large Water Districts

Water District	Projected Annual Demand (acre-ft/acre)
Weber Basin Water Conservancy District - Wasatch Back Service Area	1.98
Weber Basin Water Conservancy District - Wasatch Front Service Area	2.8
Metropolitan Water District of Salt Lake & Sandy	2.6
Jordan Valley Water Conservancy District	2.52

Expected annual demand at ultimate development ranges from about 2.0 to 2.8 acre-ft per gross developable acre. The lower end of this range is associated primarily with development on the Wasatch back where lower population densities and greater open space are expected. More urban areas along the Wasatch Front all have demands closer to the higher end of the range.

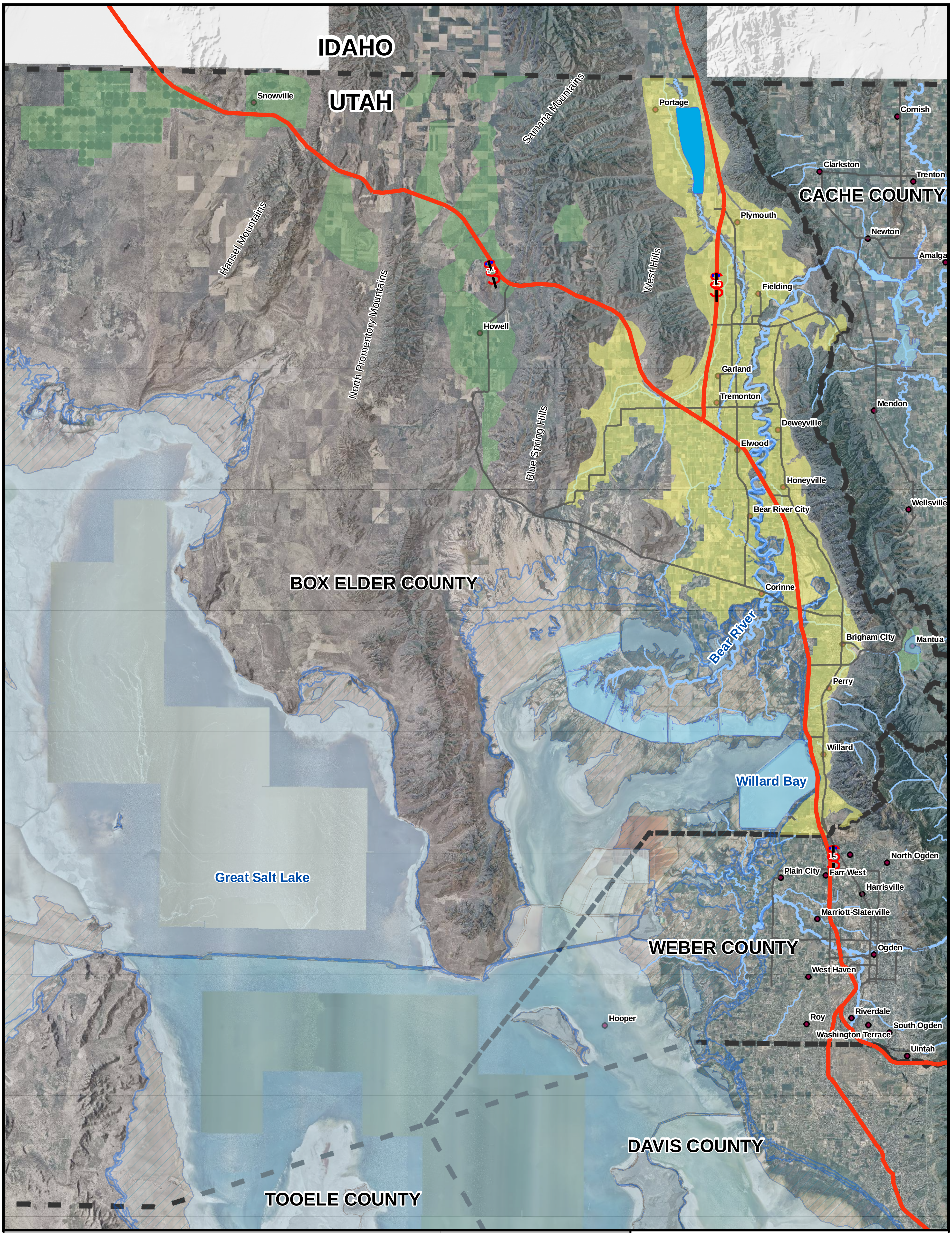
Based on the developable area in Box Elder County, this suggests that the ultimate water demand in Box Elder will fall within the ranges summarized in Table 2.

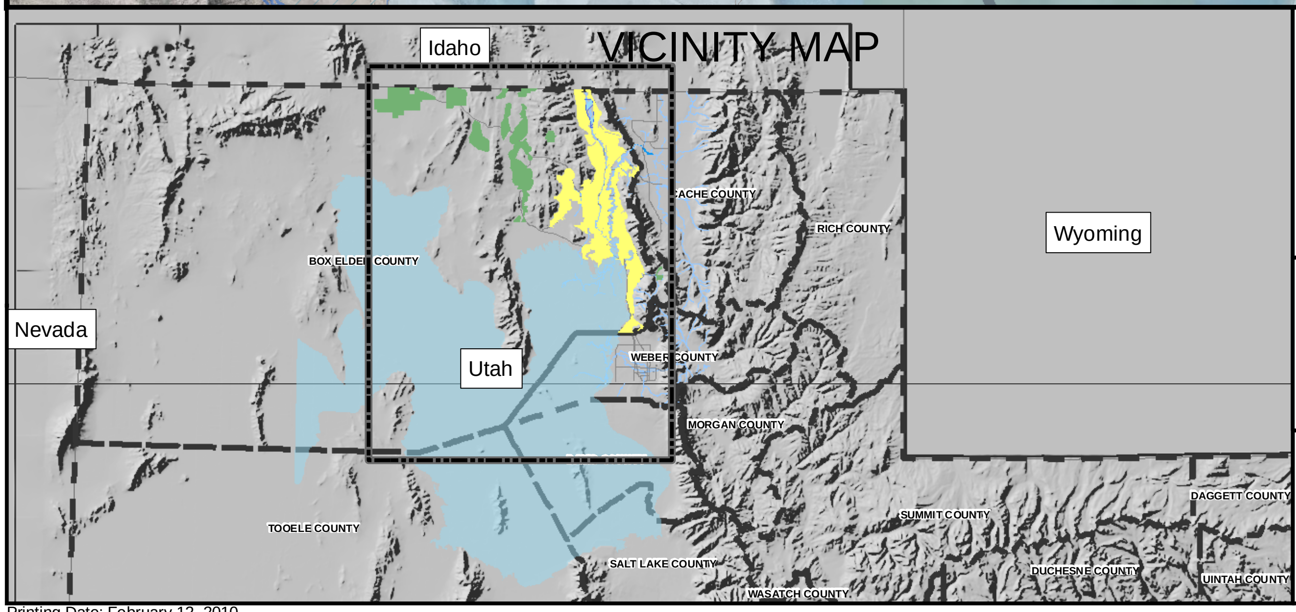
Table 2
Projected M&I Water Demand for Box Elder County at Ultimate Development

Area	Developable Area (acres)	Demand at Low End of Density[1] (acre-ft/yr)	Demand at High End of Density[2] (acre-ft/yr)
Bear River Service Area (Bear River Valley)	149,000	298,000	417,200
Areas Served by Other Water Sources	84,000	168,000	235,200
Total County	233,000	466,000	652,400

[1] 2.0 acre/ft per gross developable acre
[2] 2.8 acre/ft per gross developable acre

Within these ranges, it seems likely that the Bear River Valley will ultimately fall near the upper end of development density, while the other areas of the County will fall near the lower end of development density. If this is the case, the Bear River Valley will have a projected ultimate demand of 417,200 acre-ft/year and the rest of the county will have a total demand of 168,000 acre-ft/year for a total County demand of 585,200 acre-ft/year.





LEGEND

Developable Area

- Bear River Pipeline Service Area
- Other Areas
- County Boundaries
- Proposed Washakie Reservoir

2

0 3 6 12
Miles

Figure 1 - Developable Service Area

Bear River Pipeline Concept Report

State of Utah
Division of Water Resources

Bowen Collins & Associates, Inc.
CONSULTING ENGINEERS

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PART 4 – PUBLIC INVOLVEMENT PLAN

Public Involvement Plan

Bear River Pipeline Project

Prepared for:

State of Utah Division of Water Resources

December 2010 (Second Draft)

Table of Contents

Figures

Tables

Appendix

Abbreviations, Acronyms, and Short Terms

DWRe	Division of Water Resources
PIP	Public Involvement Plan
Pipeline	Bear River Pipeline
Pipeline area	General area of the Bear River Pipeline
Pipeline Project Team	Staff members from DWRe, Bowen Collins & Assoc. and HDR Engineering, Inc.

1.0 INTRODUCTION – PURPOSE OF THE DOCUMENT

This Public Involvement Plan (PIP) outlines the efforts to be undertaken to maximize participation by the public, interested groups, agency and elected officials in the completion of the Bear River Pipeline project in Box Elder and Weber Counties.

1.1 PROJECT OVERVIEW

The State of Utah Division of Water Resources (DWRe) was directed to begin a Concept Study and produce a Concept Report on the Bear River Pipeline project as part of the implementation of the Bear River Development Act (Act). The Act gives the DWRe the authority to divert water from the Bear River and deliver it to Box Elder, Cache, Weber, Davis, and Salt Lake Counties (Figure 1 – Study Area).

The Bear River's average annual inflow to the Great Salt Lake is over one million acre-feet, and the average surplus flow is approximately 275,000 acre-feet. The Bear River is one of the few rivers in the state where there is still a developable water supply. Up to 220,000 acre-feet of Utah's water rights on the Bear River will be developed for the communities in the service areas of the Bear River Water Conservancy District (BRWCD), Cache County, Weber Basin Water Conservancy District (WBWCD), and Jordan Valley Water Conservancy District (JVWCD). The overall development will consist of reservoir storage and conveyance facilities necessary to deliver water from the Bear River to the three participating water agencies and Cache County. The main conveyance facility will be the Bear River Pipeline.

Many preliminary studies were completed in support of the Act (see Chapter 2 for summaries of previous studies). Studies about a conveyance pipeline (Bear River Pipeline) were included. The main goal of this recent Concept Report is to identify a recommended alignment for the Bear River Pipeline from its source on the Bear River to the proposed Washakie Reservoir site and from the Washakie Reservoir to the proposed West Haven Water Treatment Plant (WTP).

The DWRe's Basin Plans and other water supply planning studies of the area indicate that future demand for water in Box Elder, Cache, Davis, Weber, and Salt Lake Counties will significantly exceed current and planned supplies within the next three decades. Planning for the development of major new water supplies requires many years, and even decades.

Additionally, as Weber and Box Elder Counties have grown over the last decade, the need to identify a route(s) for the Bear River Pipeline through these counties has intensified. Limited rights-of-way exist and many of those rights-of-way are being identified and planned for other utilities and uses. DWRe needs to begin to clearly identify the Bear River Pipeline route so that land may be preserved for the Pipeline and impacts to the community and the environment may be minimized (Figure 2 – Recommended Alignment).

The Concept Report will allow DWRe to prioritize and implement property acquisition planning activities. Information generated by the Concept Study and contained in the Concept Report will also provide DWRe with revised Pipeline project design criteria and project scope, a concept design, an updated project cost estimate, and a clear project development plan that includes public involvement, environmental permitting, and property acquisition.

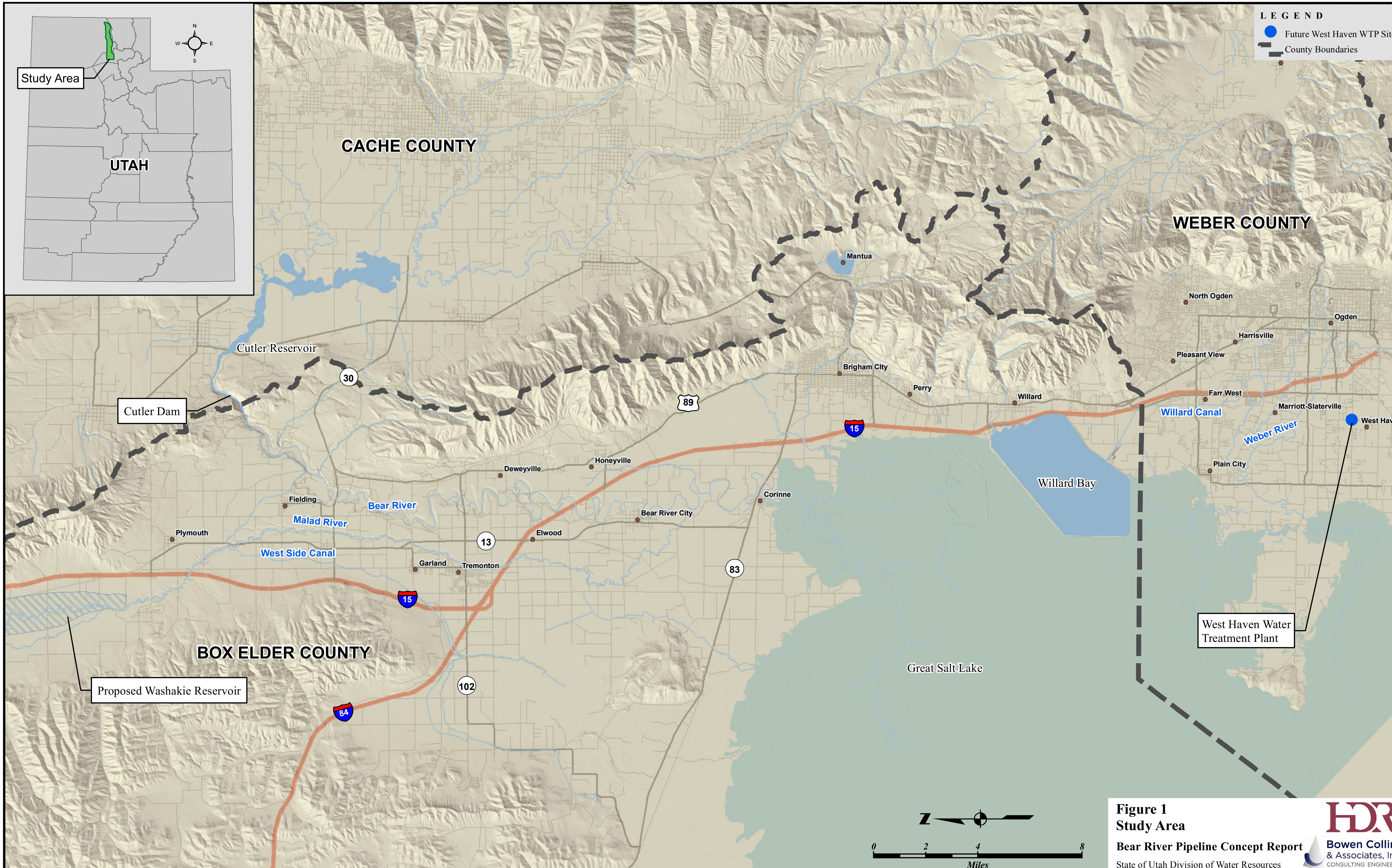

Figure 1
Study Area

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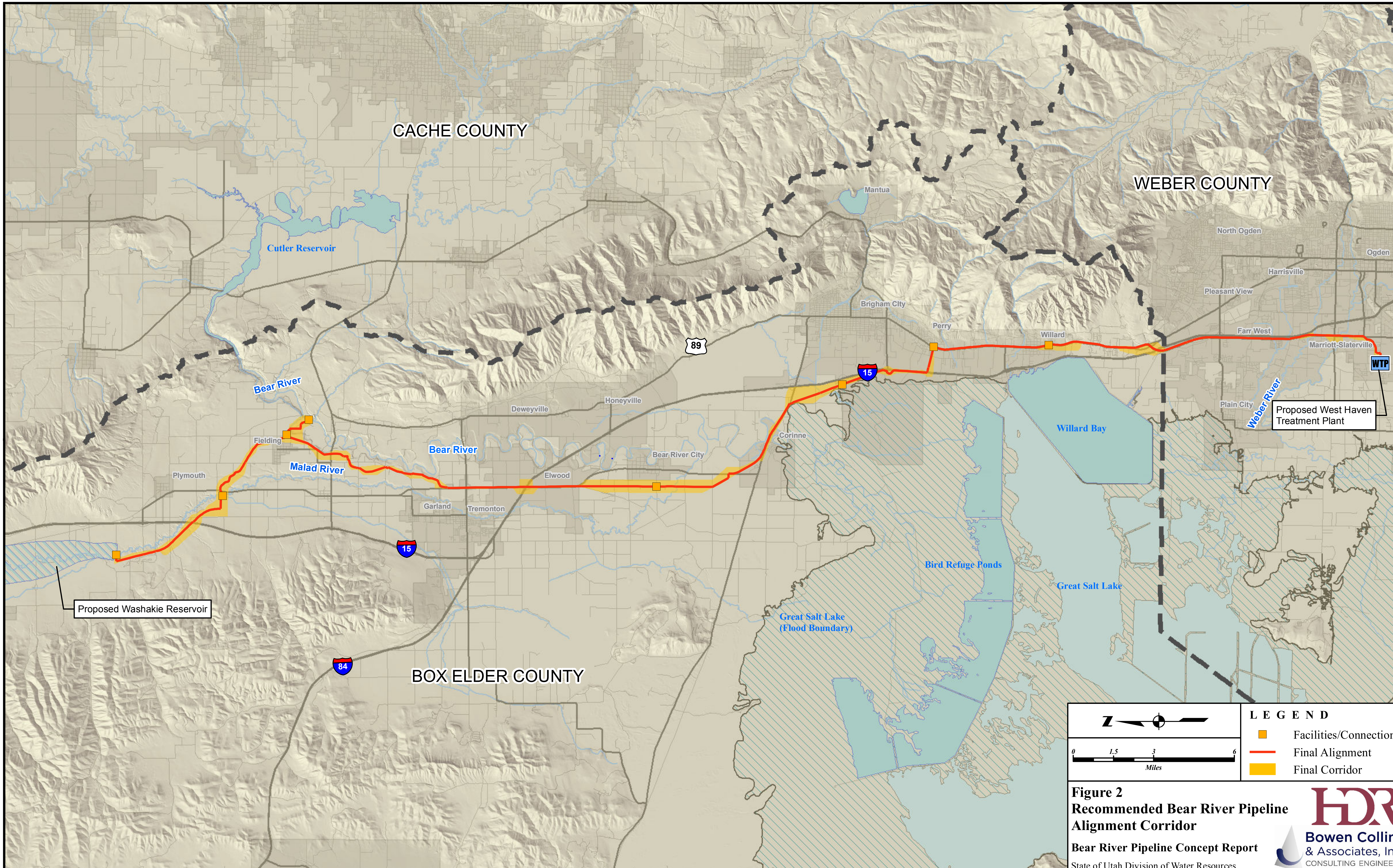

Figure 2
Recommended Bear River Pipeline Alignment Corridor

Bear River Pipeline Concept Report

State of Utah Division of Water Resources

HDR
Bowen Collins & Associates, Inc.
CONSULTING ENGINEERS

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1.2 PIPELINE PROJECT TEAM

A team of consultants from Bowen Collins and Associates and HDR Engineering, Inc. will carry out the Pipeline Concept Report project. This Pipeline Project Team has prepared this PIP and will apply the public involvement methods included in this plan. The key Pipeline Project Team contacts moving forward are listed in Table 1. It will be important to keep this information up-to-date as new members of the team are added. Refer to Chapter 5 for a list of Work Group members.

Table 1 Pipeline Project Team Contacts

Name	Role	Phone	Email
Eric Millis	DWRe	801.538.7298	ericmillis@utah.gov
Marisa Egbert	DWRe	801.538.7266	marisaegbert@utah.gov
Alana Spendlove	Public Information	801.743.7829	alana.spendlove@hdrinc.com
Steve Thurin	Water Distribution	425.468.1546	steven.thurin@hdrinc.com
Thayne Clark	Engineering	801.495.2224	tclark@bowencollins.com

2.0 PUBLIC INVOLVEMENT OBJECTIVES

It is very important during any planning process to have early and continuing opportunities for the public to be involved in the identification of alternatives and environmental impacts as a result of each alternative. This is an important project that will affect the economic development of the entire region. Thus, a strong PIP is needed to properly identify effective and useful ways to inform and engage the public.

Using the International Association of Public Participation's (IAP2) "Public Participation Spectrum" as a tool for measuring the level of public involvement appropriate for this project, the Pipeline Project Team proposes to conduct an "involved" level of public participation on this project. The main goal for this level of involvement is to work directly with the public throughout the process to ensure that the public concerns and suggestions are consistently understood and considered.

The primary objectives of this PIP are as follows:

- Establish a public involvement framework for informing the public on the status of the pipeline.
- Provide clear and concise information to the public.
- Ensure that the public understands their role in affecting the outcome of the project.

The primary goals of this PIP are to:

- Educate the public about the need and value of the Bear River Pipeline.
- Inform the public about the significance of Corridor Preservation.
- Minimize public conflict by providing appropriate and timely project information.

The major key messages for this project are:

- Meticulous planning for the project is necessary to support expected population growth and economic development in Box Elder, Weber, Cache, Davis, and Salt Lake Counties.
- Water is critical to meeting the needs of the growing population and economic development in Box Elder, Weber, Cache, Davis, and Salt Lake Counties.
- While the Bear River Pipeline is not needed right now, early planning is vital while potential corridors are still relatively unencumbered.
- Planning and preparation is needed for the Bear River Pipeline now when the costs of rights-of-way are likely lower than they may be in the future.
- Preparation is needed for the Bear River Pipeline before it is critically needed.
- Cache, Weber, Box Elder, Davis and Salt Lake Counties will use the water from the Bear River Pipeline.
- This is a long-term project. Current analysis indicates this pipeline is not needed for 20 years.

Prior Project Commitments:

- The basic parameters of the Bear River Pipeline are defined in the Bear River Development Act, enacted in 1991 and modified in 2000.

Bear River Pipeline Public Involvement History:

- The Pipeline does not have an extensive list of public involvement activities. Public meetings to discuss certain aspects of the project were conducted at the beginning of the Concept Study and are listed in Chapter 5 of the Concept Report.

3.0 PUBLIC INVOLVEMENT METHODS

This PIP addresses the need to effectively engage and receive input from three primary groups: (1) the general public, (2) agency and elected officials, and (3) stakeholder and interested groups. Reaching out to a variety of individuals and organizations should be included in any public involvement process. Stakeholders include individuals, permanent or ad hoc groups, business owners, and officials at all levels of government who have an interest or may be affected by a decision. To achieve this, a variety of methods will be used for the various target groups. Additional strategies may be used if desired.

3.1 GENERAL PUBLIC

Several methods, described below, will be employed to engage the general public in order to gather information and input regarding the Bear River Pipeline.

3.1.1 Build Project Awareness and Involve the Public

In order to build project awareness to the general public, the Pipeline Project Team will produce a project brochure. A draft version is included at the end of this report. The brochure will explain the purpose of the Bear River Pipeline project and will graphically display the study area and the recommended alignment. It will also describe the general project timeline and will provide contact information for further questions.

Other means of building awareness and involving the public are listed in Table 2. The methods in bold print in this table will be discussed in further detail.

Table 2. Public Involvement Methods

Method	**Method**
Paid advertisements	Mediation for opposition groups
Mailed letters/postcard	Individual interviews
Flyers (door-to-door)	Comment forms (website, meeting)
Posters	Brochure / Fact sheets
Email blast	Surveys (phone, mail, online)
Project Website	**Public meetings**
Local newspapers	Focus groups
Workshops	**Community Advisory Committees**
Interactive GIS corridor map	Maps
City outlets: newsletters, website, utility bills	Discussion panels
Grassroots campaign to foster accurate information word of mouth	Blogging
Presentations to community groups, HOA’s, Rotary Clubs, schools, etc.	Social media (Facebook, Twitter, etc.)
Information booths at community events	Visualization such as photo-simulation or illustration
Press releases / media relations	Information hotline
Technical reports and/or other information placed in city libraries and public buildings	Frequently Asked Questions (FAQ)

3.1.1.1 Project Website

A project website is a good way to reach people who might otherwise not participate in public meetings or other forms of public involvement. Websites also allow an agency to reach people across a large geographic area.

For these reasons, the Pipeline Project Team will use a website, housed within the main DWRe webpage, as another means of providing information to and gathering feedback from the public. The website will contain materials such as meeting dates, project updates, draft and final documents and other pertinent project information. All project materials provided to the public will have a link to this site. The site will also contain a contact section with information on how to be included on the project mailing list as well as contact information for the Pipeline Project Team. The website should be modified during the life of the project to include items such as: photos, interactive maps, videos, animations and comment forms.

Not everyone has access to the Internet; therefore, it is necessary for any web-based information to be accompanied by similar printed material that is available through other means.

3.1.1.2 Press Release / Media Relations

Media outreach is essential to involving the community in the project and attaining a high level of attendance at public information meetings. To achieve this, the Pipeline Project Team will do the following:

- Prepare and distribute two press releases (listed in Table 3). The first press release will announce the beginning of the Concept Study (previously completed) and the second will publicize the Concept Report completion and recommended alignment. The Pipeline Project Team may also choose to send out additional press releases as the project progresses into right-of-way acquisition, environmental studies, design and construction of the pipeline.

- Be available to media for consultation should the media desire to conduct a full story from a press release.

Table 3. Press Releases

No.	Date	Topics
1	June 2009	Concept Study Initiation
2	December 2010	Concept Report Completion

3.1.1.3 Public Meetings

Public meetings are a formal way to solicit input from members of a community. Concerns and important issues can be identified and discussed. Public meetings differ from other types of meetings in that they need to be formal and structured, involve open participation (there is no control over who attends since you are inviting the public), and can often address a variety of issues other than just the originally intended issue. When a public meeting is held in a community it is important for the individuals in charge of the meeting to make sure the appropriate issues are covered. However, it is also important to be aware of and address other related issues that come up during the meeting.

The Pipeline Project Team will hold one public information meeting at the completion of the Concept Report to discuss the report conclusions with the public and to announce the next steps in the Bear River Pipeline project. The Pipeline Project Team will hold the meeting at a location within the study area that maximizes the ability for interested groups to attend. It may be necessary to hold the meeting several times at multiple locations due to the size of the study area. The purpose of this meeting is to disseminate project information to the public. DWRe may choose to hold additional public meetings as the project progresses into design and construction. The schedule and topics for each public information meeting are included in Table 4.

Table 4. Public Information Meeting Schedule and Topics

Public Meeting No.	Timeframe	Topics
1	December 2010	Concept Study findings and schedule for the Bear River Pipeline project

3.1.1.4 Community Advisory Committees

A Community Advisory Committee (CAC) is comprised of a group of citizens assembled for a specific purpose. They may provide advice to a decision maker, develop a report or product, implement or supervise the implementation of a plan or action and serve as an important link to the community. Membership should be carefully selected and members' roles and responsibilities should be clarified at the onset of the committee. Members will meet regularly until their task is complete. A CAC can be used at any step in the decision-making process or throughout the entire process. A list of suggested participants is provided in Table 5.

Table 5. Community Advisory Committee (Suggested)

Committee Member Name	Representing Organization
Kevin Hamilton – Director	Box Elder County
Robert Scott – Planning	Weber County
Bob Fotheringham	Cache County
	Davis County
	Salt Lake County
Dan Davidson – Manager	Bear River Canal Company
Kathi Stopher	Bear River Bird Refuge
Bronson Smart	USDA Natural Resources Conservation Service

3.2 AGENCY AND ELECTED OFFICIALS

In addition to general public, it is necessary to continue to meet with agency representatives and elected officials from Box Elder, Weber, Cache, Davis, and Salt Lake Counties in order to define the specific data needed for future permitting efforts and associated mitigation strategies (see Chapter 5.2).

The participation from agency and elected officials is crucial to the success of the PIP. The Pipeline Project Team will obtain this participation primarily in two ways: establishing and maintaining correspondence with agency and elected officials; and by holding individual meetings with elected officials and other agencies as the project progresses. Important federal, state and local agencies that should be coordinated with are listed in Table 6.

Table 6. Agency Coordination Contacts

FEDERAL AGENCIES		
Name	**Title**	**Organization**
Bronson Smart	State Conservation Engineer	USDA Natural Resources Conservation Service
Jason Gipson	Chief, Intermountain Section	U.S. Army Corps of Engineers
Larry Crist	Field Supervisor	U.S. Fish and Wildlife Service
		Environmental Protection Agency
Glenn Carpenter	West Desert District Manager	Bureau of Land Management
Larry Walkoviak	Upper Co. Regional Director	Bureau of Reclamation
STATE AGENCIES		
Rex Harris	North District Engineer	Utah Department of Transportation, Region 1
Jim Karpowitz	Director	Utah Division of Wildlife Resources
Wilson Martin	State Historic Preservation Officer	Utah State Historical Society
Blain Hamp		Utah Division of Forestry, Fire and State Lands
LOCAL AGENCIES		
		Weber County
Dave Bunkerson	Public Works Director	Farr West Town
Gene Bingham	Public Works Director	Harrisville
Ken Martin	Irrigation	Marriott-Slaterville
Mel Blanchard	Public Works Director	North Ogden
Chuck Shurtliff	Water	Ogden
Mitch Wilson	Public Works	Plain City
Fred Hellstrom	Public Works	Pleasant View
Scott Venestra	Public Works Director	West Haven
		Box Elder County
Steve Warner	Engineering	Elwood Town
Troy McNeely	Public Works Director	Honeyville
Richard Nimori	Mayor	Corinne
Bruce Leonard	Public Works Director	Brigham City
Bud Knudsen	Water	Portage Town
		Plymouth Town
		Fielding Town
Mark Fryer	Public Works Director	Garland
Robert Thayne	Mayor	Deweyville Town
Neil Nelson	Mayor	Bear River City
Paul Nelson	Public Works Director	Perry
Paul Fulgham	Public Works Director	Tremonton
Gayleen Nebeker		Willard
		Cache County

The agency coordination process includes gathering input from state and federal agencies early in the development process and receiving input from those agencies at key points in the project.

3.3 STAKEHOLDER AND INTERESTED GROUPS

Although the primary focus of this PIP is to involve all members of the public, the Pipeline Project Team recognizes that key stakeholders and interested groups often have the most at stake during major projects and as a result require additional attention from a public involvement standpoint.

It is important to understand and identify all potentially affected or interested stakeholders. Stakeholder identification should be analyzed periodically over the life of the project. Table 7 lists the stakeholders that have been identified so far. Below are a few questions that are helpful when identifying potential stakeholders.

- Who are the internal and external stakeholders (including agencies) and how are they affected by the project?
  - Water conservancy districts
  - State and Federal agencies
  - Water users
  - Property/land owners
  - Local businesses
  - Local municipalities and counties

- How much do they know about the project?
  - City representatives are likely more aware of this project than the general public.
  - The public needs to be given fair notice of the study and opportunities for public participation.

- How does the public feel about the project?
  - Favor?
  - Disfavor?
  - Neutral?

Table 7. Key Stakeholders

Name	Title	Organization
Dan Davidson	Manager	Bear River Canal Company
Voneene Jorgensen	General Manager	Bear River Water Conservancy District
Mark Anderson	Assistant General Manager	Weber Basin Water Conservancy District
Bart Forsyth	Assistant General Manager	Jordan Valley Water Conservancy District
Bob Fotheringham	Water Manager	Cache County
		Bona Vista Water Improvement District
		Taylor-West Weber Water Improvement District
		Pineview Water Users
		Plain City Irrigation
		South Slaterville Irrigation
		Wilson Irrigation
		Hooper Irrigation
Scott Daniels	Political Chair	Sierra Club
Lynn de Freitas	Executive Director	Friends of the Great Salt Lake
Ted Wilson	Executive Director	Utah Rivers Council
Scott Baxter	President	Audubon Society
Kathi Stopher		Bear River Bird Refuge
Connely Baldwin		PacifiCorp
		Chevron Pipe Line Co.
Chad Jones	Communications Director	Questar
		Ruby NG Pipeline

3.4 PROJECT TIMELINE

Table 8 outlines the project activities over the next few years that may require associated Public Involvement.

Table 8. Public Involvement Timeline

Activity	Target Start Date
Complete Concept Report	November 2010
Hold a public meeting to announce the findings from the Concept Report	December 2010
Provide the project brochure	December 2010 through the next phase of the project
Create a project website	January 2011
Hold briefings for area developers, realtors, etc.	January 2011
Implement property acquisition planning activities	August 2011
Complete property acquisition activities	December 2023
Begin environmental process	2013 (Suggested), continue to update as property acquisition progresses
Begin design of the pipeline	January 2021 (Estimated)
Begin construction project	2025
Water Need Date	2035

4.0 DOCUMENTATION

4.1 MAILING LIST

The Pipeline Project Team will prepare a mailing list and will maintain it throughout the project. The list will include all interested or affected agencies, interested parties, and individuals commenting during public meetings or through the project website. The list will be used for distribution of public meeting announcements, new releases, other notices to the public and distribution of any other project related materials. Any interested parties can request to be added to the mailing list via the project website, at public information meetings or by contacting the Pipeline Project Team.

4.2 RESPONSES TO PUBLIC INQUIRIES

The Pipeline Project Team will likely receive public inquiries by a variety of means, including, but not limited to, public meeting comment forms, letters, e-mail, website contact, phone calls, and personal contacts with the public. The Pipeline Project Team will review and respond to these inquiries as necessary and will summarize and record these comments and responses in a spreadsheet.

5.0 PROGRAM MONITORING

This PIP will be reviewed periodically during the project to ensure all elements of the plan are working effectively to engage the target audience. Reviews will take place after each public and task work group meeting, and the plan will be adjusted based on information received at the meetings. The revisions may occur if it becomes evident that a particular interest group has not been engaged or as a result of poor attendance at meetings, indicating that a new approach to public involvement is needed.

BEAR RIVER PIPELINE PROJECT
STAKEHOLDER LIST

AFFILIATION	NAME
WEBER COUNTY	
Commission	Craig Dearden
	Ken Bischoff
	Jan Zogmaister
Planning	Robert Scott - Director
Engineering	
Farr West	
Engineering	Dave Bunkerson - Public Works Director
Harrisville	
Engineering	Gene Bingham - Public Works Director
Water - Culinary	Bona Vista
Mayor	Richard Hendricks
Marriott-Slaterville	
Engineering	Trent Mayerhoffer - Irrigation
Engineering	Ken Martin - Irrigation
Mayor	Keith Butler
Water - Culinary	Bona Vista
North Ogden	
City Administration	Ed Dickie
Community Development	Craig Barker - Director
Culinary Water Division	Bill Gross - Superintendent
Public Works	Mel Blanchard - Director
Ogden	
Engineering (Public Services)	
Water	Chuck Shurtliff or Craig Frisbee
Planning	Ron Atencio - Planning Commission
Community Development	Keith Morey - Director
Plain City	
Public Works	Mitch Wilson
Pine View Water	
Bona Vista Water	
Pleasant View	
Community Development	Bruce Talbot - Director
Public Works	Fred Hellstrom - Water Superintendent
Mayor	Doug Clifford
West Haven	
Public Works	Scott Venestra - Director
Planning	Steve Anderson - Engineer
Mayor	Brian Melaney
Hooper Water Improvement District	
Taylor-West Weber Water Improvement District	
Bona Vista Water Improvement District	
BOX ELDER COUNTY	
Commission	Brian Shaffer
	Jay Hardy
	Rich Vandyke
	Lorna Ravenberg
Community Development	Kevin Hamilton - Director
Engineering	Bill Gilson - Supervisor
Elwood (Box Elder Town)	
Engineering	Steve Warner - Water
Mayor	Lynn Hardy
Honeyville (Box Elder City)	
Engineering (Public Works)	Troy McNeely (Director)
Engineering (Water)	Dave Forsgren
Engineering (Streets) Mayor	Richie Aoki Ellen Cooh
Corinne (Box Elder City)	
Engineering	Richard Nimori - Mayor
Brigham City (Box Elder City)	
Public Works	Bruce Leonard - Director
Water Division	Rene Cedillo - Supervisor
Planning	Mark Bradley - City Planner
Community Development	Jared Johnson - Director
Portage (Box Elder Town)	
Water	Bud Knudsen
Planning	Jay Briscoe

BEAR RIVER PIPELINE PROJECT
STAKEHOLDER LIST

AFFILIATION	NAME
Plymouth (Box Elder Town)	
Engineering	**N/A**
Fielding (Box Elder Town)	
Engineering	**N/A**
Garland (Box Elder City)	
Engineering	Mark Fryer - Public Works Director
Planning	Arlon Bennett - Director
Mayor	Richard Owen
Deweyville (Box Elder Town)	
Engineering	
Mayor	Robert Thayne
Bear River City (Box Elder Town)	
Engineering	Neil Nelson - Mayor
Perry (Box Elder City)	
Engineering	Paul Nelson - Public Works Director
Planning	Rachael Tribe - Director
Tremonton (Box Elder City)	
Public Works	Paul Fulgham - Director
Water	Jon Miller
City Manager	Richard Woodworth
Willard (Box Elder City)	
Engineering	Gayleen Nebeker - Public Works Director
Planning	Jay Agular - Director
CACHE COUNTY	
Executive	Lynn Lemon
Water Department	Bob Fotheringham
Road Department	Darrell G. Erickson
Planning and Zoning	Lee Nelson
Cache County Council	Cory Yeates - Logan Seat #1
	H. Craig Petersen - Logan Seat #3
	S. Brian Chambers - Northeast District
	Gordon A. Zilles - Southeast District
	Kathy Robison - Logan Seat #2
	Craig "W" Buttars - North District
	Jon White - South District
OTHER	
Bear River Valley Chamber	Susan Thackeray
Bear River Canal Co.	Dan Davidson - Manager
Bear River Bird Refuge	Kathi Stopher
UDOT Reg 1	Rex Harris - N. Dist. Engineer
UTA	
PacifiCorp	Connely Baldwin
Questar	Chad Jones, Communications Director
Chevron Pipe Line Company	Joe Castaneda, Right of Way Specialist
Ruby NG Pipeline	Bill Healy, Project Manager
Utah League of Cities and Towns	
Utah Division of Wildlife Resources	Jim Karpowitz, Director
US Fish and Wildlife	Larry Crist, Field Supervisor for Ecological Services
Army Corps of Engineers	Jason Gibson, Chief, Intermountain Section
Natural Resources Conservation Service	Sylvia Gillen, State Conservationist
Utah State Historical Society	Wilson Martin, State Historic Preservation Officer
Bureau of Land Management	Glenn Carpenter, West Desert District Mgr.
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UT. Div. of Forestry, Fire, and State Lands	Blain Hamp
Sierra Club	Scott Daniels - Political Chair
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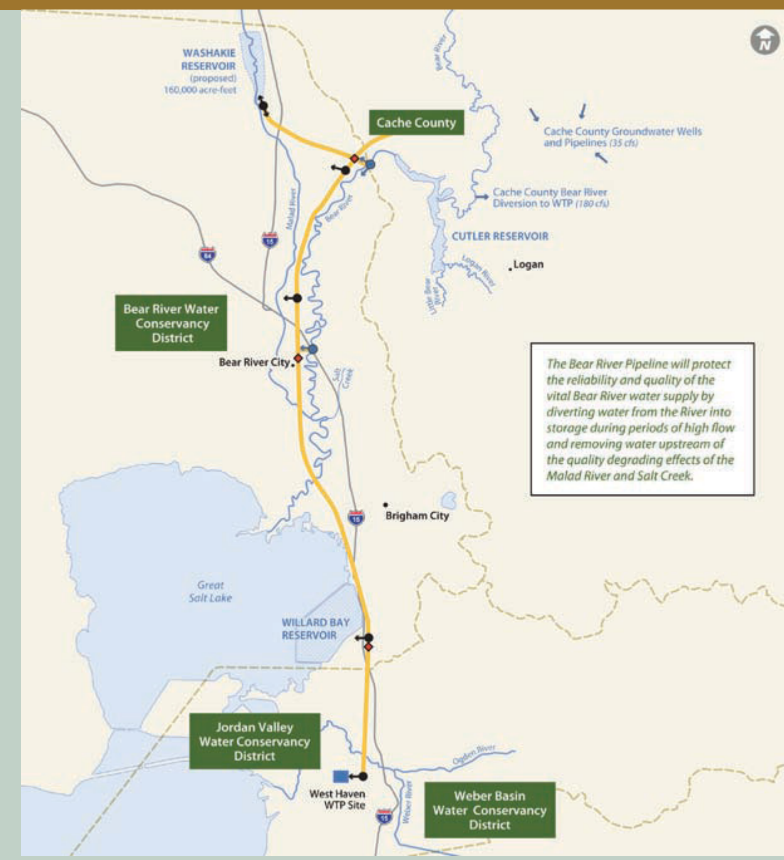
PART 5 – PUBLIC INVOLVEMENT BROCHURE

PROJECT SUMMARY

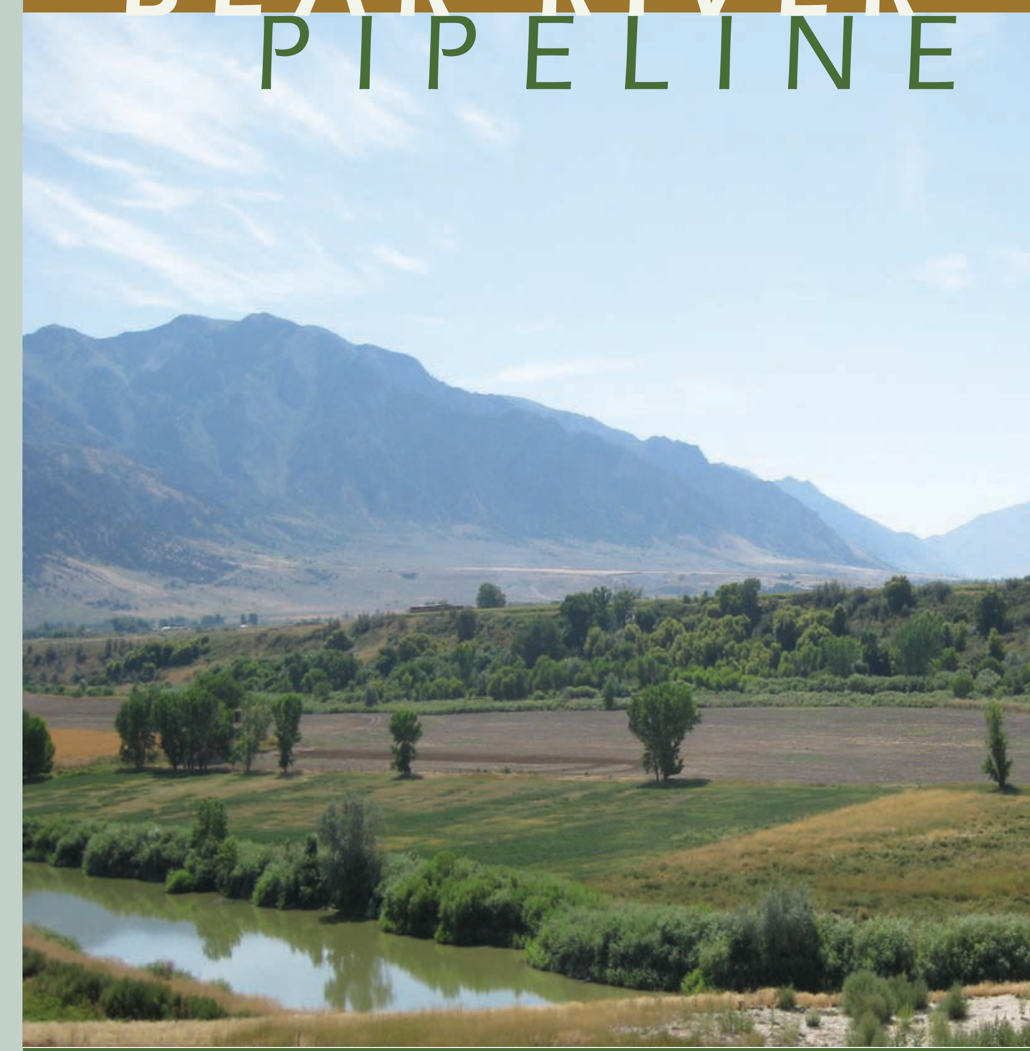
The State of Utah Division of Water Resources (DWRe) was directed to begin studies on the Bear River Pipeline Project as part of the implementation of the Bear River Development Act. The main goal of this Concept Study is to identify a recommended alignment for the Bear River Pipeline from its source on the Bear River to the proposed Washakie Reservoir site and from the Washakie Reservoir to the proposed West Haven Water Treatment Plant. The Project will divert water from the Bear River and deliver it to Box Elder, Cache, Weber, Davis, and Salt Lake counties. The Project will develop up to 220,000 acre-feet of Utah's water rights on the Bear River for the communities in the service areas of the Bear River Water Conservancy District, Cache County, the Weber Basin Water Conservancy District, and the Jordan Valley Water Conservancy District. The overall Project will consist of reservoir storage and conveyance facilities necessary to deliver water from the Bear River to the four participating water agencies.

As Weber and Box Elder counties have grown over the last decade, the need to identify the route(s) for water conveyance facilities has intensified. Limited rights-of-way exist and many of those rights-of-way are being identified and planned for other utilities and uses. DWRe needs to begin to clearly identify the pipeline route so that land may be preserved for the project, adverse impacts to the community and the environment may be minimized, and so the route may be combined with future utility, transportation, and recreational trail planning. This Concept Study allows DWRe to prioritize and implement property acquisition planning activities. Information generated by the Study also provides DWRe with revised Project design criteria and Project scope, a concept design, an updated Project cost estimate, and a clear Project development plan that includes public involvement, environmental permitting, and property acquisition.



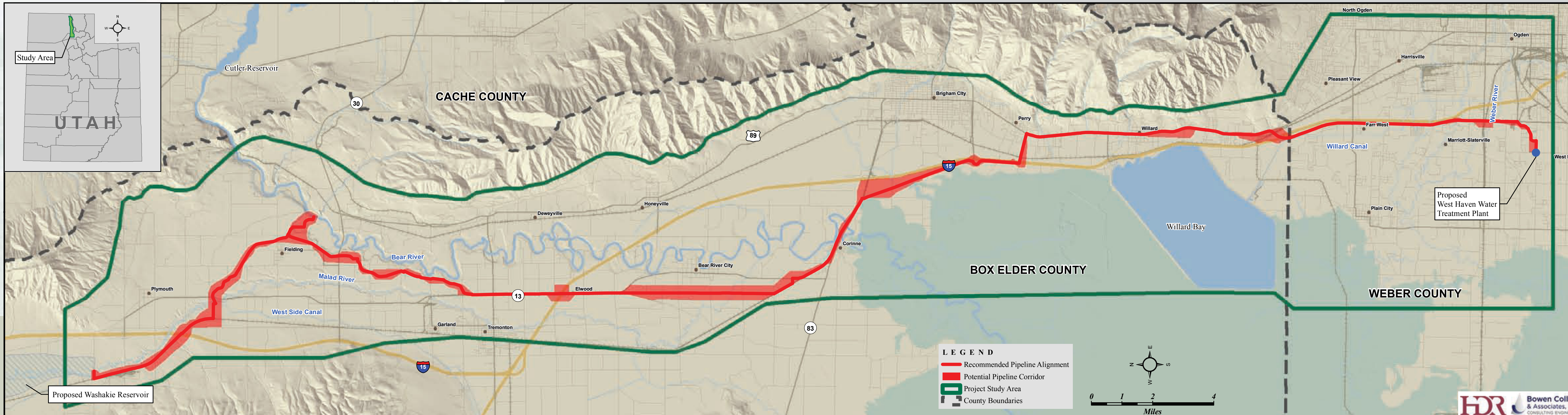
For more information please contact:
Marisa Egbert, P.E.
Utah Division of Water Resources
1594 W. North Temple , Suite 310 (84116), PO Box 146201
SLC, Utah 84114-6201
801-538-7266 (phone) 801-538-7279 (fax)
marisaegbert@utah.gov

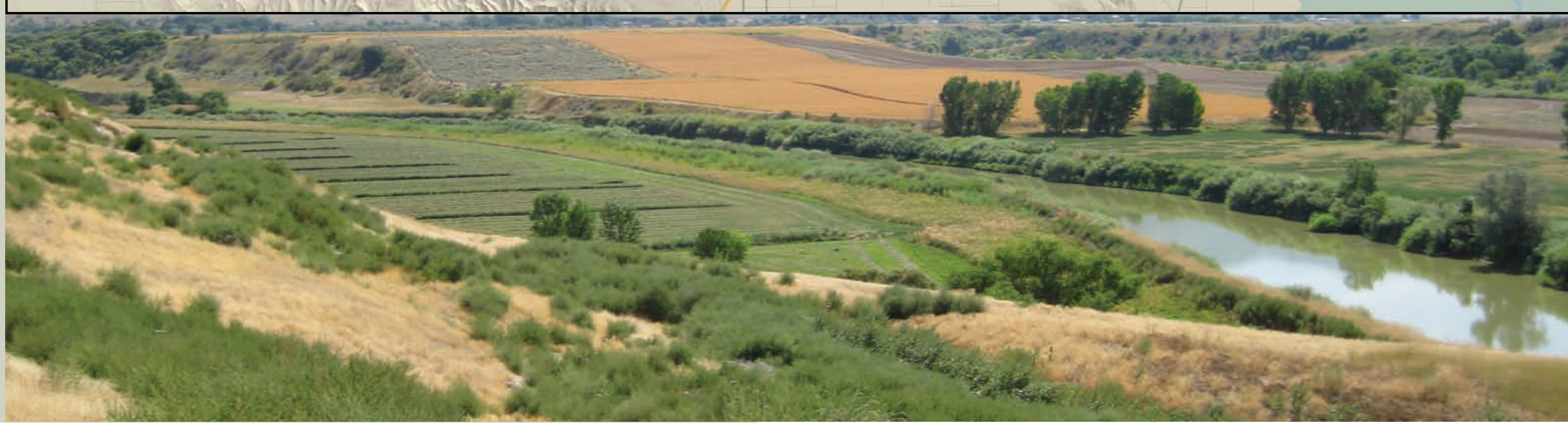
BEAR RIVER PIPELINE



STATE OF UTAH DIVISION OF WATER RESOURCES

STUDY AREA WITH RECOMMENDED ALIGNMENT





The DWRe has completed a Bear River Pipeline Concept Study as an initial evaluation of the engineering, environmental, and real estate issues associated with this part of the overall Bear River Project. One product of this Concept Study is the delineation of a Recommended Alignment for the Bear River Pipeline. The Recommended Alignment identified in this Study does not define the exact real estate parcels that must be acquired to complete the Bear River Project. Instead, the alignment will provide guidance to the DWRe as they work with local, state, and federal decision-makers and with local land-owners to develop water delivery points needed for these growing communities.

PART 6 – STAKEHOLDER LIST AND MEETING NOTES

BEAR RIVER PIPELINE PROJECT
STAKEHOLDER LIST

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Friends of the Great Salt Lake	Lynn de Freitas - Executive Dir.
Rivers Council	Ted Wilson - Executive Dir.
Audobon Society	Scott Baxter - President

BOWEN COLLINS & Associates, Inc.
Consulting Engineers

756 East 12200 South
Draper, UT 84020
Tel: (801) 495-2224
Fax: (801) 495-2225

MEETING NOTES

Meeting Date:	March 5, 2009	**Notes By:**	**Jason Luettinger**
Subject:	Bear River Kick Off Meeting	**Job No.:**	**233-09-01**
Attendees:	See attached list	**Location:**	

A kickoff meeting for the Bear River Pipeline Concept Study was held with the State Division of Water Resources (DNR) on March 5, 2009. Meeting attendees included representatives from the State DNR, Bowen Collins & Associates (BC&A), and HDR, Inc. (see attached attendees list). The purpose of this meeting was to introduce project team members, to review the project scope of work, and to discuss key issues related to the project. An agenda for the meeting is attached. The following is a summary of the key points of discussion.

Welcome and introductions

Meeting Purpose. The purpose of this meeting is to receive guidance from the Division on study issues and available data and to prepare for the Kick-off Meeting with the Bear River Work Group.

Review of project objective. The State of Utah Division of Water Resources (DWR) has been planning the Bear River project for more than 30 years. Many studies have been completed in support of the project. Water will be diverted from the Bear River and delivered to Box Elder, Weber, Davis and Salt Lake Counties. As Weber and Box Elder counties have grown over the last decade, the need to identify the route for the Bear River Pipeline has intensified. Limited rights-of-way exist and many of those right-of-ways are being identified and planned for other utilities. DWR needs to begin to identify the route so that land may be preserved for the project. The main goal of this study is to identify three possible routes for the Bear River pipeline from its diversion on the Bear River to the Slaterville Diversion on the Weber River. These three alternate routes will allow DWR to begin the environmental permitting process for selecting a final route and to prioritize property acquisition planning activities. Information generated by the study will also provide DWR an updated cost estimate and plan for the project.

Review of scope of services (We reviewed the scope of services)

Review of project schedule (attached)

May 1, 2010 completion
Consensus on general schedule

Communication (see attached contact list)

General Discussion

Bob Fotheringham– Cache County Representative
Need to identify how will project benefit Cache County?

JVWCD and MWDSLS have good idea of what they want already.

Need Kickoff Meeting with others. Concerns that Cache County be involved in this study. Make sure they are included

Perception is that all water moving to Weber and Salt Lake counties.

Public Information plan must address this perception.

Box Elder County may feel this way to a lesser degree.

Boundary of Bear River WCD encompass approximately Willard Bay to Cache County line.

Bob's (Cache County) position is new to the County. Some of his ideas may be beyond the scope of this study.

Washakie Reservoir – $1 billion estimate. Steve's perception is that this project offers little storage for a big price tag.

Bear River WCD Issues:

1. Way to deliver water to benefit of Box Elder County.
2. Interest in Public Information Meetings
3. Large turnouts to a Brigham City, Proctor and Gamble, others?

Communication plan – Public questions to be directed to the State. Same with work groups and stakeholders.

Bob is excited about project. Is there a mechanism for water exchange with Cache County? They will be concerned with how is Bear River water being used downstream.

“Crappy Bear River Water”. Need to address poor water quality concerns.

BCA requested copies of all past studies.

Project scope will easily creep if not managed closely. Group warned to be careful about side tangents. Use as much historic data as possible.

Kathy discussed ROW issues.

Need to establish criteria/goals
Work with Stakeholders
Work with property owners to acquire property where possible. Early property acquisition by state is at risk due to potential changes from environmental study.

Existing Mapping – State has nothing. Check with GIS manager. Eric Edgley – GIS Manager (801-538-7274)

Jason discussed network analysis program. Software developed for courier industry. Work closely with Thayne Clark and HDR ROW team. Develop model similar to POMA.

Mike question to State – Do we look at routing pipe directly into Willard Bay, then use canal from Willard to Slaterville?

Should project look at this? Yes. State would like to study this alternative.

WBWCD does not prefer this alternative because of water quality concerns, and perception that current project to increase capacity of Willard Bay may somehow be related to the Bear River Project, rather than Weber River water storage.

Water quality data is available from both the river and the reservoir.

Steve says there is not a strong technical reason not to use Williard Bay. Much of the issue appears to be political.

NEPA Concerns?

Concern that WBWCD is increasing the storage of Willard Bay (already planned) to store Bear River water instead of Weber River.

Environmental

We don't know the level of environmental study that will be required.
USCOE 404 permit is a guarantee.
Wetlands Impacts will be an issue.
Section 404B.I. states that the project must consider the least damaging practable alternative. This will tie in with the routing study data.

Questioned whether there is any way that the project will NOT require NEPA? Avoid federal money – all state funding?

Possibly only a USCOE permit will be required.
May end up developing a mini EA to get there anyway.

Better to assume that a full NEPA will be required from the start. Can't back up the process.

Environmental required before State can aquire property?
Can't use excuse that property has been acquired in order to define future project
"At risk" purchase at this early phase of the project.
Must be voluntary aqquisition.

No action alternative will be considered.

Other issues to be considered:
Climate change?
Population growth?
Cultural Resources?

WBWCD and JVWCD have both completed supply and demand studies.

State wants to encourage northern entitites to perform these studies as well.

Project Schedule:

Pushed back based upon late start. May 2010 completion?
Mike noted that project may slow down due to numerous stakeholders involvement.

Monthly Meetings will be scheduled.

Mike will send out communication contact list.

Existing Data?
State has an entire book shelf full of documentation.
Steve doesn't think there is much of use. Maybe some canal data.
Detailed study has never been completed on this project.

Steve was assigned to develop a list of data needs from State.

Look at canal companies.

Mapping – GIS
Kathy has access to tax assessor data.

State will allow us to work directly with staff on the DWRSIM model. Keep Mike and Gina in the loop.

Specific Project Issues:

Define Study Area
Must divert before Millard River

Washaki Reservoir?
Questions remain. Questioned whether reservoir site should be a feature in this project.

Length of additional pipe to Washaki Reservoir?
Brain storm evaluation to define benefit of extending pipeline this far north.

Willard Bay will eventually be part of the project.
Honeyville?
Beeton?

Northern boundary

- I-15
- Look further north to Washaki
- Quick cost benefit analysis is needed
- Convey through river to 1-15 crossing saves pipe

No major water quality concerns with river vs. pipe
More operational / environmental than water quality

Running pipe to Washaki would increase cost significantly.

Public relations concerns – New pump Station and intake may create questions about why a pipeline doesn't run north.

Property requirements for intake and pump station?
Mike says about 8 acres
Steve thinks that up to 50 acres may be required.
Depends upon intake design

Backing up water would require more land.
Intake may take every drop of water from river at times.

May complicate facility. Murdock diversion example – sizable pool required in river.

Look at different options for intake. Could be big or small impact.

Piggable Pipeline?

Boundaries:

- Slaterville on South
- Elevation limit on East
- Lake on West (Willard Bay open to alternatives. Make sure WBWCD is OK).
- 1-15 on North, may move down to Millard River with cusory look north to Washaki.

Honeyville & Beeton Reservoirs? Honeyville is closer to project. Beeton is north.

Don't want to talk about these two reservoirs in study.

Data needs: 1992 CH2M Hill study on reservoir sites.

Public Involvement – Need to develop a list of cities, counties, and companies, others. "Project Stakeholders".

Proactive defense plan from State? Consider an early press release to describe purpose of study, rather than reacting to press.

All stakeholders need to communicate the same message regarding the study. Develop a communicaiton plan for the project.

State to receive all phone calls.

Intake – Any limitations at Slaterville?
WBWCD Controls
Current diversion will not handle flows.

Slaterville to Water Treatment Plant – There is a gap in the pipeline that needs to be addressed.

Gap in alignment. Make sure that there will be no fatal flaws in the future.

Water can be transferred back to Willard Bay or straight to WTP.

Lowell half of project has been studied extensively. This project will study project to the north. Need to address the gap in between.

Water Quality discussion – Steve/HDR

350 mg/L TDS goal at JVWCD is unlikely to be achieved.

Treatment Options – lime softening or split stream desalination may be required to hit 350 mg/L with this water.

400-500 mg/l TDS typical at best. May get as low as 300+ mg/L during very high flows. Not typical.

Worst TDS as high as 2,000 mg/L.

Treatment is required to meet 350 mg/L goal. This message should be clear to water agencies.

Much of year, water is not available in Bear River to meet demands. Project requires storage or pipeline isn't useful. More storage needs than Washaki can provide.

Transfer reservoir somewhere along alignment may be considered.
May require additional land.
Engineering concept must include evaluation of reservoirs required to operate system.

WBWCD doesn't want to use Willard Bay.
Mindset used to be "no way". Hard stance may be changing, but must first get through enlargement project and not tie to Bear River water.

Cannot discuss using Willard Bay right now due to impact in perception on enlargement project today.

Willard should be considered. Talk to WBWCD about looking at this alternative.
WBWCD should be motivated since they will have to pay a portion of Bear River Project.

Easement Widths:
150 ‘ recommended
100’ permanent
50’ temporary.

Recreational combined use?
Starting from scratch on this issue. May provide a real benefit to the public. This is a positive feature of the project that should be included in the Public Information Plan.

Ownership of land versus easement is recommended by JVWCD.

Exchange of water to Cache county to be addressed.

Work Group Meeting

Set up date for work group meeting, April 13 at 1:00 p.m.

Develop a list of issues and assumptions requiring Work Group consensus

- Generalized alignment alternatives
- Design and operational assumptions and results (pipeline capacity requirements, project operations, water quality goals
- BRWCD and Cache County water needs (strategize water exchange/delivery options and opportunities).

Set date for next regular progress meeting

Set date for 2nd progress meeting – April 30th at 9am.

State of Utah Division of Water Resources
Bear River Pipeline Project
Kickoff Meeting

March 31, 2009

Discussion Items

1. **Review of project objective.** The State of Utah Division of Water Resources (DWR) has been planning the Bear River project for more than 30 years. Many studies have been completed in support of the project. Water will be diverted from the Bear River and delivered to Box Elder, Weber, Davis and Salt Lake Counties. As Weber and Box Elder counties have grown over the last decade, the need to identify the route for the Bear River Pipeline has intensified. Limited rights-of-way exist and many of those right-of-ways are being identified and planned for other utilities. DWR needs to begin to identify the route so that land may be preserved for the project. The main goal of this study is to identify three possible routes for the Bear River pipeline from its diversion on the Bear River to the Slaterville Diversion on the Weber River. These three alternate routes will allow DWR to begin the environmental permitting process for selecting a final route and to prioritize property acquisition planning activities. Information generated by the study will also provide DWR an updated cost estimate and plan for the project.

2. **Review of scope of services (attached)**

3. **Review of project schedule (attached)**
   a. May 1, 2010 completion?
   b. Consensus on general schedule

4. **Communication (see attached contact list)**

5. **Data Needs**
   a. Reports and background data of State of Utah

6. **Specific Project Issues**
   a. Project study area, definition of starting and ending points in alignment (attached map)
   b. Consensus on generalized alignment alternatives
   c. Review the BC&A Team's initial ideas concerning project alternatives and Public Involvement approach
   d. Develop an understanding of public involvement process and timing
   e. Intake location(s) and discharge requirements and location(s)
   f. Water Quality from the river probably won't come close to meeting JVWCD or WBWCD standards, should we study mitigation
   g. There isn't enough water in the river during much of the year to meet the project demands without a large terminal storage reservoir
   h. WBWCD doesn't want to assume any use of Willard Bay
   i. A 400 cfs pipeline could require 150 feet of easement, standards for width?
   j. How to connect the pipeline to the treatment plant?

k. How to get firm water up to Cache County?
l. Environmental issues

7. Work Group Meeting

a. Set up date for work group meeting
b. Develop a list of issues and assumptions requiring Work Group consensus
    i. Generalized alignment alternatives
    ii. Design and operational assumptions and results (pipeline capacity requirements, project operations, water quality goals
    iii. BRWCD and Cache County water needs (strategize water exchange/delivery options and opportunities).

8. Upcoming Meetings

a. Work group meeting, April 13 at 1:00 p.m.
b. Next progress meeting – April 30th at 9am.

Concept Report for the Bear River Pipeline
State of Utah-Division of Water Resources

Agenda
Box Elder County
Stakeholder Kickoff Meeting
April 13, 2009

1. **Welcome and introductions**

2. **Meeting Purpose.** The purpose of this meeting is to convey to Box Elder County stakeholders the purpose of the Bear River Pipeline Concept Report Study and receive guidance and input.

3. **Review of project objective.** The State of Utah Division of Water Resources (DWR) has been planning the Bear River project for more than 30 years. Many studies have been completed in support of the project. Water will be diverted from the Bear River and delivered to Box Elder, Weber, Davis and Salt Lake Counties. As Weber and Box Elder counties have grown over the last decade, the need to identify the route for the Bear River Pipeline has intensified. Limited rights-of-way exist and many of those right-of-ways are being identified and planned for other utilities. DWR needs to begin to identify the route so that land may be preserved for the project. The main goal of this study is to identify three possible routes for the Bear River pipeline from its diversion on the Bear River to the West Haven Water Treatment Plant. These three alternate routes will allow DWR to begin the environmental permitting process for selecting a final route and to prioritize property acquisition planning activities. Information generated by the study will also provide DWR an updated cost estimate and plan for the project.

4. **Review of scope of services**

5. **Review of project schedule**
    a. May 1, 2010 completion

6. **Communication**

7. **Specific Project Issues**
    a. Project study area
    b. Public Involvement approach and draft news release
    c. Box Elder County water needs (strategize water exchange/delivery options and opportunities).
    d. Water deliveries along the pipeline
    e. Environmental issues

8. **Questions?**

Concept Report for the Bear River Pipeline
State of Utah-Division of Water Resources

Agenda
Cache County
Stakeholder Kickoff Meeting
April 13, 2009

1. **Welcome and introductions**

2. **Meeting Purpose.** The purpose of this meeting is to convey to Cache County stakeholders the purpose of the Bear River Pipeline Concept Report Study and receive guidance and input.

3. **Review of project objective.** The State of Utah Division of Water Resources (DWR) has been planning the Bear River project for more than 30 years. Many studies have been completed in support of the project. Water will be diverted from the Bear River and delivered to Box Elder, Weber, Davis and Salt Lake Counties. As Weber and Box Elder counties have grown over the last decade, the need to identify the route for the Bear River Pipeline has intensified. Limited rights-of-way exist and many of those right-of-ways are being identified and planned for other utilities. DWR needs to begin to identify the route so that land may be preserved for the project. The main goal of this study is to identify three possible routes for the Bear River pipeline from its diversion on the Bear River to the West Haven Water Treatment Plant. These three alternate routes will allow DWR to begin the environmental permitting process for selecting a final route and to prioritize property acquisition planning activities. Information generated by the study will also provide DWR an updated cost estimate and plan for the project.

4. **Review of scope of services**

5. **Review of project schedule**
    a. May 1, 2010 completion

6. **Communication**

7. **Specific Project Issues**
    a. Project study area
    b. Public Involvement approach and draft news release
    c. Cache County water needs (strategize water exchange/delivery options and opportunities).
    d. Environmental issues

8. **Questions?**

Concept Report for the Bear River Pipeline
State of Utah-Division of Water Resources

Meeting Notes
Stakeholder Kickoff Meeting
April 13, 2009

1. **Welcome and introductions**
   The following were in attendance:

Eric Millis/DWRe	Gina Hirst/DWRe	Marisa Egbert/DWRe
Richard Bay/JVWCD	Bart Forsyth/JVWCD	Tage Flint/WBWCD
Mark Anderson/WBWCD	Scott Paxman/WBWCD	Terry Hickman/BC&A
Voneene Jorgensen/BRWCD	Bob Fotheringham/Cache County	
Mike Collins/BC&A	Craig Bagley/BC&A	Terry Warner/HDR
Steve Thurin/HDR	Kathi Thompson/HDR	

2. **Meeting Purpose.** The purpose of this meeting was to receive guidance and input from the stakeholders on the Bear River Pipeline Concept Report.

3. **Review of project objective.** The State of Utah Division of Water Resources (DWR) has been planning the Bear River project for more than 30 years. Many studies have been completed in support of the project. Water will be diverted from the Bear River and delivered to Box Elder, Weber, Davis and Salt Lake Counties. As Weber and Box Elder counties have grown over the last decade, the need to identify the route for the Bear River Pipeline has intensified. Limited rights-of-way exist and many of those right-of-ways are being identified and planned for other utilities. DWR needs to begin to identify the route so that land may be preserved for the project. The main goal of this study is to identify three possible routes for the Bear River pipeline from its diversion on the Bear River to the Slaterville Diversion on the Weber River. These three alternate routes will allow DWR to begin the environmental permitting process for selecting a final route and to prioritize property acquisition planning activities. Information generated by the study will also provide DWR an updated cost estimate and plan for the project.

4. **The project scope of services was reviewed**

5. **Project schedule**
   a. Estimated May 1, 2010 completion

6. **Communication (see attached contact list)**

7. **Specific Project Issues**
   a. **The limits of the study area were discussed**. A map was provided that showed the starting and ending points as they were defined in the State's Request for Proposal. The scoped starting point is where the Bear River crosses I-15. The scoped ending point is currently the Slaterville Diversion. After some discussion, the group expressed interest in expanding the limits of the

study upstream to a connection to an upstream reservoir (could assume Washakie) and downstream to the proposed West Haven Water Treatment Plant site.

The potential need to provide raw water storage in the system was discussed. JVWCD indicated that they have about 70 acres available on future plant site for a raw water storage facility.

WBWCD indicated that they have an existing federal easement/right-of-way between the Slaterville Diversion and the West Haven WTP site associated with an existing canal. That easement could possibly be used for a new pipeline.

It was mentioned that the pipe should not terminate in a river or canal.

Eric Millis stated that this study should meet the needs of all the Stakeholders.

Information on the proposed West Haven WTP can be obtained from Mark Anderson and Bart Forsyth.

Bob Fatheringham expressed interest in getting Bear River water from the project into Cache County. One potential method would be to get project water into the Bear River Canal and exchange water that the canal is currently using an transfer it to Cache County. This may require a pipeline and pumping facilities. Dan Davidson/Bear River Canal Company can be contacted to get information on that canal system.

b. **Upstream storage impact on our project**

   i. Connections. The Stakeholders expressed a desire for the project to provide turnouts at Slaterville, Willard, and a couple of locations in Box Elder County. It was mentioned that Pineview Water Systems is currently preparing a water master plan of the South Willard area.

   ii. Sizing of conduit. The State needs to provide information on the design discharge for the Bear River Pipeline. In addition, the Stakeholders mentioned their preference to purchase right-of-way for the pipeline rather than acquire easements. That approach is probably cheaper and easier over the life of the project and helps avoid a lot of property issues.

c. **Potential Utilization of Willard Bay.** It was mentioned that Pineview Water Systems is interested in purchasing water from Willard Bay. Tage mentioned that it might be feasible to put water in one side of the bay and take it out of the other as long as there is a way that water can be bypassed around that facility. It was mentioned that the bay is probably too shallow to place a large pipe through it. Any work to modify existing Willard Bay facilities would require meeting a lot of federal requirements. WBWCD is interested in storing and utilizing more water from the Ogden and Weber Rivers, not the Bear River (primarily due to water quality).

d. **Generalized pipeline alignment alternatives were briefly discussed.** The consultants are looking at potential alignments along an existing railroad, along the I-15 corridor, and along existing canal corridors. They were also going to investigate whether a corridor on a quad map called out at "abandoned railroad" is available.

e. **Public Involvement approach and draft news release.** The group reviewed a draft news release prepared by Gina Hirst. Regarding public involvement, the Stakeholders thought that 2 levels of public relations should be utilized. The first level should include community leaders so that they know what is going on. Voneene reported that there are a lot of unhappy people in Box Elder County because of how recent power and gas projects that required right-of-way were handled. It was suggested that we ask community (cities and counties) officials how to potentially involve private property owners and citizens in this planning process. It was also suggested that the planning group meet with community officials one-on-one with representatives from either BRWCD or WBWCD present. Terry Hickman also mentioned that we need to be careful no to pre-judge the NEPA process before putting anything on paper. It was decided that it was best to do the work associated with this project with the knowledge and concurrence of the communities and associated water districts. The meetings with community representatives could be held at the offices of the associated water conservancy districts.

f. **Bear River Water Quality Issues.** JVWCD or WBWCD expressed their desire to keep TDS below 300 mg/l. At times, the TDS concentration may go up to 400 mg/l. Some type of treatment may be required to mitigate water quality issues. Addressing taste, odor, and aesthetic water issues will be important.

g. **Easement width recommendations.** The Stakeholders recommended a minimum permanent right-of-way width of 100 feet and acquiring property for staging and storage areas every mile or two. The preference would be to purchase the property where possible. Excess property could be sold after the project has been constructed.

h. **BRWCD and Cache County water needs.** The consultants should coordinate with these two agencies to coordinate and learn of their long-term needs for M&I and agricultural water. Cache County suggested that they may look at some Aquifer Storage and Recovery Projects as on way of utilizing Bear River Water.

i. **Design and operational assumptions and results.** The Stakeholders will need to provide BC&A with information regarding pipeline capacity requirements, project operations, water quality goals. BC&A/HDR will need to review data from the State's Bear River watershed model to determine when and how much water is available. JVWCD is planning on utilizing 105 MGD of Bear River Water. The West Haven WTP could possibly be a 210 MGD facility.

j. **Environmental issues.** The first thing in addressing environmental issues will be to document the need for the project. It will also be important to identify alternative means to meet that need. Since this project will likely be constructed in the future, it is possible that there may be some future federal regulations or issues that do not currently exist with which we must comply.

8. Stakeholders Issues

a. Cache County
   i. Would like to see the pipeline extended north
   ii. Wants to meet with the consultants, BRWCD, and the Bear River Canal Company when those coordination meetings occur
   iii. Interested in discussing regulatory storage for the project

b. Bear River Water Conservancy District
   i. Want to consider options that take the Bear River pipeline north to the proposed Washakie Reservoir site, or some other storage facility
   ii. Wants locations of future turnouts in Box Elder County identified
   iii. Want to begin making plans to utilize Bear River water
   iv. Project team needs to be sensitive to easement/right-of-way issues that existing in Box Elder County
   v. This project is important to meet the projected growth demands of Box Elder County

c. Weber Basin Water Conservancy District (Primary contact: Mark Anderson)
   i. Provide turnouts for each entity
   ii. Make sure this project is completed in accordance with the language in the RFP, as it contained language and requirements from the Bureau of Reclamation.

d. Jordan Valley Water Conservancy District (Primary contact: Bart Forsyth)
   i. Acquisition of right-of-way for the pipeline. Purchase the property that will be needed.

e. State of Utah
   i. Ensure that this project meets the needs of the major Stakeholders.

9. Set date for next regular progress meeting: June 2, 2009 at 1:00 PM

Concept Report for the Bear River Pipeline
State of Utah-Division of Water Resources

Meeting Notes
Progress Meeting
April 30, 2009

1. **Stakeholders Meeting on April 13**
    a. Public news release. ***Gina will send Mike Collins the latest version*** and we will distribute it to the stakeholders for the input and attempt to finalize it. Will ask them for their further thoughts on when to distribute.
    b. Discussed the fact the Box Elder County and Cache County want the study extended north. They feel like they are not getting their project needs addressed with the existing study area.

2. **Meeting with Jordan Valley Water Conservancy District on West Haven WTP**
    a. Discussion of planning by JVWCD/WBWCD on their West Haven WTP. They have given us a map showing their land purchases and a preliminary layout of the treatment plan facilities. This is all of the work that they have done on the site.

3. **Setting up meeting with Box Elder and Weber County Officials**
    a. The date for our meeting with the Box Elder County mayors has been delayed, ***Gina will follow-up with Voneene/BRWCD and DWR staff*** and set up a time for the meeting.
    b. ***Mike Collins will talk to Tage Flint/WBWCD and get his input on*** getting a similar meeting set up with Weber County.
    c. Packet for Meetings with Box Elder and Weber County officials. ***Gina asked that we prepare a project summary packet for use in our meetings with officials. Mike Collins will prepare a draft*** and distribute it to the group for review.

4. **Data gathering.**
    a. Steve discussed past reports that have been gathered and that they will be scanned and distributed to the project staff.
    b. He also handed out an initial draft of a stakeholder list. ***Steve will send this list out to the larger project group including the stakeholders to*** get their input.
    c. Steve would like Gina to talk to David Coles about getting him to work with us on the operational model for the Bear River. *Gina will talk to David about working with us.*

5. **Contract Amendment for Addition of Study Area Based on Stakeholder Meeting**
    a. Discussed $330,000 contract amendment request to extend study north and south. Gina is working on it with staff and the BOWR but will not know a final answer until June 12, the BOWR meeting.

b. Discussed that we are basically in a holding pattern until this decision is made because we do not want to do any major field work or engineering work until this is decided so we can do the whole reach at once.
c. ***Steve Thurin will develop draft pros/cons for doing this additional work*** and distribute it to the project team for their input. Gina can then use this with the BOWR.
d. Gina asked how much the amendment request would be without right of way. Mike Collins stated that it would be approximately $215,000 with only engineering and environmental.

6. Invoices

a. ***Gina asked that we submit HDR's invoices with ours and also breakdown our project work by tasks. Mike Collins said that he would do this.***

7. Set date for next regular progress meeting

a. June 16, 2009, 9:00 a.m. at DWR

Concept Report for the Bear River Pipeline

State of Utah-Division of Water Resources

Meeting Notes

Stakeholder Progress Meeting

June 2, 2009

1. **Welcome and Introductions**
   The following were in attendance:

Dennis Strong/DWRe	Eric Millis/DWRe	Gina Hurst/DWRe
Marisa Egbert/DWRe	Bart Forsyth/JVWCD	Scott Paxman/WBWCD
Darren Hess/WBWCD	Voneene Jorgensen/BRWCD	Whitney Gardner/Cache Co.
Dewayne Jensen/Carollo	Steve Thurin/HDR `	Mike Collins/BC&A
Terry Hickman/BC&A		

   Whitney Gardner was attending for Bob Fotheringham (Cache County)

2. **Meeting Purpose.** Provide primary Stakeholders (DWRe, JVWCD, WBWCD, BRWCD and Cache County) with progress made since our last Stakeholders meeting on April 13, 2009.

3. **Cache County Council Meeting Summary.** Eric, Gina, Steve, Mike and Terry attended the Cache County Council Meeting on May 26, 2009. Eric and Mike gave a brief presentation on the scope of the Project. A summary of the Project and maps were handed out to the County Council and the audience. Members of the Cache County Council (list of these members was attached to the June 2nd meeting agenda) expressed support for the Project. They saw a need for high water to be captured before it goes to the Great Salt Lake. They indicated that a storage facility will be an integral component of the project. They wanted to know how Cache County would directly benefit from the Project.

4. **Box Elder County Meeting.** Voneene invited public officials and representative of Box Elder County irrigation companies to a Project information meeting held in the BRWCD Logan offices (a list of attendees was attached to the June 2 agenda). Eric, Gina, Marisa, Steve, Mike and Terry attended the meeting. Eric, Gina and Mike made a presentation of the Project scope to the group. Major concerns were expressed that the pipeline (or boundaries of the Project study area) be extended north to the proposed Washakie Reservoir site. They were concerned that the water was going south without a storage facility being proposed. The concern was that the water would not stay in Box Elder County and they wanted to make sure that a portion of the water be held upstream of the current proposed northern limits of the Project study.

5. **Status of Extending Study Limits.** Voneene gave a report on the Box Elder County Meeting. Again, expressing concern that the scope of the study, at some point, include the area between the proposed Washakie Reservoir and current study boundary. She also indicated that some feel that the purpose of the Project was to provide water to people south of Box Elder County. Dennis expressed his thoughts that the concern of taking the pipeline study north of the present scope is a question of money and need; Cache and Box Elder Counties do not need the water now but Counties to the south do. Dennis felt that some people in Box Elder County may not fully understand the concept of water exchange. However, he understands that the exchange story does not work unless you have a storage facility and that would probably be Willard Bay. Dennis acknowledged, that politically, Willard Bay can't be proposed as part of the Bear River Pipeline Study at this time. Dennis realizes that the Project scope, as currently proposed, is not complete. He suggested that we should probably extend the scope north to the proposed Washakie Reservoir site. Eric asked Mike how he came up with the dollar figures to take the scope of the study to the proposed Washakie Reservoir site. Mike used the same calculations he used for ROW, Engineering, and Environmental analysis that was used on the current scope.

6. **Study Progress.** Steve gave an update on the State water model. He said that it is being updated from a monthly to a daily time step model. The model depicts how water can be delivered to each of the users. You can figure out where water is going and how to get it there. The model may have utility in trying to figure out the exchange issue with Box Elder and Cache Counties. Steve indicated that with storage, you can develop 220,000 af of water. However, you will need more storage than is planned for the proposed Washakie Reservoir.

7. **Next Meeting Date.** August 18, 2009 at 1:30 PM and DNR.

Concept Report for the Bear River Pipeline
State of Utah-Division of Water Resources

Agenda
Stakeholder Progress Meeting
June 2, 2009

1. **Welcome and introductions**

2. **Cache County Meeting Summary**

3. **Box Elder County Meeting Summary**

4. **Status of Extending Study Limits**

5. **Study Progress**

    a. Mapping
    b. Data gathering
    c. State water model

6. **Set date for next regular progress meeting**

Concept Report for the Bear River Pipeline
State of Utah-Division of Water Resources

Agenda
Stakeholder Progress Meeting
August 5, 2009

1. **Welcome and introductions**

2. **Weber County meeting summary**

3. **Study limits**

4. **Study progress**

    a. Mapping (handout)
    b. Project approach (handout)
    c. Data gathering
    d. Project tour
    e. State water model (discussion on preliminary results)

5. **Set date for next regular progress meeting**

Concept Report for the Bear River Pipeline
State of Utah-Division of Water Resources

Meeting Notes
Stakeholder Progress Meeting
August 5, 2009

1. **Attendees:**
    a. Gina Hurst
    b. Marisa Egbert
    c. Eric Millis
    d. Mike Collins
    e. Steve Thurin
    f. Voneene Jorgensen
    g. Bart Forsyth
    h. Bob Fotheringham
    i. Tage Flint
    j. Scott Paxman
    k. Mark Anderson

2. **Weber County meeting summary**
    a. The Weber County commission did not meet with us because of conflict (at the last minute). The meeting is rescheduled for August 25 at 8:00 a.m. at the Weber County Courthouse.

3. **Box Elder County Mayors**
    a. We have scheduled a meeting with the Mayors of Box Elder County for August 19 at 7:00 p.m.

4. **Study limits**
    a. Study limits have been extended from the Washakie Reservoir to West Haven WTP

5. **Study progress**

    a. Mapping, we handed out updated mapping showing the new project limits.
    b. Project approach, we handed out a project approach on routing selection, we discussed the various task items.
    c. Discussed initial project tour to examine potential routes.
    d. State water model, we discussed preliminary results.

Steve Thurin discussed that the initial modeling results show that the project with just Washakie Reservoir will not deliver the full 220,000 acre-feet of project water. Initial estimates are 140,000 with only Washakie and 172,000 with Washakie and Willard. Tage Flint commented that this is a shift in the plans that have been put forward all along. Bart asked for us to look at scenarios that can meet the project requirements, how much can the project deliver based on different scenarios of storage and delivery. Bart also commented that the lower yield will impact the cost per acre-foot of the project. Steve committed to work with the state's water modeler to examine scenarios for different reservoirs and different required yields from the project.

6. Set date for next regular progress meeting

a. We set the date for the next meeting for September 24 at 2:00 p.m.

Weber County Commissioners Meeting

Bear River Pipeline Concept Report

Meeting Notes

25 August 2009

1. Welcome and Introductions.

The following were in attendance:

David S. Humphreys (Board of DWRe)	Gina Hurst (DWRe)	Marisa Egbert (DWRe)
Tage Flint (WBWCD)	Mark Anderson (WBWCD)	Steve Thurin (HDR)
Mike Collins (BC&A)	Terry Hickman (BC&A)	

2. Meeting Purpose.

Provide Weber County Commissioners with information on the Bear River Pipeline Concept Study. We met with the three Commissioners separately beginning with Commissioner Craig Dearden at 8:00 AM, followed by Commissioner Kenneth Bischoff and then Commissioner Jan Zogmaister.

3. Meeting Summary.

Tage introduced those in attendance to each Commissioner and then gave a brief explanation for the purpose of the meeting. Gina discussed the purpose and need of the study and provided contact information and a one page informational handout that will be sent to the public once key Stakeholders have been made aware of the study. Mike handed out a map of the study area and provided details of the scope of the study. The remainder of the discussion involved answering questions and taking comments provided by the Commissioners.

Commissioner Dearden was supportive of the project. He mentioned that we should attend the Weber Area County of Governments (WACOG) meeting and present our study information. He said we will be able to cover all of the Mayors in Weber County in one meeting.

Commissioner Bischoff was supportive of the project. He questioned why we did not meet with all of the Commissioners at once since this is an informational meeting only and we are not asking for them to make a decision. We told him that we were just following Commission staff direction.

Commissioner Zogmaister was supportive of the project. She suggested that we work with the Weber County Pathways group (Rob Scott was a contact). They are identifying areas in Weber County for recreation corridors. She mentioned that she is very involved with this group. We explained that trails for foot traffic and biking are often placed on top of buried waterlines and that is one aspect of this study that has been identified. Commissioner Zogmaister also requested that as soon as we identify a corridor, that we let the Commissioners know so that they can help promote the project.

Concept Report for the Bear River Pipeline
State of Utah-Division of Water Resources

Agenda
Stakeholder Progress Meeting
September 24, 2009

1. **Welcome and introductions**

2. **Study progress**

   a. Finished with the field work and data collection input all the pipeline alternative segments (the network of pipe alts)
   b. Assigned most of the cost rating factors to pipeline segments
   c. Identified land cost areas based on location and zoning
   d. Currently compiling actual pipe costs and associated construction costs (jack & bore, high GW, etc)
   e. We have tracked down the Questar gas pipelines, and another gas pipeline called the Ruby Pipeline, and obtained the utility information for Brigham City. We are investigating the west side of Willard Bay.
   f. Will perform shortest cost analysis here soon
   g. Draft Chapter-Assumptions and Criteria

3. **Draft Chapter-Assumptions and Criteria (handout)**

4. **State water model (discussion on analysis)**

5. **Bear River Water Conservancy District Meeting**

6. **Weber County COG Meeting, October 5, 4:30 p.m.**

7. **Set date for next regular progress meeting**

Concept Report for the Bear River Pipeline
State of Utah-Division of Water Resources

Agenda
Stakeholder Progress Meeting
December 3, 2009

1. **Welcome and introductions**

2. **Study progress (see attached agenda)**

3. **State and stakeholder meetings**

4. **Set date for next regular progress meeting**

Stakeholders Meeting Summary of Progress to Date

12-03-09

1. **Progress to Date**
   a. Data Collection
   b. Network of Pipeline Alignment Options
   c. Field work
   d. Cost Data

2. **Review and Discuss the Pipeline Alignment Options** (large map)
   a. Willard Bay East Options
   b. Willard Bay West Options
   c. Bear River Bird Refuge

3. **Cost Analysis**
   a. Review Pipeline Construction Concept (Construction Figure)
   b. Review ROW and Construction Variations
   c. Segments Assigned Cost Factors Based on Anticipated Construction Costs
   d. Cost Factor Basis (Construction Figure)
   e. Cost Factor Categories and Ratings (Rating Table)
      i. Urban Rating
      ii. Utilities
      iii. Groundwater Depth
      iv. ROW Width
      v. Special Crossings: Canals, Rivers, RR, Freeways
      vi. Steepness Factor
      vii. ROW Purchase Costs

4. **Review Fatal Flaws** (large map)
   a. Multiple Fault Crossings
   b. Narrow ROW width (<60 feet)

5. **Cost Analysis Overview**
   a. Create equivalent length for each segment in pipeline options network based on cost
   b. Routing Areas and Points (Routing Map)
   c. Evaluate the least cost route between each point
   d. Select the shortest (least cost routes) and create a list of alternatives
   e. Top five alternatives are Short List

6. **Summarize the Upcoming Tasks**
   a. Develop an alignment short list
   b. Perform evaluations of real estate, engineering, and environmental

Bear River Pipeline Concept Report
State of Utah-Division of Water Resources

COORDINATION MEETING
Wednesday January 6, 2010

1. Progress To Date

a. December Stakeholder Meeting Summary

b. Completed Cost Analysis Model

c. Developed Draft Short List of Alignment Options

2. General Discussion Items

a. Discuss/Review Top 10 Pipeline Alignment Options

b. Discuss/Review Alternative Pipeline Alignment Options

c. Discuss Development of Pipeline Alignment Short List

3. Action Items

a. Projected Schedule and Next Coordination Meeting

b. Action Items Review (no previous action items):

Action Item	Assigned To	Date Needed

Concept Report for the Bear River Pipeline
State of Utah-Division of Water Resources

Agenda
Stakeholder Progress Meeting
January 12, 2010

1. **Welcome and introductions**

2. **Progress To Date**

    a. December Stakeholder Meeting Summary

    b. Completed Cost Analysis Model

    c. Developed Draft Short List of Alignment Options

3. **General Discussion Items**

    a. Discuss/Review Top 10 Pipeline Alignment Options

    b. Discuss/Review Alternative Pipeline Alignment Options

    c. Discuss Development of Pipeline Alignment Short List

4. **Action Items**

    a. Projected Schedule and Next Coordination Meeting

Concept Report for the Bear River Pipeline
State of Utah-Division of Water Resources

Agenda
Stakeholder Progress Meeting
February 24, 2010

1. **Welcome and introductions**

2. **Progress To Date**

    a. January Stakeholder Meeting Summary

    b. Cost Evaluation of Short List Alignment Options

    c. Report: Draft Chapter 4

    d. Detailed Report Outline

3. **General Discussion Items**

    a. Review Chapter 4 – Project Assumptions and Criteria

    b. Discuss/Review Short List Alignments

    c. Discuss/Review Short List Hydraulic Evaluation

    d. Discuss/Review Short List Cost Evaluation

    e. Discuss Next Month's Work Plan

4. **Action Items**

    a. Next Progress Meeting

Bear River Pipeline Concept Report

State of Utah-Division of Water Resources

COORDINATION MEETING

Wednesday February 24, 2010

1. Progress To Date

a. January Stakeholder Meeting Summary

b. Report Outline and Draft Chapter 4

c. Developed Final Short List of Alignment Options

d. Short List Hydraulic and Cost Analysis Complete

2. General Discussion Items

a. Discuss Project Assumptions – Flow Rates and Operational Scenarios (Steve)

b. Discuss/Review Short List Pipeline Alignment Options

c. Discuss/Review Short List Hydraulic and Cost Evaluations

   i. Discuss the I-15/BR Option

   ii. Discuss alternative option for West of Willard Bay

d. Discuss Plan for Development of Final Pipeline Alignment

   i. Non-Cost Evaluation Approach

3. Action Items

a. Projected Schedule and Next Coordination Meeting

b. Schedule Final Alignment Coordination Meeting March 10th

c. Action Items Review (no previous action items):

Action Item	Assigned To	Date Needed

Bear River Pipeline Concept Report
State of Utah-Division of Water Resources

STAKEHOLDERS MEETING NOTES
Wednesday February 24, 2010
Notes Processed on March 5, 2010 by Thayne Clark

Attendees:

Mike Collins/BC&A	Gina Hirst/DWRe
Thayne Clark/BC&A	Marisa Egbert/DWRe
Steve Thurin/HDR	Eric Millis/DWRe
Duane Jensen/Carollo	Bart Forsyth/JVWCD
Scott Paxman/WBWCD	Mark Anderson/WBWCD
Bob Fotheringham/Cache County	Voneene Jorgensen/BRWCD (not present)

1. Progress To Date – Summarized by Thayne Clark

- Development of the final Short List of Pipeline Routes has been completed.
- Report Outline is out for review
- Chapter 4 DRAFT is out for review

2. Review Chapter 4 – Project Assumptions (Steve Thurin leads discussion)

- **Discuss Scenarios for Project Water Supply**
    - Scott Paxman provided a paragraph entitled "The Potential Use of Willard Bay Reservoir" for explanation of why Bear River water would not be placed in Willard Bay.
    - Scenario #2 was discussed. Bob Fotheringham had concerns about the purchase of Cache County or Box Elder County water rights to supply the project. He felt that the fundamental purpose of the Bear River Project only includes looking at using surplus water in the Bear River, not looking at alternatives of water rights purchase from existing supplies.
    - Bob felt that communities in Cache and Box Elder Counties would not support this approach (see attached similar comments and discussions provided by Mike Collins from Feb 26th meeting with Voneene Jorgensen of BRWCD).
    - Discussion of assumed pipeline flow rates for supply and delivery, including assumptions of take-out locations.
    - **Feb 26th meeting with Voneene Jorgensen:** BRWCD will work with us to finalize the location and flow rates of the BRWCD delivery points. BRWCD will also develop an ultimate (30 year) water demand projection for the District. BRWCD will most likely need Bear River Project water first, before the other users – the demand projection project will help to verify and quantify that. Phasing will play into future deliveries to BRWCD (See attached notes from Feb 26th meeting with Voneene Jorgensen of BRWCD).

- **Discussion on Water Quality of the Bear River**
    - Water Quality Management Plan for the Bear River Watershed should be a part of the overall project discussion and recommendations.
    - It would be helpful to include the MCL for each water quality parameter in Table 8 of Chapter 4.
- **Review Chapter 4**
    - Gina Hirst requested that the text related to why certain reservoirs were not being considered as future storage options be revised for accuracy.
    - The potential diversion sites listed on Table 4-8 should better match the water names used on Figure 4-1.
    - Additional review comments were solicited from Workgroup members
    - An updated electronic copy of the document will be provided

3. Review Short List of Pipeline Alignment Options (discussion led by Thayne Clark)

- **Review of the plan and profile maps of the Short List**
    - Review of each of the Short List Alignment Options in detail – profiles too.
    - It was noted that the I-15/Bear River Option should be considered as a phasing approach, where an adjacent pipeline corridor should be preserved for future purchase and construction of a pipeline.

- **Short List Cost Analysis**
    - Review the cost summary tables and graphics. Costs are for comparison purposes only.
    - Option at I-15/Bear River was the lowest cost. Keep option as a phasing approach.
    - Option #2 and Collinston Diversion (CD) Option were next lowest cost. Both options present good alternatives on either side of the Bear River, connecting the I-15/Bear River with Washakie.
    - Further look at potentially phasing in the I-15/Bear River Option with either of Option #2 or CD Option.

- Report Chapter 6 is currently being written as the analyses are completed.

- Next step is to perform final Short List Cost Analysis, then Non-Cost Analysis.

- Next meeting to be scheduled for March 24th , 2PM at DNR – Tentatively

ATTACHMENTS

Thayne Clark

From: Mike Collins
Sent: Monday, March 01, 2010 4:15 PM
To: bartf@jvwcd.org; 'Bob Fotheringham'; Eric Millis; Gina Hirst (ginahirst@utah.gov); marisa egbert; PE Mark D. Anderson (manderson@weberbasin.com); Richard Bay; spaxman@weberbasin.com; tflint@weberbasin.com; Voneene Jorgensen
Cc: Thayne Clark; Thurin, Steven M.
Subject: Bear River Project-Bear River Canal Company Water Rights

Team,

We met with Voneene last Friday at her office. We were there to discuss master planning for the Bear River Water Conservancy District. We did, however, end up spending some time discussing Chapter 4, Project Assumptions. Voneene was concerned about the following text in the report.

Scenario #2 – Water Right Acquisition Scenario

Scenario #2 also assumes the construction of a 160,000 acre-foot off stream storage reservoir at the Washakie site. Rather than assuming the construction of 70,000 acre-feet of additional downstream storage (as in Scenario #1), it assumes that the Bear River Project acquires between 40,000 and 50,000 acre-feet (preliminary numbers) of the water supply of the Bear River Canal Company. This represents between 20 and 30 percent of the annual delivery to the BRCC. This water is assumed to be available for acquisition by the DWRe and for conversion to M&I water supply because of urban development of lands currently irrigated by the BRCC. Alternatives to outright acquisition of the water could include negotiation of arrangements to fallow agricultural lands during those 30 percent of years when the Bear River Project supplies are inadequate, or the development of water conservation projects to conserve the necessary water.

Voneene's concerns were that the BRCC water instead of someday being used in Box Elder County would be used to satisfy future water demands in Weber, Davis, and Salt Lake Counties. Voneene was concerned to the point that she did not want the scenario presented in the report. I feel that it is important to include all potential scenarios for supplying water. We already have the dam site that cannot be mentioned, the dam that cannot be used, now we would have the water supply that cannot be named. However, I understand Voneene's concerns (Voneene, if I have not expressed them correctly, let everyone know). Here is how I would propose to present the scenario in such a way that Box Elder County does not feel like their future water supply is being stolen (or anyone else does either).

The project will need to be phased in the future. Here is one way it could be phased:

Phase 1-BRWCD builds a pump station on the Bear River, BRCC water rights are leased or bought to supply BRWCD with a water supply for a period of time.
Phase 2-Washakie is built and pipeline from I-15 and the Bear River is built to West Haven WTP, diversions can occur to WBWCD, JVWCD, and Cache County
Phase 3-Second reservoir is built, BRCC water rights can convert back to BRCC or BRWCD can acquire them
Phase 4-Pipeline from proposed Collingston Diversion to I-15 and the Bear River is built

This would allow us to talk about BRCC as a potential water source for the project and also allow the project to be built in phases. It would also identify the BRCC water as being used in Box Elder County. There is the potential that BRWCD will need the Bear River Project before WBWCD and JVWCD. This would allow this to occure without major expenditures.

Let me know what you think, Steve, weight in.

REVISED PROJECT PHASING 03-04-10

Proposed Project Phasing
Bear River Pipeline Project
State of Utah-Division of Water Resources

Phase 1-Interim Supplies for Bear River Water Conservancy District (BRWCD)

The Bear River Project (Project) builds a pump station on the Bear River in Box Elder County to service the BRWCD, direct flow water rights on the Bear River are leased or bought to supply BRWCD with a reliable water supply during this phase of the Project. No additional storage on the Bear River is constructed at this time. Phase 2 of the Project is not constructed until Cache County, Weber Basin Water Conservancy District (WBWCD), or Jordan Valley Water Conservancy District (JVWCD) need water supply from the project.

Phase 2-Initial Project Storage and Initial Pipeline

Washakie Reservoir or some other reservoir is built and the storage develops an additional water supply for the Project. Water is released from storage to the Bear River. A pipeline from a diversion on the Bear River near the I-15 crossing is built to convey water from the Bear River to the West Haven WTP. With the additional water supply developed by the storage, diversions can occur to WBWCD, JVWCD, and Cache County as well as supplementing flows to BRWCD. Deliveries can be made to Cache County through exchange to either groundwater extraction or direct diversions from the Bear River. The full water right of the Project of 220,000 acre-feet is not yet developed.

Phase 3-Additional Reservoir Storage

Additional reservoir storage is developed for the Project. This will allow for full development of the water rights needed for full project development. Direct flow water rights obtained in Phase 1 of the Project can convert back to their water right holders or BRWCD can acquire them permanently for use in Box Elder County. Project water supply is delivered to all Project participants through the BRWCD pump station(s), groundwater extraction or river diversions for Cache County, and deliveries to the West Haven Water Treatment Plant for WBWCD and JVWCD.

Phase 4-Pipeline From Proposed Collinston Diversion

As a result of either water quality concerns or overall delivery requirements of the project, a pipeline is constructed from the Collinston Diversion to the Phase 2 intake from the Bear River thus completing the pipeline from the Washakie Reservoir to the West Haven Water Treatment Plant. Water can then be delivered to additional areas of Box Elder County under pressure. Any water quality concerns in the Bear River from below Cutler Reservoir to the I-15 diversions can be alleviated.

Bear River Pipeline Concept Report for State of Utah - Division of Water Resources

Agenda
Stakeholder Progress Meeting
March 24, 2010

1. **Welcome and Introductions**

2. **Progress To Date**

   a. February Stakeholder Meeting Summary

   b. Environmental Evaluation of Short List Alignment Options

   c. Real Estate Evaluation of Short List Alignment Options

   d. Report Chapter 6 (Routing Study) Almost Completed

3. **General Discussion Items**

   a. Discuss/Review Environmental Considerations (See attached Figures)

   b. Discuss/Review Real Estate Considerations (See attached Figures)

   c. Discuss Short List Non-Cost Evaluation

   d. Discuss Scenario #2 in Project Assumptions, Revised Project Implementation Plan

   e. Discuss Next Month's Work Plan

4. **Action Items**

   a. Next Stakeholder Progress Meeting

Bear River Pipeline Concept Report
State of Utah-Division of Water Resources

CACHE COUNTY COORDINATION MEETING NOTES
Friday April 23, 2010
Notes Processed on April 26, 2010 by Thayne Clark

Attendees:

Bob Fotheringham/Cache County
Mike Collins/BC&A
Thayne Clark/BC&A
Craig Bagley/BC&A
Steve Thurin/HDR

1. Cache County Water Supply

A. Cache County will develop water demand projections and develop a plan for where the future water is needed. In the interim, the project will develop an estimate of long term build out demand for the county.
B. Discussed the possibility of sharing a water treatment facility with BRWCD at a common location near the Box Elder County and Cache County boundary on Highway 30.
C. Future water demand area is most likely on the northwest side of the County. The Clarkston and Newton areas could use irrigation water for potential agricultural lands.
D. Aquifer studies are being completed by UGS – this will also study the feasibility of aquifer storage and recovery.
E. Cache County would prefer a physical connection to the Bear River Pipeline Project in order to guarantee water from Washakie to Cache County during low flow years. Exchanges for Bear River water may not always be guaranteed. The use of exchanges should be more fully explained and reliability evaluated. See options for physical delivery below.

2. Delivery System Options to Cache County

Discussion of how to deliver Bear River Project water to Cache County:

A. Exchange water by diverting it from the Bear River or tributaries under Bear River Canal Company rights while BRCC deliveries are made from releases from Washakie Reservoir. Bear River Project would pay for the diversion facilities and for conveyance to the treatment plant.
B. Construct a pipeline from Collinston Diversion to Cutler Reservoir:
   1) Pump Bear River Water from Collinston Diversion up to Cutler Reservoir (water would come from either the Bear River directly or from Washakie Reservoir).
   2) Pump out of Cutler to northwest Cache County for irrigation use (Benson, Newton, Clarkston, areas)
   3) Exchange Bear River water for Logan Canyon or Blacksmith Fork water via agreement with canal companies in Cache County who currently divert from Logan Canyon or Blacksmith Fork (Benson Irrig. Co., Wellsville Irrig. Co., etc.) and treat the better quality Logan Canyon or Blacksmith Fork water for municipal/industrial use.

4) Pipeline capacity would be maximum Cache County delivery rate of 180 cfs.
5) Pipeline/exchange costs would be included as part of the overall Bear River Project.

C. Aquifer Storage Option – same as above option except exchange Logan River or other source water for Bear River water that would be stored in aquifer for additional groundwater withdrawals. Cost of ASR facilities would be included as part of the overall Bear River Project.

Bear River Pipeline Concept Report

State of Utah-Division of Water Resources

STAKEHOLDERS MEETING NOTES

Wednesday May 12, 2010
Notes Processed on May 27, 2010 by Thayne Clark

Attendees:

Mike Collins/BC&A
Thayne Clark/BC&A
Steve Thurin/HDR
Scott Paxman/WBWCD
Bob Fotheringham/Cache County
Kathi Thompson/HDR
Marisa Egbert/DWRe
Eric Millis/DWRe
Bart Forsyth/JVWCD
Mark Anderson/WBWCD
Voneene Jorgensen/BRWCD

1. Progress To Date – Summarized by Thayne Clark

a. Analysis of Short-Listed Alignment Options - Completed
b. Field Trip Taken to Box Elder County – Discussions with Bear River Canal Company Chairman about sharing facilities (West Side Canal)
c. Cache County Water Delivery Meeting – discussion to follow
d. Report Chapter 6 (Routing Study) Completed and Draft Handed Out

2. Review Chapter 6 and Discuss Final Alignment Recommendation

a. Summarized Chapter 6 – Handed out draft to stakeholders
b. Review the Non-Cost Analysis Results – Collinston Option ranked highest based on assumptions of System Compatibility.
c. Final Alignment Recommendation: Collinston Diversion – discussion with map of Collinston Option and Option No. 2 for comparison. Voneene expressed some concern about Collinston Option being recommended over Option No. 2. She felt that Option No. 2 was located nearer to areas with future water demands. She will look into it more and we will meet with here May 26th to discuss in more detail.
d. Kathi (HDR) suggested that we carefully approach the public involvement in the selection of the final alignment. The general consensus was that the parcel level real estate analysis be performed to identify sensitive areas and then present the alignment to the larger group of stakeholders (community leaders).
e. Final alignment would be discussed first with BRWCD and Cache County in May 26th. From there the final alignment would be established. The final alignment would be defined as a corridor – width depending on available parcels and type of surrounding landuse.

3. West Side Canal Supply Option

a. Discussion: should we look at the option of utilizing the West Side Canal to provide supply water directly from Cutler Reservoir? The work group felt that interagency coordination might be logistically complicated. Also for the canal winter maintenance would be during peak use of the canal for Washakie supply.

b. Generally the use of the canal could save up to $35million in capital costs alone by reducing total pumping head. With this savings, the project could spend about $1,550 per foot on canal improvements.

c. Bart suggested that the option of utilizing the canal be replaced with the option of constructing a dedicated supply pipeline directly from the top of Cutler – saving even more pumping head. BC&A will develop this as an option on the final alignment and evaluate hydraulics. Pumping costs should offset pipe costs, and make supply deliveries more secure – also saving annual pumping costs.

4. Cache County Delivery Options

a. Discussed areas of development in Cache County with Bob – mainly the northwest portion of the county will see future growth. This area of the County is also short on water.

b. BC&A is working with Bob to develop what project facilities are required to deliver water to Cache County. These deliveries include pipe to Culter from Washakie, pumping from Cutler, pipe to heads of canals in Cache County.

c. The main Cache County delivery facility includes a pipeline from Collinston diversion area up to Cutler Reservoir to supply Washakie water back to Cache County in case exchanges are unavailable. This option could utilize the supply pipeline from Cutler mentioned earlier – just reverse flow from the pump station at Collinston and pump Cache County's share of water up to Cutler from Washakie.

d. Steve (HDR) will continue to look at availability of exchanges for Cache County from Bear River Canal Company at Cutler – utilizing the State's model.

Bear River Pipeline Concept Report
State of Utah-Division of Water Resources

BRWCD and Cache Co. Coordination MEETING NOTES
Wednesday May 26, 2010
Notes Processed on May 26, 2010 by Thayne Clark

Attendees:

Mike Collins/BC&A	Marisa Egbert/DWRe
Thayne Clark/BC&A	Voneene Jorgensen/BRWCD
Bob Fotheringham/Cache County	Bill Bigelow/H.A.L.

1. Discussion of the Final Alignment Selection

a. **Summary:** The Draft Routing Study (Chapter 6 of the Report) recommended the Collinston Option over Option No. 2. The selection of the Collinston Option was based mainly on the non-cost evaluation, of which the System Compatibility played a critical role in ranking the Collinston Option as the highest.

b. **BRWCD** evaluated potential benefits of Option No. 2 and the Collinston Option to determine which option would better meet their needs. BRWCD indicated that Option No. 2 is their preferred final alignment, generally in terms of its compatibility with future growth and water needs. The following reasons for selecting Option No. 2 were presented by BRWCD:

   i. BRWCD feels that future water demands will be on the west side of Box Elder County, south of Tremonton and north of Corinne. A pipeline nearer to that area would be more compatible with their needs.

   ii. Some Bear River Project water could be used for developing currently undeveloped agricultural land on the west side of the county. Bear River Canal Company could expand their conveyance system to make this ag. development happen.

   iii. The hills to the west of Tremonton could serve as a potential location to a future water treatment plant (elevation advantage).

   iv. **Cache County** (Bob) also agreed that Option No. 2 would be their preferred option because it allows for more potential canal company exchange possibilities by expanding irrigated land to the west.

c. **BC&A will** adjust the non-cost factors ratings to include an increased System Compatibility rating for Option No. 2 and a slightly decreased rating for the Collinston Option. Since the non-cost factors are somewhat subjective by nature, we can easily justify the change in the System Compatibility rating due to this discussion with Cache County and BRWCD stakeholders. Their preference for the location of the pipeline alignment, based on their water needs, will affect the final outcome of the non-cost evaluation more in favor of Option No. 2.

d. **BC&A will** perform a conceptual ultimate demand study for BRWCD (Box Elder County) and for Cache County. The results of these studies will be included in the Engineering Analysis portion of the Report – helping the stakeholders to understand where the future demands will be needed in these two counties. The purpose of these studies is to establish a basis for the pipe sizing, where to provide delivery facilities, and other facilities that might impact the cost of the overall project. The studies will be completed in draft over the next three weeks. Review comments from the counties will be incorporated before they are finalized as a part of the Concept Report (most likely as Tech Memos in the Appendix of the Engineering Analysis Chapter).

2. Other

a. Bob re-iterated that this project should not include options that include utilizing water not from the Bear River Project allocation.
b. **Cache County and BRWCD:** The phasing approach may include an option that looks like the I-15/Bear River Option, but this option by itself is not viable. In the phasing approach the I-15/Bear River Diversion option could be included, but a contractual commitment to build the remaining pipeline would be required by BRWCD and Cache County. The next Stakeholders Meeting will have more discussion on these phasing ideas.

Bear River Pipeline Concept Report for
State of Utah - Division of Water Resources

AGENDA
Work Group Progress Meeting
Tuesday July 13, 2010

1. Progress To Date

a. Development of Final Pipeline Alignment Corridor

b. Engineering and Environmental Analyses in Progress

c. Updated Bear River System Model

d. Real Estate Evaluation in Progress

e. Public Involvement Plan in Progress

2. General Discussion Items

a. Review Revised Report Outline

b. Briefly Discuss Results of Updated Bear River System Model

c. Review Final Alignment Corridor

d. Discuss/Review the Draft Results of the Real Estate Analysis

e. Discuss/Review the Draft Public Involvement Plan Approach

f. Other

3. Action Items

a. Next Work Group Progress Meeting

Bear River Pipeline Concept Report for
State of Utah - Division of Water Resources

AGENDA
Work Group Progress Meeting
Tuesday September 21, 2010

Bowen Collins & Associates, Inc. CONSULTING ENGINEERS

HDR

1. Progress to Date

a. Engineering Analysis of the Recommended Pipeline Alignment
b. Geotechnical Analysis Completed (Chapter 7-4)
c. Real Estate Analysis and Plan Completed (Chapter 9 & 11-3)
d. Environmental Analysis in Progress (Chapter 8 & 11-2)
e. Public Involvement Plan in Progress (Chapter 11-4)

2. General Discussion Items

a. Review Hydraulic Scenarios and Results of the Engineering Analysis

b. Review Bear River Project Facilities for Cache County

c. Review Chapter 4 – Project Assumptions

d. Review UPDATED Report Outline

e. Distribute Draft Chapter 2 for Review

f. Distribute Draft Chapter 5 for Review

g. Distribute Draft Chapter 9 – Real Estate Analysis

h. Discuss Project Implementation Plan Chapter 11 (Real Estate Plan – Section 11-3)

i. Discuss Upcoming Tasks Prior to Next Meeting:
   - Chapter 1 and 3 – Introduction and Project Description
   - Chapter 7 – Finalize the Conceptual Design
   - Chapter 8 – Environmental Analysis
   - Chapter 10 – Project Costs
   - Chapter 11 – Implementation Plan (Project Phasing, Environmental Compliance, and Project Schedule)

3. Action Items

a. Next Work Group Progress Meeting

MINUTES

Bear River Pipeline Concept Report

State of Utah - Division of Water Resources

WORK GROUP MEETING
Tuesday September 21, 2010
Notes Processed on September 22, 2010 by Thayne Clark

Attendees:

Mike Collins/BC&A	Eric Millis/DWRe
Thayne Clark/BC&A	Marisa Egbert/DWRe
Steve Thurin/HDR	Bart Forsyth/JVWCD
Scott Paxman/WBWCD	Mark Anderson/WBWCD
Bob Fotheringham/Cache County	Voneene Jorgensen/BRWCD
Kathi Thompson/HDR	Alana Spendlove/HDR

1. Progress To Date – Summarized by Thayne Clark

a. As listed in the agenda

2. General Discussion Items

a. Review Hydraulic Scenarios and Discuss Engineering Analysis

- Summarized the six hydraulic scenarios and the piping and pumping facilities required to meet the scenarios.
- The option of connecting the water supply to the Collinston Pump station from Cutler Reservoir (to reduce pumped head) will be mentioned in the Report as an option that should be evaluated at the design phase of the project. Connecting a large diameter gravity pipe to Cutler Reservoir has some potential major problems: multiple river crossings, how to actually connect to Cutler Dam facilities, and difficult pipeline construction adjacent to the river.
- The Collinston Pump Station will require two sets of pumps – one high head pumping 480 cfs to the south and one low head pumping at 400 cfs to Washakie.

b. Cache County Facilities Discussion

- Bob F. summarized the purpose for the Cache County Facilities shown in the facilities map distributed to attendees. Generally Cache County desires that a physical system for delivery of Bear River water be included in the overall project facilities and costs.
- Bob F. expressed Cache County's standpoint that the 25,000 ac-ft groundwater development as part of the Bear River Project is not permissible as part of the Bear River Development Act (copies of the Act were distributed). It states clearly that groundwater development options should not be evaluated in the project, but rather surface water from the Bear River. The County is in the process of looking at the safe groundwater yield for the basin. They are also looking at developing 25,000 ac-ft separately from the Bear River Project.

- Since groundwater storage/supply should not be included in the Bear River Project, this additional storage (previously assumed to be taken from 25,000 ac-ft groundwater development) will now be added to the required surface water storage system.
- The State's model should reflect that this 25,000 ac-ft will be added to the unnamed storage reservoirs to make sure the project continues to deliver 220,000 ac-ft as planned. For now, the model will not be re-run to reflect this adjustment in where the storage comes from – it will be assumed that it can be added to surface storage.
- **ACTION ITEM:** Steve Thurin will look at additional model run that has no Washakie Reservoir storage, but has one upstream storage reservoir and one downstream reservoir.
- The facilities shown in the distributed figure of the Cache County Facilities will be included in the overall project costs. They may change with time, but need to be included to show that Cache County has a real Bear River water delivery system.
- Cache County has not determined when (what projected year) they would need Bear River water. Funding the demand study is a lower priority of the County. If the State would provide funding for a consultant to perform the demand projections, the information could be included in this study.
- Box Elder County generally is estimating between 2026 and 2055 they would need Bear River water. **ACTION ITEM:** BRWCD will finalize their demand study to estimate when the Bear River water is needed in Box Elder County – most likely they will need water in the year 2035.

c. Implementation Discussion

- Most likely the Implementation Schedule for the project will start with a projected water delivery date of 2030-2035 and work back from that with environmental planning, real estate planning, public involvement, and engineering/construction planning.
- The critical issue is to get an estimate of what the overall Bear River Project will cost (or what the cost of water will be), so that member agencies can appropriately plan for when they want to (or can) utilize the Bear River water. It was emphasized that the project cost weighs into agencies' decisions of what year the water is needed.
- BCA will develop a full cost of the Bear River Project, including storage reservoirs, pipeline, pump stations, diversions, ROW acquisition, and engineering/admin. Cost will line-item Cache County facilities, and other costs for the southern deliveries. A 50 year project life will be used to estimate annual costs.

d. Public Involvement Discussion

- Suggested to start public involvement at the County/Board level.
- Project information should be disseminated only by the State – so that consistent information is conveyed in a controlled manner.
- Carefully coordinate the timing of the release of information, so that all stakeholders/groups know about the project equally.
- Don't let the project sit quietly for long periods of time. Take consistent small steps in disseminating information.

- Be careful with wording of the project facilities, so that it does not insinuate that a final decision has been issued – or that the facility location has been established.
- Keep the information very general at first.

e. Real Estate Discussion

- First step for the State is to look at agreements with UDOT to establish a majority of the alignment. State can connect the dots later with the in-between public lands and expansion of the UDOT ROW's.
- These UDOT agreements should be worked on in the next year. Funding and/or manpower must be allocated for this task ASAP. State will look at establishing a follow-on contract for real estate services.
- These agreements should be written, signed, and approved – so they are legitimate over time.

f. Environmental Discussion

- The project must be a complete project – or at least the phased pieces of the project must stand on its own in terms of being capable of delivering water and at the required amounts.
- The participating agencies must be able to show a need for the water for overall project justification.
- Corps of Engineers will most likely be the lead federal agency on this project.
- The early ROW agreements with UDOT will not cause any problems with the later environmental permitting/studies, as long as the reasoning for selecting the pipeline alignment is not based on the fact that these agreements were already in place.

g. Upcoming Schedule of Tasks

- The next tasks for the project include the following:
    1. BCA will finalize text and drawings of Chapter 7 – Engineering Analysis and Concept Design (**ACTION ITEM:** this will be sent out electronically within the next two weeks)
    2. HDR/BCA will finalize the text of Chapter 8 – Environmental Analysis (**ACTION ITEM:** this will be sent out electronically within the next two weeks)
    3. Finalize Chapter 1 & 3
    4. Compile ALL chapters in a DRAFT Report and bring to the next meeting. The DRAFT Report will contain the first take on the project scheduling and implementation – for review and comment.
- **ACTION ITEM -- Comments for the review of the following Chapters are DUE on October 12th.**
    1. Chapter 2, 4, 5, and 9
    2. Chapter 11 (Real Estate and Public Involvement Sections only)
    3. Public Involvement Plan (revised)
    4. Report Outline (revised)
- **Next Meeting is scheduled for October 27th at noon.**

Bear River Pipeline Concept Report for
State of Utah - Division of Water Resources

AGENDA
Work Group Progress Meeting
Wednesday, October 27, 2010

1. **Progress to Date**

   a. Draft Report in Progress

   b. Processing Comments

2. **General Discussion Items**

   a. Review Comments and Discussion

      1) Cache County Groundwater, Scenario 2

      2) BRWCD Exchange Option

      3) When Will Cache County and Box Elder County Need Water?

      4) Potential Use of Willard Bay Wording

      5) Public Involvement

   b. Overall Bear River Project and Cost Estimate

   c. Distribute Draft Chapter 8 – Environmental Analysis

   d. Discuss Project Schedule
      1) Draft Report
      2) Comments
      3) Final Report

3. **Action Items**

   a. Next Work Group Progress Meeting

PART 7 – CHAPTER 8 PHOTOS

The following photos are grouped within their respective sections (1–11) and represent the typical habitats observed within the proposed ROW (within 200 ft of the location of the proposed pipeline). The photos were taken during the field surveys on July 21, 22, and 28, 2010, and capture habitat that would be affected during the construction of the pipeline. The photo points correspond with the points on the GIS map in Figure 8-2 through Figure 8-8.

Section 1

Photo point 1

View of the northernmost end of the proposed pipeline ROW at the proposed Washakie Reservoir diversion site. The views of the Malad River floodplain habitat (left) and upland steppe habitat (right) are representative of both habitat types (floodplain and shrub).

Photo point 2

Railroad corridor to the north (left) and south (right) that the proposed ROW would follow. The adjacent cropland is typical of most cropland throughout the ROW.

Section 2

Photo point 3

View to the north of the West Side Canal and surrounding cropland along the proposed ROW. A large swallow colony was observed in the western bank of the canal.

Section 3

Photo point 4

View of the Bear River floodplain looking east (left), south (center), and west (right) at the Collinston diversion. A majority of the floodplain is currently used for grazing or cropland.

Photo point 5

View looking north of the Malad River crossing of the proposed ROW that is typical of floodplains in the ROW with riparian and some small shrubby vegetation. About 4% of habitat within the ROW is floodplains.

Section 4

Photo point 6

Views looking north of an alfalfa field (left) adjacent to the Corinne Canal (right) along the proposed ROW that is representative of hay and alfalfa field habitat. About 17% of habitat in the ROW is hayfields.

Photo point 7

A northward viewpoint of typical riparian habitat within the proposed ROW and adjacent to the Corinne Canal containing mostly box elder, Russian olive, Siberian elm, and rose species. About 2% of habitat within the ROW is riparian habitat.

Section 5

Photo point 8

Views to the south (left) and north (right) along Highway 13 of an urban residential segment of the proposed ROW. About 33% of the ROW is within urban areas such as this.

Section 6

Photo point 9

Southbound view of cropland on the east and west sides of 5200 West. About 29% of habitat within the ROW is cropland.

Section 7

Photo point 10

Shrub-steppe habitat within the proposed ROW composed mostly of sagebrush and weedy grasses. Shrub habitat makes up about 4% of habitat within the ROW.

Photo point 11

View of a large pasture adjacent to the proposed ROW that is typical of pasture habitat in the ROW. Pasture makes up about 4% of habitat within the ROW.

Photo point 12

View of the junction of a railway corridor (left) and canal corridor (right) that the proposed pipeline would follow. Cropland surrounds both corridors.

Section 8

Photo point 13

View of the Bear River as it crosses under Highway 13 and the proposed ROW.

Section 9

Photo point 14

View of the eastern edge of the Bear River Bird Refuge, a large wetland refuge that gets its water from the Bear River. The proposed ROW runs along the easternmost side of the refuge adjacent to an existing gas pipeline. About 7% of habitat within the ROW is wetland habitat.

Photo point 15

View looking north of the proposed ROW and the surrounding pastures.

Section 10

Photo point 16

View looking south on Highway 89 of a debris dam embankment and the highway.

Photo point 17


Historic homes (left) and businesses (right) adjacent to the proposed ROW and Highway 89.

Photo point 18

View of a pasture that borders the proposed ROW.

Section 11

Photo point 19

View of a canal corridor that represents most small canals crossed by the proposed ROW.

Photo point 20

SR 126 south (left) and north (right) along the proposed ROW.

Photo point 21

View looking east from the southernmost point of the proposed ROW.