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Proposal to the Utah State NRD Trustee and USEPA CERCLA Remedial Project Manager for a Groundwater Extraction and Treatment Remedial Project in the Southwest Jordan Valley

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KENNECOTT UTAH COPPER CORPORATION
JORDAN VALLEY WATER CONSERVANCY DISTRICT

Proposal to the Utah State NRD Trustee and USEPA CERCLA Remedial Project Manager

for a

Groundwater Extraction and Treatment Remedial Project In the Southwestern Jordan Valley

Submitted December 16, 1999

Revised April 28, 2000
Revised January 15, 2001
Revised April 25, 2003
Revised August 7, 2003

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1.0 INTRODUCTION

Kennecott Utah Copper Corporation (KUCC) and the Jordan Valley Water Conservancy District (JVWCD) make this joint proposal (Proposal) to Dr. Dianne R. Nielson, the Utah Trustee for natural resource damages (NRD), who also acts as Director of the Utah Department of Environmental Quality (UDEQ). In addition, the Proposal has been made to Dr. Eva J. Hoffman, the United States Environmental Protection Agency (USEPA) Remedial Project Manager for the KUCC Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site remediation and Mr. Jerry Olds, P.E., State Engineer for the State of Utah. Public hearings and a comment period regarding this Proposal are tentatively scheduled for August and September of 2003.

KUCC and JVWCD propose to develop and construct a groundwater extraction and treatment project with groundwater remedial functions that will provide treated, municipal quality water to the public in the Affected Area of the southwestern Jordan Valley (Project) as defined in the Consent Decree dated August 21, 1995, entered in Civil Action No. 86-C-0902G in the United States District Court for the District of Utah ("the Consent Decree"). KUCC and JVWCD seek to utilize for the Project the trust fund set up under the Consent Decree, in a manner consistent with the terms of the Consent Decree and to restore the injured ground water resource.

The concepts of this Proposal have been presented to the governing organizations of Herriman City, Riverton City, South Jordan City and West Jordan City and a technical review committee comprised of representatives from various federal, state and local governmental agencies, as well as representatives from local municipalities and local residents.

1.1 Executive Summary

In summary, the Project outlined in this Proposal:

- Is designed to provide a minimum of 8235 acre-feet/year (afy) of municipal quality water to the public in the Affected Area.
- Includes the construction and operation of two reverse-osmosis water treatment plants. One plant, the Zone A Plant, is to be built, owned and operated by KUCC. The other, consisting of the Zone B Facilities and the Lost Use Facilities, is to be built, owned and operated by JVWCD.
- Includes construction and operation of pipelines and extraction wells.
- Seeks to utilize all portions of the Trust Fund, except that relating to administration costs. The Trust Fund consists of the existing Irrevocable Letter of Credit (ILC) and the cash portion of the Trust Fund. KUCC and JVWCD seek full credit against the ILC in exchange for 7000 afy of municipal quality water. JVWCD seeks the cash portion for an additional 1235 afy of municipal quality water.
- Provides additional costs and in-kind contributions to the Project of approximately $180 million by KUCC and $23 million by JVWCD.
- Anticipates providing some of the municipal quality water to the public in the Affected Area by December 2005 if the Proposal is approved by September 2003, or approximately twenty-eight (28) months following approval of the Proposal.
- Presents an allocation of water rights to the Utah State Engineer. The allocation of water rights is necessary to meet the intent of the NRD Consent Decree. KUCC and JVWCD submitted change applications in July 2000 to accomplish the proposed allocations. Additional change applications were submitted in 2002 to integrate KUCC's acid extraction program with the change applications submitted in 2000. Approvals of the 2002 change applications associated with the acid extraction are pending.
- Integrates the CERCLA remedial response for the Bingham Creek acid and elevated sulfate plume with the actions required to satisfy the NRD Consent Decree.

This Proposal provides an overview of the expected development of the Project. Because the Project is intended to be ongoing for more than forty years, not all circumstances can be anticipated, much less addressed. Many of the circumstances, as well as the definitive rights and obligations of KUCC, JVWCD and

the State under the Project and implementing agreements, are referred to throughout this Proposal and summarized in Section 5.6 (Concentrate Disposal), Section 9 (Project Funding) and in Section 13 (Liability and Agreements) below.

2.0 BACKGROUND

2.1 Natural Resource Damage Claim and Consent Decree (UDEQ)

The Utah Department of Health filed a complaint in 1986 under the provisions of CERCLA seeking damages from KUCC "for injury to, destruction of, and loss of natural resources." The Utah Department of Health was acting as the CERCLA Trustee in making this claim. The claim pertained to injury to surface and groundwater resulting from the release of pollutants and hazardous substances from milling and mining activities by KUCC and its predecessors in the southwestern part of the Salt Lake Valley.

In 1990, UDEQ, the successor Trustee, arrived at an NRD settlement with KUCC. An NRD Consent Decree was proposed to the United States District Court for the District of Utah.

JVWCD (then the Salt Lake County Water Conservancy District) petitioned the court to allow JVWCD to intervene, claiming that the proposed Consent Decree was insufficient to address damages to the groundwater aquifer. Following a hearing in 1991, the District Court allowed JVWCD to intervene, finding JVWCD uniquely situated to contribute to resolving the underlying factual and legal issues associated with the UDEQ claim. The court did not approve the Consent Decree proposed in 1991.

An appeal to the 10th Circuit Court of Appeals followed, which was dismissed for lack of jurisdiction. The subsequent petition for a writ of certiorari to the United States Supreme Court also was denied.

The three parties (KUCC, UDEQ and JVWCD) then entered into negotiations for a revised settlement. Numerous technical discussions were held regarding potential remedial responses. These discussions resulted in a proposed Consent Decree dated May 30, 1995. In August 1995, the District Court approved and entered the final NRD Consent Decree.

The 1995 Consent Decree required KUCC to complete all source control efforts it had been pursuing since 1990. It also created a trust fund for administration by the State CERCLA Trustee for natural resource damage. KUCC has now completed all source control work.

The Trustee utilized the cost of restoration methodology in computing the amount of damage. The value of the settlement was based on the cost of a possible alternative for returning the volume of contaminated water (8,235 afy) to beneficial use. This method is to extract water through wells, and build and operate a treatment plant to produce municipal quality water. It was calculated that a treatment plant using nanofiltration or reverse osmosis technology would have an 85 percent net output of municipal quality water. This equates to 7,000 acre-feet of water as provided for in the Consent Decree, with a loss of 1,235 acre-feet of water in the treatment process.

The treatment system concept used for damage calculation requires extraction wells and related facilities, collection pipelines, a treatment plant, a brine discharge pipeline and a distribution pipeline. The costs of producing 7,000 acre-feet of water annually for 50 years in 1995 dollars, was calculated to be $4,000 per acre-foot. The $4,000 per acre-foot cost of treatment includes the capital costs of construction of a treatment plant (40%) and the cost to operate, maintain and replace facilities over an estimated life of 50 years (60%). The present value of funding for such a project was estimated at $28 million in 1995 dollars.

The Consent Decree required that KUCC provide funding for a Natural Resource Damages Trust Fund with two components. First, KUCC provided the ILC in the amount of $28 million, escalating annually at seven percent. The $28 million was equivalent to the present value of the cost of restoring the ground water through the restoration methodology described above. Second, the Trust Fund included a cash payment of $9 million that was provided to the State Trustee. The $9 million was estimated as the cost of replacing that amount of ground water that would be lost in the concentrate from the treatment process and is sometimes referred to as the "lost use" component of the NRD Trust Fund. The Consent Decree provides that the $9 million "shall be expended only to restore, replace or acquire the equivalent of the surface or groundwater resources for the benefit of the public in the affected area..." The $9 million has been invested by the State of Utah and has increased in value. This portion of the Trust Fund, also sometimes referred to as the cash portion, is to be used for the Lost Use component of the Project or Lost Use Facilities as more fully described in Sections 5 and 10 below.

The following table shows the increasing value of the $28 million ILC and the $9 million cash payment:

Table 2.1 State NRD Trust Fund			
Date	KUCC Irrevocable Letter of Credit Value [(a)] (Millions)	$9 Million Cash Payment Value [(b)] (Millions)	Total Value (Millions)
September 1995	$28.0	$9.0	$37.0
September 1996	$30.0	$9.5	$39.5
September 1997	$32.1	$9.9	$42.0
September 1998	$34.3	$10.4	$44.7
September 1999	$36.7	$10.9	$47.5
September 2000	$39.3	$11.5	$50.8
September 2001	$42.1	$12.3	$54.4
September 2002	$45.0	$13.2	$58.2

(a) Increases at seven percent annually
(b) Assumed annual increase of five percent, as invested by UDEQ.

The NRD Consent Decree acknowledges the separate CERCLA remedial action process by the USEPA. The Consent Decree contemplates the likelihood of formulating a remedial response for the NRD that would correlate with the remedial response required by USEPA under federal CERCLA requirements. Because of this, the Consent Decree requires that "the Trustee shall not expend funds secured by the letter of credit until the earlier of two years after the issuance of the Record of decision (ROD) or July 1, 2000, unless the Trustee determines that there exists a direct and immediate threat to the public health or the environment that necessitates expenditures to restore, replace or acquire the equivalent of the resource."

Prior to the expenditure of such funds, KUCC can obtain a reduction in the amount of the ILC if KUCC provides and delivers municipal quality water through treatment of contaminated water to a system of a purveyor of municipal and industrial (M&I) water in a manner that is acceptable to the Trustee, and in a manner that meets the specific requirements of the credit provisions. "Municipal Quality Water" is defined in the Consent Decree as water originating west of the Welby Canal with total dissolved solids (TDS) concentration of 500 mg/L (and 250 mg/L sulfate), and water originating east of the Welby Canal to 800 mg/L TDS (and 250 mg/L sulfate). Allocation of the right to use surface or groundwater resources "shall be by the Utah State Engineer pursuant to Utah water law."

The other requirements that KUCC must satisfy to receive the reduction described above include the following:

a. The water must be accepted by the M&I purveyor with the water right to put the water to beneficial use, in exchange for which the purveyor is to pay KUCC no more than the operation and maintenance costs absent the contamination up to $49 per acre-foot in 1995 dollars;

b. The extraction of the contaminated water must proportionately prevent or reduce the spread of aquifer contamination;
c. The municipal quality water must be a sustainable water supply of 40 years or more; and
d. KUCC's project cannot increase materially the Trustee's unit cost to produce the remainder of the 7000 afy of municipal quality water.

As indicated above, two years after the issuance of the ROD or July 1, 2000, whichever is later, the ILC portion of the Trust Fund not allocated for a KUCC project may, at the Trustee's option, be converted to cash which shall be used by the Trustee to restore, replace or acquire the equivalent of the natural resource for the benefit of the public in the Affected Area.

The Project outlined in this Proposal seeks to utilize one half of the ILC for a KUCC project and one half of the ILC for a JVWCD project. The KUCC project is generally referred to as the Zone A Plant and the JVWCD project is generally referred to as the Zone B Facilities, which are more fully discussed in Sections 5 and 10 below.

2.2 Federal CERCLA Requirements Design (USEPA)

Substantial commencement of remedial studies under the federal requirements of CERCLA (also known as Superfund) followed the approval of the NRD Consent Decree. The main concern of the CERCLA process is the protection of human health and the environment.

In 1995, the USEPA Remedial Project Manager (of Region VIII) formed a Technical Review Committee (TRC) to oversee the remedial studies. Represented on the TRC are UDEQ, USEPA, Utah Department of Natural Resources, Utah State Engineer, Salt Lake City-County Health Department, JVWCD, US Geological Survey (USGS), University of Utah, local municipalities, a local chapter of the Sierra Club and other community stakeholders.

During 1995-1998, KUCC conducted many studies as part of a remedial investigation/feasibility study (RI/FS). The TRC provided oversight during this process. Much information and data were produced and provided by KUCC regarding the characteristics of the Affected Area, including hydrogeology, groundwater quality, groundwater recharge sources, a well inventory and future groundwater and contaminant movement in the Affected Area.

The feasibility study portion of the RI/FS included groundwater modeling by KUCC to project various scenarios of future groundwater and contaminant movement. This modeling involved groundwater flow modeling, particle tracking and solute transport modeling. Various scenarios of remedial action were modeled, addressing future time periods of 25, 50 and 150 years. A groundwater model provided by the USGS

served as the basis of this modeling, and the final results were reviewed and approved by the USGS. A summary of this modeling is attached (Appendix A).

The final draft RI/FS reports were issued by KUCC in March 1998. In March 2000, KUCC formulated a remedial response that correlates with the NRD Consent Decree requirements and presented this response to the USEPA, UDEQ and TRC. The USEPA Remedial Project Manager accepted this proposed remedial action plan and submitted the integrated remedial response program to the federal Remedy Review Board for their consideration and approval in May 2000. The next steps in the federal CERCLA process involved public hearings and ultimately issuance of a ROD by USEPA, which occurred on December 13, 2000 (Appendix B).

Following the issuance of the ROD, KUCC prepared a Remedial Design Work Plan, Preliminary Design and Final Remedial Design and submitted these to USEPA and the State of Utah. The Final Remedial Design (December 2002) details the technical and operating design of the ground water remediation program, including the Zone A Plant discussed in Section 5 below. The Final Remedial Design also includes a groundwater monitoring plan and third party mitigation plan in the event of quantity or quality related issues at third party sites. This document is available at the West Jordan library or at UDEQ offices.

As a result of details presented in the Final Remedial Design, USEPA issued a draft "Explanation of Significant Differences" dated April 14, 2003, for the selected remedy in the ROD. Generally, the differences do not change the overall approach, which uses barrier wells to prevent the spread of contamination; treatment and beneficial use of the sulfate contaminated water; and extraction of the low pH plume.

2.3 KUCC/JVWCD Study and Conceptual Design

KUCC and JVWCD jointly commissioned a study to determine the best method of accomplishing the goals of the NRD Consent Decree and federal CERCLA remedial requirements for contaminated groundwater in the southwestern Salt Lake Valley. KUCC and JVWCD retained the firm of Camp Dresser and McKee (CDM) to perform this study, which resulted in a conceptual design for an extraction well and treatment project that meets State and Federal expectations. The conceptual design will produce 7,000 afy of municipal quality water, as was contemplated for the treatment component of the State NRD Consent Decree. It also provides for additional replacement of water beyond that contemplated by the Consent Decree, including the 1,235 afy of water otherwise lost in the treatment process. This "Lost Use" water will result from treatment of shallow groundwater under JVWCD water rights and will produce at least 1,235 afy, and up to 2,300 afy of treated water.[1]

[1]CDM noted that the recovery rate (85%) assumed in the supporting document for the Consent Decree would likely not be achieved for a portion of the project. Thus additional groundwater extraction may be required to produce the 7,000 AF of treated water as required under the Consent Decree.

KUCC and JVWCD requested that CDM consider a 50-year operating period for the Project. CDM has shown net present value of costs for construction and 50 years of operation, maintenance and replacement for the Project. This exceeds the 40-year operation period specifically required in the Consent Decree. Later sections in this Proposal will show that some of these costs based on the 40-year period will exceed the Trust Fund amounts. KUCC and JVWCD will provide additional funds to make up this difference.

Since the completion of the CDM report, additional preliminary design and cost estimates have been completed by Carollo Engineering (Zone B and Lost Use) and KUCC Engineering Services (Zone A). The Carollo and KUCC estimates represent the latest cost estimate information and the basis for Project costs presented in this Proposal.

2.4 JVWCD System and Service Area

JVWCD is a political subdivision of the State of Utah. It was created in 1951 by the State Legislature under the Water Conservancy Act. The District remains under the jurisdiction of the Third District Court of the State of Utah. A board of eight trustees, who represent seven geographical divisions, governs JVWCD. Board members are nominated by either the county commission or city council, depending upon the division they represent. The Governor appoints each trustee for a four-year term.

JVWCD provides M&I water to most areas of Salt Lake County that lie outside of the Salt Lake City service area. Parts of northern Utah County are also served by JVWCD. Figure 2.4A shows this service area.

JVWCD provides water under wholesale water purchase contracts to nineteen member agencies, including cities, improvement districts, state agencies and private companies. JVWCD also provides and distributes water to individual homes and businesses on a retail basis in areas where no viable retail agency exists. JVWCD also provides wholesale service indirectly to High Country Estates Phase II Homeowners Associates. JVWCD treats and transports water to the Metropolitan Water District of Salt Lake & Sandy.

JVWCD operates a raw water collection system that collects water not only from local mountain streams in Salt Lake Valley, but also imports water from the Weber, Provo and Duschesne Rivers. JVWCD operates two water-treatment plants and a treated-water transmission system within Salt Lake Valley. This system is shown in Figure 2.4B. The system contains hundreds of miles of aqueduct, transmission and distribution pipelines, and can convey water from any source to virtually any point within Salt Lake Valley. The system also involves wells, booster pump stations and treated water storage reservoirs.

3.0 PURPOSES OF PROPOSED PROJECT

KUCC and JVWCD have formulated the Project to meet the intent of the NRD Consent Decree, as well as the requirements and intent of the federal CERCLA process. These purposes are described in the following paragraphs.

3.1 Meet the Requirements and Intent of the NRD Consent Decree

The purposes of this Project include the following:

- Reduce the spread of aquifer contamination through extraction of contaminated water that will proportionately prevent or reduce the spread of contamination.
- Restore the ground water resource by treating contaminated water and providing drinking quality water for the public in the Affected Area, and
- Remediate the aquifer over the long term.

3.2 Meet the Intent and Remedial Requirements of CERCLA

The ROD detailed the preferred remedy addressing groundwater contamination in the southwestern Jordan Valley. The preferred remedy includes groundwater treatment and is intended to work in conjunction with this Proposal. The Project includes the following elements outlined in the ROD and reconfirmed in the draft "Explanation of Significant Differences" dated April 14, 2003 (Appendix B).

- Protect human health and the environment,
- Withdraw and treat the heavily contaminated waters from the core of the acid plume in Zone A (discussed in Section 4 below),
- Install barrier wells at the leading edge of the contamination (1500 ppm sulfate or less) and pump and treat the waters to prevent further plume movement,
- Provide reverse osmosis treated water for municipal use,
- Monitor the plume,
- Dispose of treatment concentrates in pipeline used to slurry tailings to the tailings impoundment prior to mine closure, and
- Develop a post-mine closure plan to handle treatment residues.

3.3 KUCC/JVWCD Purposes

KUCC and JVWCD have additional purposes that will benefit the public beyond the requirements of the State NRD Consent Decree or federal CERCLA requirements, which are included in the Proposal. These purposes are to:

- Implement a project that is comprehensive and efficient in groundwater development, water delivery, operational and political issues,

- Improve the treated water quality delivered to JVWCD beyond the 500-800 mg/L total dissolved solids (TDS) level contemplated in Section I.D. of the Consent Decree, to 250 mg/L TDS,

- Restore and replace groundwater from the Affected Area (see Consent Decree for definition of Affected Area) that is lost as a concentrate stream resulting from membrane treatment processes. JVWCD proposes a shallow groundwater membrane treatment project under its own water rights to accomplish this purpose, which is contemplated in the Consent Decree,

- Initially utilize existing facilities for concentrate disposal, in order to create additional cost savings and permitting efficiency, and

- Better meet the needs of growing municipalities in the Zone A area (described in Section 4 below) by providing treated water at a high elevation that allows for westward land development.

4.0 AFFECTED AREA AND PUBLIC IN THE AFFECTED AREAS

4.1 Affected Area

The NRD Consent Decree requires that the Trustee use the benefits of the Trust Fund to restore, replace or acquire the equivalent of the natural resource "for the benefit of the public in the Affected Area..." (V.D.4). The Consent Decree further defines "injury to...groundwater" as contamination caused by KUCC's mining and leaching operations resulting in: 1) increased levels over baseline of total dissolved solids, including sulfates, 2) pH levels lower than baseline, 3) metals concentrations exceeding baseline, or 4) solid phase contamination in the aquifer that can be re-dissolved in the future." (Section I(c))

For purposes of the Proposal, the total envelope is divided into two zones, Zone A and Zone B. Zone A encompasses approximately the western half of the Affected Area, and includes the high sulfate and low pH portion of the plume emanating from the Bingham Canyon area. Zone A includes the area commonly referred to as the "acid plume."

Zone B encompasses approximately the eastern half of the Affected Area, and includes areas affected by the former evaporation ponds in South Jordan. It includes the majority of the area referred to by the TRC as the "sulfate plume."

5.0 PROPOSED PROJECT

5.1 General

The physical facilities of the proposed Project are described in the conceptual design report by CDM (See Attachment). That report provides substantial detail regarding extraction, treatment process, pipelines, water treatment plants, treated water delivery locations and concentrate disposal provisions.

The proposed Project facilities are divided into Zone A Plant, Zone B Facilities and Lost Use Facilities. The CDM conceptual design report explains the cost-effective reasons for this segregation. Since the completion of the CDM report, additional preliminary designs and cost estimates have been completed by Carollo Engineers (Zone B and Lost Use) and KUCC Engineering Services (Zone A). The Carollo and KUCC estimates represent the latest cost estimate information and are the basis for Project costs presented in this Proposal.

5.2 Groundwater Extraction

KUCC plans to utilize existing extraction wells 1193 and 1200[2] in Zone A. Additionally, KUCC will operate well LTG1147, its "sulfate extraction well", north of Herriman. This will contain and contract the plume in the Lark area. Some of this extracted water may be used as feed for the Zone A Plant. These extractions will provide sufficient feed water to the Zone A Plant to provide for 3,500 afy of treated water from the deep, principal aquifer.

KUCC plans to operate its acid plume extraction wells 1146, 1201 and other acid extraction wells to be completed over the next 15 years to remove the majority of the mass of the acid plume as quickly as possible (see Appendix D). These wells are also shown on Figure 5.2A. Table 5.2A shows the estimated annual volumes of groundwater extraction from these wells.

JVWCD will utilize new extraction wells B1 through B7 in Zone B for groundwater extraction from the principal aquifer for treatment at the Zone B Facilities, as shown in Figure 5.2A. Table 2-1 in the CDM report gives more information on each well. (Note that wells B6 and B7 from the CDM report have been combined to a single, higher production well shown as B6 in Figure 5.2A. Well B8 from the CDM report is shown as B7 in Figure 5.2A.)

New wells SW1 through SW4 are additional shallow wells to extract up to 3,000 afy from the shallow aquifer zone, which lies above the deeper principal aquifer in areas just west of the Jordan River. This water will be treated at the Lost Use Facilities and

2 In the past, or in other documents, KUCC wells 1193 and 1200 were previously referred to as wells K60 and K109.

will satisfy the lost use portion of the NRD Consent Decree by providing for the replacement of water lost in the waste stream as part of the treatment process. Table 5.2A tabulates the average annual extractions from these wells. The annual extraction volumes from individual shallow and deep wells may vary, based upon operating experience that will be gained by KUCC and JVWCD over the forty year life of the Project.

TABLE 5.2A **Annual Groundwater Remediation Extraction Volumes**	
Wells	Annual Extraction (AF)
Zone A Acid Wells	2400-4000
Zone A (wells 1193 and 1200)	2800-3500
Zone A sulfate well (1147)	1600
Zone B (wells B1-B7)	4300
Shallow Wells SW1-SW4	1600-3000
Total	11,900-15,600 AF

If necessary, additional extractions may be made by KUCC to contain and contract critical portions of the acid and highly elevated sulfate plume to protect human health and the environment.

5.3 Collection Pipelines

Collection pipelines ranging in diameter from 8-16 inches will collect extracted water from Project extraction wells and convey the feed water to either the Zone A Plant or Zone B/Lost Use Facilities. Collection pipelines for the Project are shown in Figure 5.2A.

5.4 Water Treatment Plants

CDM originally evaluated the treatment process required to produce municipal quality water from groundwater in the Affected Area in their 1999 study and report. The membrane process known as reverse osmosis (RO) was selected by CDM. JVWCD has selected a treated water quality with a maximum TDS concentration of 250 mg/L. The process to accomplish this has been further studied through pilot testing by KUCC and JVWCD.

Two RO water treatment plants are proposed. Figure 5.2A shows a Zone A Plant, located south of the Bingham Reservoir, at approximately 8400 West 10400 South. The Zone A Plant will be constructed on land owned by KUCC. Combined Zone B/Lost Use (shallow groundwater) Facilities will be constructed on land owned by JVWCD, at 8300 South 1000 West. This location is also shown in Figure 5.2A. Although the Lost Use and Zone B water treatment processes will be combined in a common treatment plant building, the two processes will perform independently.

Figure 5.4A is a treatment flow chart for the Zone A Plant that schematically shows water flows and facility relationships. Figure 5.4B is a treatment flow chart for Zone B.

KUCC has prepared design criteria and a preliminary site layout for the Zone A Plant. Carollo Engineers has prepared design criteria for the Zone B/Lost Use Facilities processes. These design criteria are explained in Table 6.1 in Appendix H. Carollo has also prepared site layout for the Zone B/Lost Use Facilities, which are shown on Figure 6.1 and 6.3 in Appendix H.

Treatment plant flow rates are shown on Table 5.4A. Abbreviations in this table include acre-feet per year (afy) and million gallons per day (MGD).

Table 5.4A
Treatment Plant Flows

Treatment Process	Feed Water		Product (Treated) Water	
	(afy)	(MGD)[b]	(afy)	(MGD)[b]
Zone A	4600[a]	4.46	3500	3.46
Zone B	4300	4.26	3500	3.46
Lost Use	1600-3000	3.0	1235-2300	1.22-2.27

(a) Approximate. Zone A will deliver sufficient feed water to produce 3500 AF/yr of permeate.
(b) Based on treated volume produced in 330 days per year.

The feed water and treated water from the Lost Use (Shallow Wells) Facilities is shown in Table 5.4A by ranges. The lower range corresponds to the minimum treated water annual volume of 1,235 acre-feet, as required by the Consent Decree to offset lost use of concentrate. The upper range represents an annual treated water volume of 2,300 acre-feet.

KUCC and JVWCD have completed pilot/demonstration RO plants for Zone A and Zone B over the last three years. Results from these pilot plant studies have demonstrated the technical and economical feasibility for the use of RO technology as proposed in this document. Scale up of RO technology is not difficult, as the RO plants will be constructed in a modular fashion (i.e. larger RO plants require additional banks of membranes and additional pumps to feed them). Both pilot plants produced permeate for several months, the quality of which was significantly

better than primary drinking water standards.

The pilot study report for the Zone B RO Plant is attached as Appendix H. A copy of the Zone A pilot study report is available for review at the State Division of Environmental Response and Remediation upon request.

5.5 Treated Water Deliveries

The two treatment plants are located within the service area of the JVWCD infrastructure for treated water conveyance. The delivery of treated water to the JVWCD system is shown in Figures 5-5 and 5-8 of the CDM report, and slightly modified in Figure 5.2A herein.

The Zone A Plant will produce water at a relatively high elevation, in JVWCD's pressure zone C or higher. This plant will produce water that will be conveyed to the Zone A metering station along 10200 South. From this point, JVWCD will route water into their distribution system. This will be a substantial benefit to the public in the Affected Area by receiving treated water at a high elevation to allow for westward land development in Herriman, Riverton, South Jordan, and West Jordan.

The Zone B treated water will be conveyed westward to JVWCD's 78-inch Jordan Aqueduct at 7800 South 3600 West. This will provide water to the public in the Affected Area, either directly or by exchange.

5.6 Concentrate Disposal

KUCC proposes to use its existing tailings slurry conveyance pipeline from Bingham Canyon to the North Tailings Impoundment for conveyance of concentrate from the Zone A Plant (see Figure 5.4A). The much greater flow of KUCC tailings slurry in this pipeline will serve to stabilize the Project concentrate streams (Table 5.6A).

Table 5.6A indicates that the change in chemistry in tailings water from addition of RO concentrate is very small, within the range of variability of tailings water quality. Therefore, it is unlikely that this addition will change the characteristics of the tailings discharge significantly.

Table 5.6A Effect of Zone A Reverse Osmosis Concentrate on Tailings Line Chemistry				
Parameter	Tailings Line 2002 Ave.	Zone A RO Concentrate (Typical)	Composite Flow*	Net Change (percent)
SO_4	4103	5971	4135	0.78
TDS	7934	10,317	7975	0.5
pH	6.97	7.3	6.97	0.00
Ca	716	2054	739	3.21
Cl	1623	680	1607	-0.99
K	142	19	140	-1.41
Mg	510	620	512	0.39
Na	940	294	929	-1.17
Al	0.094	< 0.010	0.092	-2.13
As	0.007	0.023	0.007	0.00
Cd	0.003	< 0.001	0.003	0.00
Cu	0.155	0.027	0.155	0.00
Mn	12.11	< 0.010	11.904	-1.70
Pb	< 0.005	< 0.005	< 0.005	NA
Se	0.042	0.014	0.042	0.00
Zn	0.054	0.022	0.05300	-1.85

Notes: All values in mg/L except pH
*Composite flow uses MDL as concentration of metals in concentrate
Tailings water flow, 34,500 gpm; RO concentrate flow, 600 gpm. Range of tailings concentrations typically ± 20 percent.
NA = Not Applicable

Disposal in the KUCC tailings impoundment will simplify permitting issues associated with discharge. The tailings impoundment is subject to a Utah Pollutant Discharge Elimination System (UPDES) and State of Utah groundwater permit, and KUCC will continue to be responsible for meeting discharge requirements from the impoundment. After mine closure or at such other time, when operation of the tailings line slurry will cease, KUCC proposes to discharge the RO concentrate directly to the Great Salt Lake through the existing tailings pond discharge system. The composition of the discharge after 30 years is estimated to be similar to that shown in Table 5.6A.

Sections 3 and 6 of the CDM report fully explain the recovery rate of the RO treatment processes and the concentrate streams. Pilot studies have confirmed these approximate rates. In summary, they will be as shown in Table 5.6B:

Table 5.6B Project Concentrate Flows		
Treatment Process	Concentrate Flow Rate (MGD)	Concentrate Discharge Location
Zone A	1.1	Before mine closure to KUCC tailings pipeline and tailings impoundment; After mine closure to GSL via concentrate discharge pipeline
Zone B	0.8	To Jordan River*
Lost Use	0.4-0.7	To Jordan River*

*See text below for explanation

KUCC is willing to accept the concentrate stream from treatment of Zone B deep groundwater in its tailings slurry pipeline (see Figure 5.4B). However, JVWCD proposes, as the primary approach for the Project, to discharge the concentrate streams resulting from the Lost Use component (shallow wells) and from the Zone B deep wells northward to the Jordan River. The concentrate is proposed to discharge to the Jordan River at 2900 South, downstream from the Central Valley Water Reclamation Facility (CVWRF) discharge location.

Actual concentrate samples were produced during the pilot testing phase for Zone B and Lost Use waters. These samples were used for toxicity testing utilizing standard organisms. The results of toxicity testing also indicate that permitting of concentrate discharge to the Jordan River at 2900 South will be feasible.

On this basis, JVWCD submitted a Utah Pollution Discharge Elimination System (UPDES) permit application to the Division of Water Quality for discharge of Zone B and Lost Use concentrate to the Jordan River. The permit application is currently out for public comment to discharge concentrate at 2900 South and feed water and product water at 8300 South.

Certain assumptions concerning disposal of concentrate were made in reaching the NRD settlement and in developing this Proposal. The following assumptions will be important to the feasibility of this Project:

- Prior to mine closure, the concentrate stream from the Zone A Plant, and Zone B if necessary, can be managed and conveyed in the tailings slurry pipeline operated by KUCC. The concentrate would then be disposed in KUCC's tailings impoundment and any water decanted from the concentrate stream would be disposed or handled in accordance with KUCC's UPDES and groundwater permits.

- After mine closure, or prior to that time if for any reason the concentrate stream cannot be managed within the tailings disposal system, direct discharge of the Zone A treatment plant concentrate stream to the Great Salt Lake will be addressed through KUCC's UPDES discharge permit.

- The combined concentrate streams from Zone B and Lost Use wells can be permitted under a UPDES permit to discharge at 2900 South.

6.0 GROUNDWATER IMPACTS AND REMEDIATION

6.1 Groundwater Modeling

Flow Model. KUCC developed a groundwater model of the southwestern Jordan Valley as part of the RI/FS to analyze flow paths and groundwater velocities in the principal aquifer and to evaluate remedial options. The Affected Area is within the southwestern Jordan Valley. The model area extends from the bedrock/alluvial interface at the base of the Oquirrh Mountains on the west, to the bedrock/alluvial interface at the base of the Wasatch Mountains on the east, and from approximately 6000 South on the north to the northern base of the Traverse Mountains on the south. Model calibration closely simulated observed aquifer conditions in the southwestern Jordan Valley. A more complete description of this model is included in Appendices A and D.

Transport Model. KUCC's calibrated groundwater flow model was then coupled with a contaminant transport code to model historical and future migration of storm and mine waste water that leaked from the former Bingham Creek reservoir. This model combines groundwater flow with the physical aspects of contaminant transport including advection, dispersion and chemical reactions. The transport model was calibrated to observed 1996-1997 sulfate concentrations down gradient of the former Bingham Creek reservoirs. Calibration was achieved by finding a set of transport parameters (i.e., retardation, dispersivity and porosity) within an accepted range that reasonably reproduced field-measured concentrations. The model is believed to be a reasonable first approximation of the kinematics of the Bingham Creek and former evaporation ponds plumes and allows the feasibility of various remedial strategies to be tested.

Both the flow and transport models were extensively reviewed by USEPA, UDEQ, the USGS, the TRC and outside international and nationally - recognized reviewers.

6.2 Hydrogeology

Groundwater Recharge. The principal aquifer is recharged from surface infiltration of precipitation, irrigation water and canal water, bedrock inflow and to a limited

extent surface infiltration of waters emanating from Butterfield Creek. The bedrock of the Oquirrh Mountains provides recharge to the groundwater in the western part of the southwestern Jordan Valley , and this groundwater then travels eastward into the basin. Aquifer recharge is greater in the eastern part of the southwestern Jordan Valley and in the Herriman area due to recharge from surface water.

Groundwater Extraction. Most of the water extracted from the principal aquifer is used for municipal or industrial purposes. A summary of extractions used in the modeling is included in Appendix A.

Groundwater Elevation Changes. The average depth below ground surface to the potentiometric surface of the principal aquifer in the southwestern Jordan Valley is about 235 feet. Groundwater flow is predominantly west to east from the base of the Oquirrh Mountains to the Jordan River. Groundwater elevations declined substantially throughout the southwestern Jordan Valley from 1986 to 1996. A noteworthy area of decline is in the region of the West Jordan City well field, to the north of the Affected Area. A description of recent groundwater elevation changes used in the modeling is included in Appendix A.

Groundwater Velocity. Average horizontal groundwater velocities have been estimated by KUCC to be about 550 feet per year. Isotopic analyses were conducted by KUCC to confirm this estimate. These analyses yielded a linear groundwater velocity estimate of 500-650 feet per year. A more complete discussion of these estimates and analyses is included in Appendix A.

6.3 Plume Contraction and Containment

Using the groundwater flow and transport models, the region adjacent to KUCC production wells 1200 and 1193 and the West Jordan municipal well field was investigated using the following pumping parameters: West Jordan pumping 4000 afy, well 1200 at 1600 afy, well 1193 at 800 afy, Lark sulfate well 1147 at 800 afy, and acid extraction wells (1146 and future wells) at 2400 to 4000 afy. Zone B wells are pumped at 4200 afy. Based on these extractions, predictions can be made regarding the disposition of sulfate (Appendix D).

The modeling runs suggest that the proposed containment and extraction system will be effective at keeping acidic and elevated sulfate (> 1500 mg/L) groundwater on KUCC property near the acid and sulfate extraction wells in Zone A. It also reduces sulfate concentrations throughout Zones A and B in the Affected Area. These modeling runs also suggest that the ideal environment for sulfate containment and restoration of the aquifer involve West Jordan City limiting its well field pumping to less than 3,000 afy. This is close to the sustained yield of the aquifer in that area. KUCC and West Jordan are continuing to work together to optimize extraction amounts or other mitigation technologies such as injection. See

Appendix D for further detail on plume containment and remediation as well as potential regional drawdown from extraction.

7.0 WATER RIGHTS AND MANAGEMENT WITHIN AFFECTED AREA

7.1 Consent Decree Requirements

The Consent Decree states that, "allocation of the right to use surface or groundwater resources by the public shall be by the Utah State Engineer pursuant to Utah water law." In order to obtain a credit against the ILC, the Consent Decree requires that groundwater be treated to municipal quality, and provided to a M&I water purveyor. It anticipates that municipal water rights will be used for Project groundwater extractions.

7.2 Water Rights in the Affected Area

The only water rights approved for municipal use in the area, as of the date of the first version of this Proposal in December 1999 are shown in Table 7.2A.

TABLE 7.2A
Approved Municipal Water Rights in December 1999

Water Right Number	Owner	Priority Date	Flow Rate (cfs)	Potential Annual Withdrawal (AF)
59-1210	JVWCD	1955	3.55	850
59-1536	JVWCD	1959	5.0	3613
59-1572	West Jordan City	1960	1.0	723
59-1533	Riverton City	1959	1.25[a]	903

[a] One of four points of diversion lies near the Affected Area.

Since December 1999 KUCC has gained change application approvals for some of its industrial water rights to provide municipal supply in the JVWCD service area.

JVWCD has gained approval of various change applications for shallow groundwater rights near the Jordan River in the Affected Area. These are summarized in Table 7.2B.

TABLE 7.2B Approved JVWCD Shallow Groundwater Rights				
Water Right Number	Underlying Water Right Owner	Priority Date	Flow Rate (cfs)	Potential Annual Withdrawal (AF)
57-5513 (a23590)	JVWCD	1870	11.78	5000
59-5619 (a23711)	Utah & Salt Lake Canal Co.	1870	15.48	2882
59-3500 (a23622)	South Jordan Canal Company	1870	5.77	1205
59-5622 (a23863)	WJWUC/East Jordan Irrigation Company	1870	16.85	4797
59-3529 (a23486)	JVWCD	1870	5.3	31.5

The following water rights have been approved by the State Engineer, and are in place for extraction wells in Zones A and B of the proposed Project:

TABLE 7.3A Approved Water Right Change Applications				
Water Right Number	Owner	Annual Volume (AF)	Zone	Extraction Wells
59-1210	JVWCD	850	B	B6-8
59-1536	JVWCD	3350	B	B1-8
59-1653	KUCC	1600	A	1193, 1200, 1147, 1139
59-1042	KUCC	2400	A	1193,1200, 1147, 1139
59-5314	KUCC	374	A	1193, 1200, 1147 and 1139
59-1671	KUCC	66.13	A	1147
59-1352	KUCC	136.45	A	1147

7.3 Proposal to the State Engineer Concerning Water Rights

In August 1999, KUCC proposed to the State Engineer that certain restrictions be placed on future water development in the southwestern Jordan Valley to facilitate the NRD remedial process proposed here and to prevent further migration of existing contamination. These restrictions included:

- Completion depth and pumping rate restrictions on wells drilled within 3,000 feet south of the known 250 mg/L sulfate isoconcentration line in the Herriman area (Figure 4.1A).
- Completion depth and pumping rate restrictions on wells drilled within 3,000 feet north of the known 250 mg/L sulfate isoconcentration line in the West Jordan area (Figure 4.1A).
- Prohibition of new well development within the 250 mg/L sulfate isoconcentration line in the former KUCC evaporation pond area (South Jordan) until KUCC installs its NRD remediation and water supply and treatment systems, achieves hydraulic containment of the up-gradient groundwater plume, and the system reaches steady state and achieves a sulfate level in the area below 250 mg/L.

Appropriate completion depths and pumping rates would be determined on a case-by-case basis using the most recent information on location and depth of contamination, aquifer properties and user needs. KUCC would supply this information to the State Engineer and any water user upon request. The restricted area will shrink as remediation and natural attenuation reduce the size of the contaminated zone.

The practical aspects of this request were incorporated in the State Groundwater Management Plan issued by the State Engineer in 2002 (Appendix E). Specific details regarding groundwater management in the southwestern Jordan Valley are detailed in the plan.

KUCC is committed to assist property owners affected by KUCC remediation efforts in obtaining an adequate water supply by identifying alternative water sources, providing technical assistance in siting and completion of supply wells, and providing supplemental financing in cases where the presence of contamination causes an additional cost burden to the property owner.

8.0 COST ESTIMATES

8.1 Capital Costs for Deep Groundwater Extractions

Zone A and Zone B facilities are involved in deep groundwater extractions for the Project. This is the base project that was initially contemplated by the State NRD Consent Decree. The CDM conceptual design report includes documentation and tables showing capital cost estimates for this part of the Project in Zones A and B. In summary, Table 7-2 in the CDM report shows these capital cost estimates. These estimates were updated in late 2002 and are shown in the following sections.

As previously mentioned, additional design and cost estimates have been completed since the original CDM report. JVWCD retained the engineering firm or

Carollo Engineers to perform membrane treatment pilot testing and to prepare a cost estimate for the Zone B component of the proposed Project. This report was completed in October 2002. Table 9.0A summarizes the capital costs estimated for the Zone B portion of the proposed Project. These costs are expressed in October 2002 dollars. Note the total capital cost estimate is $24.79 million. These estimates include a ten percent bid contingency, intended to represent variation in the bidding climate at the time of bidding.

The current cost estimate for Zone A facilities is also shown in Table 9.0A. In summary, the Zone A Plant is estimated at $15.5 million and Zone B Facilities at $24.8 million (October 2002 dollars).

8.2 Capital Cost Estimates for Shallow Groundwater for Lost Use

Capital costs are explained in the CDM report for the Lost Use shallow groundwater extraction facilities. Table 7-2 in the CDM report summarizes these cost estimates. CDM cost estimates were updated in 1999 and are available upon request. These estimates were also updated in late 2002 and are shown in the following sections.

Carollo Engineers performed pilot testing during 2002 for the Lost Use component, based upon shallow groundwater extracted from a prototype well. In Carollo's October 2002 report, design criteria and detail cost estimates were prepared.

The current cost estimates for the Lost Use Facilities is shown in October 2002 dollars later in Table 9.0A. The Lost Use Facilities are estimated to cost $12.3 million.

8.3 Concentrate Disposal Costs

As indicated above, Zone A concentrates are to be disposed in KUCC's tailings impoundment. Zone B concentrates also may be disposed in KUCC's impoundment if JVWCD so elects and certain conditions are satisfied. If the concentrates cannot be disposed in the impoundment for various reasons, such as permitting or after mine closure (estimated to occur in 2015-2030), the concentrates will be conveyed to the Great Salt Lake via a concentrate discharge line, provided the water chemistry at that time meets regulatory discharge limits. Bench scale testing of this alternative indicate that disposal of such concentrates to the Great Salt Lake is technically feasible without exceeding current KUCC UPDES discharge criteria or generating aesthetic issues due to low-density precipitates. If one or both of the concentrates is not suitable for direct discharge, then alternative disposal will be needed. If Zone B concentrates are being managed through KUCC's operations, and an alternative disposal option is necessary, JVWCD and KUCC will share capital costs to develop the alternative disposal project.

8.4 Operation, Maintenance and Replacement Costs

Current operation, maintenance and replacement (OM&R) costs for the Zone A Plant and Zone B and Lost Use Facilities are summarized in Table 9.0A. The OM&R costs for Zone A, Zone B and Lost Use are $12.8 million, $12.5 million, and $6.8 million respectively (shown in Table 9.0A on an net present value (NPV) basis over a 40-year operational period).

Carollo Engineers estimated the annual cost for Zone B and Lost Use components. These annual operation, maintenance and replacement (OM&R) costs on an NPV basis over 40 years also are summarized in Table 9.0A.

8.5 Avoided Capital Costs

The NRD Trust Fund was created to address contamination of groundwater that might otherwise have been developed for municipal purposes by M&I water purveyors. The Consent Decree contemplates that the water purveyor(s) receiving the Trust Fund benefits would pay the avoided cost of developing groundwater, absent contamination. This is referred to as "cost of development without contamination" in Attachment 16 of the Consent Decree and as the "avoided" costs herein.

JVWCD has performed a more detailed estimate of this avoided capital cost of development without contamination than was provided in the Consent Decree. Figure 8.5A shows the location of four wells that would have been developed by JVWCD (to extract 7000 AF annually) if contamination had not been present. The location of JVWCD transmission pipelines, pump station and reservoir facilities throughout the Affected Area would have made this an efficient endeavor. Table 8.5A lists the assumptions, and provides the details for the avoided capital cost estimate. The estimated avoided capital cost was estimated as $2.801 million in September 1999 dollars. This amount is indexed to October 2002 dollars, resulting in an estimate of $3.026 million.

TABLE 8.5A

Estimate for Avoided JVWCD Capital Cost of Groundwater Development, Absent Mining Contamination

September 1, 1999

1. Typical Well Drilling Cost Estimate:

Mobilize/Demobilize	1 LS	$27,000
Special conditions	1 LS	$6,480
Conductor casing	120 LF @ $223	$26,760
Drill 24" borehole	580 LF @ $59.40	$34,452
Geophysical logging	1 LS	$2,700
Caliper survey	1 LS	$1,080
Well installation:		
- 16" steel casing	500 LF @ $41.28	$20,640
- 16" well screen	200 LF @ $183.34	$36,668
- 2" gravel feed tube	300 LF @ $4.32	$1,296
Install gravel pack	500 LF @ $32.40	$16,200
Install annular grout seal	200 LF @ $40.42	$8,084
Initial well development	40 hr @ $243	$9,720
Install test pump	1 LS	$4,235
Well development pumping	40 hr @ $135	$5,400
Well pump testing	34 hr @ $135	$4,590
Video camera survey	1 LS	$1,945
Plumbeus/alignment testing	1 LS	$1,080
Disinfection/capping	1 LS	$1,570
Fluids/cuttings disposal	1 LS	$2,700
Total for typical well:		$212,600

2. <u>Pump building and site improvements:</u>

Land purchase	$50,000

Mobilize/demobilize	$15,060
Site improvements	$15,000
Landscaping/irrigation system	$20,800
Yard piping/structures	$6,100
Pump building/architecture	$43,420
Pump station mechanical	$41,260
Supply/install pump/motor	$41,800
Electrical systems	$28,680
Instrumentation/controls	$9,500
JVWCD RTU	$12,000
Change orders	$6,000
Total for typical well:	$289,620

III. Summary of total project costs:

Pipelines - 16,500 LF 10" PVC pipe at $4.00/LF	$66,000
Well drilling (4 wells)	$850,400
Well equipping (4 wells)	$1,158,480
Subtotal:	**$2,074,880**
Engineering @ 25%	$518,720
Contingency @ 10%	$507,488
Total Cost Estimate (rounded):	**$2,801,000**

Notes:
Assumptions:

- 7000 AF per year extraction
- Constant flow over 330 days per year (this is equivalent to flow pattern from NRD project)
- Total flow rate = 10.7 cfs
- 4 wells, each at average flow rate of 2.7 cfs (1200 gpm)
- Average well depth of 700 feet
- Brick pump building and site improvements/landscaping at each well
- Discharge to existing JVWCD transmission system.
- Well drilling costs are based on JVWCD's 1997 1159 East 4500 South well drilling costs, plus 8%.

Facilities:
(See Figure 8.4A)

- Pump building/site improvement costs are based on JVWCD's 1998-1000 1159 East 4500 South Well costs, plus 4%.

8.6 Avoided Operating Costs

The Consent Decree (article V.D.2.b.i.) requires that avoided operating costs for groundwater development without contamination be paid to KUCC toward a KUCC-proposed project funded from the Trust Fund. These avoided operating costs are to be paid by the benefiting water purveyor(s). The Consent Decree sets this cost at $49 per acre-foot in 1995 dollars. This cost is to escalate in accordance with the ENR "20 Cities" cost index. JVWCD has calculated the net present value of this operating cost contribution for a 40-year period, assuming a seven percent discount rate. The net present value is calculated as $2.762 million (in October 2002 dollars), as shown in Table 9.0A.

8.7 Total Cost Estimate

The total cost of the proposed Project is shown in Table 9.0A. In summary, the costs are as follows (in thousands of October 2002 dollars):

1. Zone A (Table 9.0A) – $40,316
2. Zone B (Table 9.0A) - $37,332
3. Lost Use (Table 9.0A) - $19,078

Total $96,726

These total Project costs do not include the costs of pilot testing and Zone A operating costs regarding the additional CERCLA response actions that KUCC has provided. They also do not include cost of land acquisition that has been expended by JVWCD and KUCC.

9.0 PROJECT FUNDING

Table 9.0A details the Project costs in October 2002 dollars. The various Project cost components are shown, including capital, O&M, and replacement. The O&M and replacement cost components are net present costs for 40 years of operation at a seven percent discount rate, based upon October 2002 dollars.

KUCC and JVWCD propose that the Project be constructed, operated and maintained by means of funding from various sources. The allocation of these funding sources is shown in Table 9.0A. However, Table 9.0A is not intended to reflect the timing of funding disbursements for various components of the Project. The Project Agreement and State Agreement set forth the detailed arrangements for funding sources and timing of funding disbursements.

To date, KUCC and JVWCD have funded membrane pilot testing, land acquisition and other activities in order to advance the Project. The following generally describes the stages of continued funding of the Project:

Stage 1:
KUCC will advance the capital costs for design and construction of the Zone A Plant and Zone B Facilities and a portion of the Lost Use Facilities.

Stage 2:
Design and construction of the Lost Use components of the Project will be funded largely from the cash portion of the Trust Fund, by means of scheduled monthly disbursements by the Trustee directly to JVWCD. JVWCD will then reach the "Complete and Operational" milepost for the Lost Use Facilities.

Stage 3:
When KUCC has reimbursed JVWCD for Zone B construction costs equal to one-half of the Zone B ILC[3], the Trustee will reduce the Zone B ILC by 50 percent and JVWCD will commit to deliver to the Affected Municipalities 1750 afy of municipal quality water. Incremental increases in such reimbursements will result in corresponding reductions to the Zone B ILC and increases in JVWCD's commitments for water delivery. When KUCC has reimbursed JVWCD for construction costs equal to the full amount of the Zone B ILC, the ILC will be reduced to zero and JVWCD commitment to deliver water to the Affected Municipalities will be 3500 afy, whether or not the Zone B Facilities reach Complete and Operational.

Stage 4:
Upon reaching Complete and Operational status for the Zone A Plant the Trustee will reduce the Zone A ILC by 60 percent.

Stage 5:

KUCC will operate the Zone A Plant following the Complete and Operational milepost. JVWCD will operate Zone B and Lost Use Facilities following the Complete and Operational milepost.

Stage 6:
KUCC will fund all OM&R expenses at the Zone A Plant. However, during the first five years of operation of the plant, the Trustee will annually release 15 percent of the remaining balance of the Zone A ILC for OM&R expenses, with a complete release at the end of five years. JVWCD and KUCC will fund all OM&R expenses at the Zone B Facilities.

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3 The ILC held in the Trust Fund is to be divided into two ILCs for the Project – the Zone A ILC for the Zone A component and the Zone B ILC for the Zone B Facilities. See Section 13.4 below.

Stage 7:
The Trustee will release amounts from the cash portion of the Trust Fund directly to JVWCD annually for OM&R costs incurred by JVWCD in operating and maintaining the Lost Use Facilities until the cash portion reaches zero.

In addition to the capital, operating, maintenance and replacement costs contributed by KUCC and JVWCD, as shown in Table 9.0A, the following contributions of land and assets currently owned by KUCC and JVWCD, or to be acquired by JVWCD, will be made to the Project:

- Zone A treatment plant site owned by KUCC
- Zone A wells and sites owned by KUCC
- Zone A water rights for wells 1193, 1200 and 1147 owned by KUCC
- Zone B treatment plant site owned by JVWCD
- Zone B and Lost Use wells owned by JVWCD
- Zone B and Lost Use water rights owned by JVWCD
- Additional In-kind contribution by JVWCD includes use of its water storage and distribution system
- Additional in-kind contributions by KUCC include:
  - Use of its tailings slurry pipeline for concentrate disposal
  - Acid plume well facilities and OM&R
  - Sulfate extraction well facilities and OM&R

Table 9.0
Distribution and Funding of Project Costs (in thousands of October 2002 dollars[a])
Based on Present Cost, 10% Contingency, and 40 years Operational Period
Discount Rate = 7%
April 4, 2003

Facility	Capital	Net Present Cost of 40 Year Operational Period: OM&R	Total	Funding Allocation: Trust Fund: ILC[b]	Trust Fund: Cash[c]	KUCC	JVWCD
Overall Project:							
Source control	133,223	30,036	163,259	0	0	163,259	0
Zone A:							
Acid wells	4,631	7,098	11,729	0	0	11,729	0
Sulfate well w/RO wells	0	0	0	0	0	0	0
Pilot Testing	1,573	0	1,573	1,573	0	0	0
RO feed wells	1,069	6,257	7,326	4,477	0	87	2,762 [g]
RO plant & pipelines	12,818	5,883	18,701	16,431 [e]	0	0	2,270 [f]
JVWCD process enhancement [d]	293	694	987	0	0	0	987
Subtotal Zone A	**20,384**	**19,932**	**40,316**	**22,481 [e]**	**0**	**11,816**	**6,019**
Zone B:							
Pilot testing	344	0	344	0	0	172	172
Land and R/W	900	0	900	0	0	200	700
RO plant [h]	10,173	4,380	14,553	3,890	0	4,153	6,510
Pipelines and wells [h]	12,783	5,808	18,591	18,591	0	0	757 [f]
JVWCD process enhancement [h]	594	2,350	2,944	0	0	0	2,944
Subtotal Zone B	**24,794**	**12,538**	**37,332**	**22,481 [e]**	**0**	**4,525**	**11,083**
Subtotal Zones A + B	**45,178**	**0 32,470**	**77,648**	**44,962 [e]**	**0**	**16,341**	**17,102**
Lost Use:							
Lost Use (JVWCD shallow wells) [h]	11,544	5,445 1,347	18,336	0	12,069	(Note k)	6,267
Trustee admin. Expenses [i]	742	0 0	742	0	742	0	0
Subtotal Lost Use	**12,286**	**5,445 1,347**	**19,078**	**0**	**12,811**	**0**	**6,267**
Subtotal Zone A, B and Lost Use	**57,464**	**5,445 33,817**	**96,726**	**44,962 [e]**	**12,811 [j]**	**16,341**	**23,369**
TOTALS	**190,687**	**5,445 63,853**	**259,985**	**44,962**	**12,811**	**179,600**	**23,369**

Notes:

(a) Cost estimates ($x1000) are based on latest designs (October 2002) from Kennecott and JVWCD/Carollo engineering.

(b) Irrevocable letter of credit, worth $28 million in 1995 dollars, to be replaced with Zone A ILC and Zone B ILC. July 2002 value: $44,961,881.

(c) Cash portion of the Trust Fund, worth $9 million in 1995. October 2002 value: $12,811,000 (estimated).

(d) Improvements to RO Plant to produce water with TDS at 250 mg/L, rather than higher TDS allowed by Consent Decree. (From December 2000 Table 9.0A, indexed to October 2002 per ENR's ratio of 1.049.)

(e) 50 percent of Letter of Credit value ($44.962 million) as of October 2002.

(f) JVWCD avoided capital cost for groundwater development of 7,000 AF/yr without contamination (see Section 8.5), indexed to October 2002 by ENR ratio of 1.049. $3.026 million is assigned as follows:
>75% ($2.270 million) to Zone A
>25% ($0.757 million) to Zone B

(g) JVWCD avoided O&M cost for groundwater development of 3,500 AF/yr without contamination - paid annually to KUCC (see Section 8.6). Cost is $49 per AF in 1995 dollars, indexed at ENR index.

(h) From October 2002 Carollo Engineers Pilot Testing Report and January 1, 2003 Carollo update – as shown in JVWCD;s "Comparisons of Cost Estimates for Zone B/Lost Use Facilities", dated January 3, 2003. Allocations to Zone B and Lost Use are as follows:

Cost (thousands)	Pipelines and Wells	Treatment Facility	Process Enhancement
Capital:			
Zone B	$12,783	$10,173	$594
Lost Use	$4,207	$7,337	$0
Totals	$16,990	$17,510	$594
O,M&R (40 yrs NPV):			
Zone B	$5,808	$4,380	-
Lost Use	$3,872	$2,920	-
Totals	$9,680	$7,300	

(i) Indexed from $500,000 in July 1995 to October 2002 by PTIF growth (1.4837).

(j) Value of cash trust fund in October 2002 dollars.

(k) Underlying water right was previously transferred to JVWCD by KUCC.

(l) Cash portion of the Trust Fund value in October 2002 dollars.

10.0 OPERATION, MAINTENANCE, REPLACEMENT RESPONSIBILITIES

10.1 Zone A Plant

KUCC will construct, own, operate, maintain and replace when necessary the following extraction wells:

1. Extraction wells 1193 and 1200 (the Zone A sulfate extraction wells)
2. Wells ECG1146 and 1201 (the "acid plume" extraction wells) and other acid wells to be drilled 5 to 15 years after initiation of Project to continue to capture acid plume.
3. Well LTG1147 located near 6200 West 11800 South ("the sulfate extraction well").

The collection pipelines from the Project extraction wells to the Zone A water treatment plant, and the concentrate discharge pipeline (to KUCC's tailings line) will be owned and operated by KUCC. The Zone A RO plant will be constructed in three phases over a period of two years. The three-phased approach of design and construction of the Zone A Plant through 2005 will allow KUCC to gain operating experience and reach a point of optimization in operational mode. The Zone A Plant and the treated water (permeate) delivery pipeline to the JVWCD system will also initially be owned and operated by KUCC. At KUCC's discretion, the ownership, operations and/or maintenance of the Zone A Plant may be transferred to JVWCD or another entity at a future time.

10.2 Zone B Facilities (for Deep Groundwater Extraction)

The facilities for extraction of approximately 4,300 afy to yield 3,500 afy of treated water will include seven extraction wells, collection pipelines, an RO treatment plant and related facilities at 1000 West 8300 South, a concentrate discharge pipeline to the Jordan River at 2900 South (this concentrate pipeline will convey both Zone B deep groundwater and Lost Use shallow groundwater concentrate), and a delivery pipeline to the JVWCD system. Following construction and startup testing, ownership of these facilities will remain with JVWCD. JVWCD will commit to operate, maintain and replace these facilities for at least 40 years thereafter. If JVWCD's operation of the Zone B Facilities becomes infeasible due to changing drinking water regulations or discharge permits or any other reason, JVWCD will commit to continue delivering 3,500 afy of water, from its other sources, to the Affected Municipalities for the remainder of the Operational Period.

10.3 Lost Use Facilities (for Shallow Groundwater Extraction)

These facilities will include five shallow extraction wells, collection pipelines, RO and other membrane treatment facilities located in an enlarged treatment building (together with the Zone B deep groundwater treatment facilities) at 1000 West 8300 South, a concentrate pipeline extending to the Jordan River at 2900 South (this

concentrate pipeline will convey both deep Zone B groundwater and shallow (Lost Use) groundwater concentrate), and a delivery pipeline to the JVWCD treated water transmission system. Following initial construction and startup testing, ownership of these facilities will remain with JVWCD. JVWCD will then commit to operate, maintain and replace these facilities for at least 40 years. If JVWCD's operation of the Lost Use Facilities becomes infeasible due to changing drinking water regulations or discharge permits or any other reason, JVWCD will commit to continue delivering at least 1,235 acre feet of water, from its other sources, to the Affected Municipalities for the remainder of the Operational Period.

11.0 ALLOCATION OF PROJECT BENEFITS

Half of the 7,000 afy of treated water from deep groundwater (3,500 afy) will result from KUCC's rights shown in Section 7.2. The 3,500 afy of treated water that is produced by the Zone A Plant will be allocated by JVWCD to directly benefit the four incorporated communities in the Affected Area. These "Affected Municipalities" are: Herriman City, Riverton City, South Jordan City and West Jordan City. The benefit to the four Affected Municipalities will be in the form of a water supply at high elevation, with discounted water rates as further described hereafter in this Section.

Under this Project Proposal, JVWCD will use its water rights to produce half of the 7,000 afy of treated deep groundwater (in Zone B). In addition, it will use its Utah Lake/Jordan River rights for shallow groundwater extraction and treatment (Lost Use). These treated waters will be reserved for the four Affected Municipalities during the entire 40-year Operational Period under wholesale contract water purchase agreements to be executed between those Affected Municipalities and JVWCD. When not contracted for by the four Affected Municipalities, these waters will be available for the benefit of any of the member agencies and customers of JVWCD (see Section 14 for further description of the rationale for this allocation).

JVWCD has performed an analysis to derive the allocation of Zone A treated water benefits to the four Affected Municipalities. The factors considered in this evaluation were: 1) total population of each Affected Municipality; 2) area of each Affected Municipality within the overall Affected Area; 3) area of each Affected Municipality within Zone A of the Affected Area, and 4) 1999 approved municipal groundwater rights in the principal aquifer within the overall Affected Area, and within Zone A of the Affected Area. Tables 1 through 4 in Appendix F show methods 1-4 of comparing and evaluating these factors. The allocation percentages for methods 1-4 are summarized in Table 11.0A. An allocation of Zone A treated water benefits is also shown in Table 11.0A.

TABLE 11.0A

Allocation of Zone A Treated Water Among Affected Municipalities[a]

Affected Municipality	Allocation (percent)	Maximum Annual Volume[b] (acre-feet)	Maximum Flow Rate[c] (MGD)[d]
West Jordan City	35	1225	1.21
South Jordan City	30	1050	1.04
Riverton City	20	700	0.69
Herriman City	15	525	0.52

Notes:

(a) These allocations will be held for the Affected Municipalities through January 2009, based upon a notification by JVWCD to the Affected Municipalities by January 2004. After January 2009, any of the Zone A waters that is not contracted for within the allocations shown above would be held for the four Affected Municipalities for Operational Period and would available for contract with any of the four Affected Municipalities.

(b) Each Affected Municipality may purchase up to its allocated percent of the actual Treated Water Annual Volume produced by the Zone A Plant, which may not exceed the volumes of water shown in this column.

(c) Each Affected Municipality may purchase up to its allocated percent of the actual Treated Water flow rates produced by the Zone A Plant, which may not exceed the flow rates of water shown in this column.

(d) Million gallons per day.

These four communities show differences in population and area in the Affected Area. Other than JVWCD's municipal water rights, only two currently approved municipal water rights, those of West Jordan City and Riverton City, lie within or near the Affected Area. Both of these lie at the extreme fringe areas, at the northeast and southern edges. KUCC and JVWCD do not propose to require capital and operating cost contributions from these municipalities. However, their benefits will be subject to the following:

- West Jordan City will not develop its water right #59-1572 at a point of diversion closer than 2,000 feet from the Affected Area as defined in the Consent Decree during the Operational Period.
- Riverton City will apply to the State Engineer to move point of diversion No. 1 of its Water Right #59-1533 to the current location of its Garamandi well, located near 4000 West 12600 South. Riverton City will not move any point of diversion under Water Right #59-1533 to a location closer than 2000 feet from the Affected Area.

JVWCD will hold the allocations shown in Table 11.0A open for the four Affected Municipalities for five years. To provide adequate time for Affected Municipalities to contract for Zone A water, JVWCD will provide written notice no later than January 2004 stating when the lower cost Zone A water becomes available. The allocations will then be held open through January 2009. Thereafter, throughout the Operational Period, any Affected Municipality would be able to contract for any Zone A water amount not previously contracted for within the allocations.

JVWCD proposes to provide benefits from treated water produced from Zone A Plant to the four Affected Municipalities by providing treated water deliveries at reduced water rates. JVWCD will accomplish this by providing Zone A water to the four Affected Municipalities at less than its base wholesale rate, without surcharges for pumping or peaking. In spite of no pumping charges, this water would be provided at a storage elevation of at least 5,150 feet above sea level, in the JVWCD pressure Zone C that normally includes pumping surcharges. The Zone A water will also be delivered, by agreement with KUCC in the Project Agreement, to an elevation of 5,350 feet above sea level, to allow for a future JVWCD pressure Zone D.

For example, the 2002 wholesale water rates for JVWCD pressure Zone C to West Jordan City, and South Jordan City are:

West Jordan City: $329.45/AF
South Jordan City: $324.79/AF

During 2002 the estimated pressure Zone D wholesale price would be at least $355 per acre foot.

In contrast, the 2002 JVWCD rate offered to the four Affected Municipalities would have been as shown in Table 11.0B.

Table 11.0B

Illustration of Discounted Wholesale Water Rate Methodology for Zone A Treated Water[1999]

Water Rate Components	Unit Cost for 1999 (per AF)[g]
• JVWCD wholesale rate (without pumping or peaking surcharges)[b]	$239.22
• Less JVWCD average water source unit cost	($142.49)
• Less JVWCD weighted average surface water treatment/wells O&M unit cost[c]	($34.62)
• Plus JVWCD "avoided operating cost"[d]	$55.15
• Plus JVWCD additional O M&R cost to reduce TDS to 250 mg/L (Zones A and B average)[e]	$25.48
• Plus JVWCD's amortized capital contribution to the Proposal[f]	$61.05
Net Discounted Water Rate:	$203.79

Notes:
(a) The illustration uses actual figures from 1999.
(b) The wholesale rate is determined annually by JVWCD using its then current rate methodology. The methodology for calculating rates in 1999, 2000 and 2001 is the "Base-Extra Capacity Method" of the American Water Works Association, as interpreted and implemented by JVWCD .
(c) Includes personnel, electricity, chemical, and equipment, calculated from the previous year.
(d) As described in the Consent Decree, this is $49 per acre-foot, in 1995 dollars, escalated at the ENR "20 Cities" cost index.
(e) See CDM Report and Proposal.
(f) $4.9 million amortized at 6%, 20 years. Thereafter, this will become a replacement sinking fund contribution, at the amortized base, indexed to future years.

The Zone A water will be made available at this reduced rate, as calculated each year by JVWCD under its then current wholesale water rate formulas and water rate study, by execution of water purchase agreements with the four Affected Municipalities. This water rate methodology will remain in effect for the Operational Period of 40 years. Appendix 5 of the Project Agreement fully explains the price methodology and conditions for the Zone A water.

Zone B and Lost Use treated water will also be reserved by JVWCD for the Affected Municipalities throughout the Operational Period of 40 years. It will be made available through normal wholesale water purchase agreements with the Affected Municipalities. Appendix 5 of the Project Agreement fully explains the water rate methodology and other conditions for these water sales to the Affected Municipalities.

KUCC and JVWCD met with city managers, technical staff and mayors of the four Affected Municipalities during September and October 1999. Upon invitation by the communities, KUCC, JVWCD and city staff made presentations to the councils of Herriman City, South Jordan City, and West Jordan City during November 1999. KUCC and JVWCD have held numerous subsequent meetings with officers and staff of the Affected Municipalities.

The Herriman City Council and the South Jordan City Council voted to endorse the Project during those meetings. Enclosed in Appendix G are the following: letters of endorsement from Herriman City and West Jordan City, the minutes from the South Jordan City Council meeting, and a letter expressing support for the Project and a desire for its allocation of reduced-price water from Riverton City.

12.0 SCHEDULE, DESIGN & CONSTRUCTION, FACILITIES OWNERSHIP

12.1 Proposed Project Schedule

Section 10 of the CDM conceptual design report recommended a schedule for pilot testing, design, construction, and startup/testing. Table 12.1A includes components of the schedule with other updates and project elements shown. Completion of construction would be accomplished by December of 2005 for Zone A and December 2008 for Zone B based on the latest available estimates and schedules associated with this Project. The schedule shown in Table 12.1A is conditioned upon:

- State Trustee and staff evaluation completed - July 2003.
- Trustee approval of Project (and execution of agreements) - October2003

Any delay in any of the above referenced milepost dates (as well as any delay in the activities mentioned in Table 12.1A) will create a corresponding delay in the overall project schedule.

TABLE 12.1A Proposed Project Schedule		
Activity	**Completed By**	
	Zone A	**Zone B**
UPDES Concentrate discharge permits	N/A	3rd Qtr 2003
Land purchases by KUCC and JVWCD	Sep. 2000 ✓	July 2004
USEPA remedial Project manager evaluation	Dec. 2000 ✓	Dec. 2000 ✓
USEPA Record of Decision	Dec. 2000 ✓	N/A
State Engineer change application approvals	April 2003 ✓	Jan. 2003✓
State Trustee and staff evaluation	July 2003	July 2003
State Engineer evaluation of Proposal	July 2003	July 2003
State public hearings	Aug/Sept 2003	Aug/Sept 2003
Trustee approval of Project Proposal	Oct 2003	Oct 2003
Execution of Project Agreement and State Agreement	Oct 2003	Oct 2003
Preliminary design	2003	2004
Final design	2004	1st Qtr 2005
Division of Drinking Water approval	2003/4	2nd Qtr 2005
Award construction contracts	2003/4	2004/5
Complete construction	June 2004	4th Qtr 2006
Startup, testing, begin operation, reach C & O status	June 2004	2nd Qtr 2007
Deliver Treated Water to Public	Dec 2005	2nd Qtr 2007
Notes: ✓ = Completed N/A = Not applicable		

12.2 Design

The design work would be performed by, or commissioned and managed by the parties shown in Table 12.2A, with oversight from UDEQ and USEPA:

TABLE 12.2A Design Responsibility	
Project Component	**Designed By**
Zone A Extraction Wells	Existing/KUCC
Zone A Plant	KUCC
Zone A Concentrate Pipeline	KUCC
Zone A Treated Water Discharge Pipeline	KUCC
Zone B Deep Extraction Wells	JVWCD
Lost Use Shallow Wells	JVWCD
Zone B/Lost Use Facilities	JVWCD
Zone B/Lost Use Concentrate Discharge Pipeline	JVWCD
Zone B/Lost Use Treated Water Discharge Pipelines	JVWCD

12.3 Construction

Construction may be performed, through contractors, by the same parties that performed the design work shown in Table 12.2A. The same parties will perform startup and testing and begin operations.

12.4 Facilities Ownership

Ownership of facilities would be as shown in Table 12.4A.

TABLE 12.4A Ownership of Facilities for Proposed Project	
Project Component	**Owned By**
Zone A Extraction Wells	KUCC
Zone A Plant	KUCC
Zone A Concentrate Pipeline	KUCC
Zone A Treated Water Discharge Pipeline to Meter Meter to Pressure Zone C or D reservoir	KUCC JVWCD
Zone B Deep Extraction Wells	JVWCD
Lost Use Shallow Wells	JVWCD
Zone B/Lost Use Facilities	JVWCD
Zone B/Lost Use Concentrate Discharge Pipeline	JVWCD
Zone B/Lost Use Treated Water Discharge Pipeline	JVWCD

13.0 LIABILITY AND AGREEMENTS

13.1 Liability

KUCC has certain CERCLA liabilities in remedial actions for contaminated groundwater. KUCC will defend, indemnify and hold JVWCD harmless from environmental claims relating to existing contamination as described in the Consent Decree and RI/FS, the feed water for and its treatment at the Zone A Plant before it becomes permeate delivered to JVWCD, and concentrates KUCC disposes. The indemnity does not apply to claims that arise from JVWCD's own gross negligent or intentional wrongful actions, among other claims.

13.2 Contract Mileposts

The following mileposts are important in the agreements for the Project:

- UPDES Concentrate Discharge Permit (Zone B/Lost Use) – A UPDES permit will be issued to JVWCD for discharge of RO concentrate to the Jordan River before JVWCD executes the agreements for the Project.
- Complete and Operational - This milepost will be reached for each treatment plant and associated facilities when the plant operator has received an operating permit from the Utah Division of Drinking Water and the operator has notified the Trustee that the facility is Complete and Operational.
- Operational Period - 40 years following the Complete and Operational status date for each plant

13.3 KUCC/JVWCD Agreement ("The Project Agreement")

KUCC and JVWCD have negotiated the Project Agreement to govern their relationship and obligations during the design, construction, and Operational Period of components of the Project. In general, the Project Agreement includes the following provisions:

- KUCC will design, construct, operate and maintain the Zone A Plant and associated facilities for the Operational Period of the plant. JVWCD will deliver the treated water from the Zone A Plant to the Affected Municipalities for the Operational Period.

- JVWCD will design, construct, operate and maintain the Zone B and Lost Use Facilities. JVWCD will deliver the requisite amount of water from such facilities or alternative sources to the Affected Municipalities for 40 years.

- KUCC has advanced certain capital funds during the right-of-way acquisition and pilot testing phases of the Project. KUCC will advance additional capital funds for the design and construction phases of the Project. These arrangements are further described in the Project Agreement, and are partially reflected in Table 9.0A.
- JVWCD will pay to KUCC the "avoided OM&R costs" for 3500 afy of Zone A treated water at a price defined in the Consent Decree. (See Section 8.6.) JVWCD will also pay to KUCC its "avoided capital cost" of developing groundwater, absent contamination, in the Affected Area. (See Section 8.5)
- JVWCD is responsible for supplemental capital funds (if any) and O M&R funds, to construct and operate the Zone B and Lost Use Facilities.
- Concentrate disposal is also addressed, as more fully discussed under Section 5.6 of this Proposal.

13.4 KUCC/JVWCD Agreement with the State of Utah ("The State Agreement")

KUCC and JVWCD have negotiated an agreement with the State of Utah to implement the Project. The State Agreement includes provisions for replacement of the Trust Fund irrevocable letter of credit with two irrevocable letters of credit (the Zone A ILC and Zone B ILC) to be reduced in exchange for (a) KUCC's agreement to construct, operate and maintain the Zone A Plant, and (b) JVWCD's agreement to construct, operate and maintain the Zone B and Lost Use Facilities, or alternative sources, in each case in order to provide municipal quality water to the Affected Municipalities.

The Zone A ILC will be reduced in capital and OM&R phases. The State Agreement provides for a 60 percent reduction of the Zone A ILC for capital expenditures upon reaching "Complete and Operational" status. At that time, KUCC commits to deliver 3500 afy of treated water for the Operational Period. The remaining 40 percent of the Zone A ILC, representing OM&R, is released at 15 percent annually over the next four years with the remainder released in the fifth year.

The Zone B ILC will be reduced by 50 percent when KUCC has reimbursed JVWCD for Zone B construction costs equal to one-half of the Zone B ILC. At that time, JVWCD commits to deliver to the Affected Municipalities 1750 afy of water for 40 years. Further reductions to the Zone B ILC will occur consistent with increases in reimbursements made by KUCC and increases in JVWCD's commitments for water delivery. The Zone B ILC will be reduced to zero when KUCC has reimbursed JVWCD for construction costs equal to the full amount of the Zone B ILC. At that time, JVWCD's commitment to deliver water to the Affected Municipalities will be 3500 afy for 40 years, whether or not the Zone B Facilities reach Complete and Operational status.

The State Trustee will release defined amounts of the cash portion of the Trust Fund directly to JVWCD during its design, construction, operation and maintenance of the Lost Use Facilities. When the Lost Use Facilities are Complete and Operational, JVWCD's commitment to deliver water to the Affected Municipalities will be 1235 afy for 40 years, JVWCD will provide additional OM&R funds to operate the Lost Use Facilities throughout the Operational Period, after the cash portion of the Trust Fund has been exhausted.

14.0 ZONES A AND B RATIONALE

14.1 Zone A

The groundwater in Zone A contains both elevated sulfate (NRD) and acid (CERCLA) contamination, with sulfate concentrations mainly above 1500 mg/L and acidic water containing elevated heavy metal concentrations. KUCC has designed a hydraulic containment system to contain and extract the acid and the elevated sulfate plumes as detailed below (see Appendix B for scope of CERCLA remedy).

The containment system will consist of acid extraction wells in the core of the acidic plume, and sulfate barrier wells constructed in the area near KUCC wells 1193 and 1200. The extracted sulfate water will be treated by a reverse osmosis membrane-filtration plant located on KUCC property. Concentrate reject from the reverse osmosis treatment process will be placed in the KUCC tailings line. Extracted acidic water also will be routed to the tailings line for neutralization by the tailings. If the tailings do not contain sufficient neutralization potential, supplemental lime will be added to the tailings. The resulting neutralized water will be recycled through the tailings impoundment for use at the Copperton Concentrator. (An alternative approach will be developed if this plan for managing concentrate streams becomes infeasible, see Final Remedial Design, Appendix A, for analysis of conceptual options) Figures 14.1A-1 and 14.1A-2 show the potential layout of the extraction wells, the locations of the treatment plants, and the model-computed distribution of sulfate concentrations in 2025 and 2050 based on this scenario (see also Appendix D).

The Bingham Creek sulfate plume would be pumped at approximately 2000 gpm and the acid plume at 1500-2500 gpm. The total extraction rate of a maximum of 4000 gpm is approximately the sustained yield of the principal aquifer in the Bingham Creek area. The pumping rate of the acid plume is well above the rate required by the NRD Consent Decree (250 gpm or 400 afy average over a five-year period) in order to remove the main mass of the acid plume as quickly as possible and extend the time in which the sulfate containment system can extract sulfate at levels below 2000 mg/L. The extraction of 2000 gpm from the sulfate extraction

wells plus another potential 1000 gpm from the Lark sulfate well has been modeled to yield at least 3500 afy of municipal quality water after RO treatment.

KUCC will utilize its existing industrial groundwater rights (part of which have been converted to municipal water rights) to extract groundwater from this zone for treatment and will deliver 3500 afy of treated, deep groundwater to the JVWCD, who will make the water available to the cities of Herriman, Riverton, South Jordan and West Jordan.

The rationale for JVWCD receiving and distributing these waters is as follows:

- JVWCD owns all of the currently approved municipal groundwater rights in Zone A
- The Consent Decree requires that the public in the Affected Area receive benefits from the Trust Fund
- JVWCD has existing infrastructure to distribute Zone A water to the four Affected Municipalities. This provides an efficiency and economy of scale to the proposed Project
- JVWCD's existing infrastructure will allow the public in the Affected Area to obtain the benefits of the Trust Fund and the M&I water
- JVWCD has current wholesale water delivery contracts and relationships with West Jordan, South Jordan and Riverton cities (see Table 14.1A). JVWCD serves retail connections in Herriman, and has held discussions with Herriman City regarding near future wholesale water deliveries from the JVWCD

Table 14.1A
JVWCD Water Purchase Contracts With Affected Municipalities

	Minimum Annual Water Purchase Contract (AF/year)		
Customer	1999	2000	2001 and thereafter
South Jordan City	7625	8175	8675
West Jordan City	8400	8400	8400
Riverton City	395	395	395

14.2 Zone B

Groundwater in Zone B is the majority of the "sulfate plume," with sulfate concentrations lower than those in Zone A. JVWCD will utilize its existing municipal groundwater rights in the Affected Area to extract principal aquifer groundwater for treatment, will receive the 3,500 afy of treated, deep groundwater, and will make that water available to all of its member agencies, including the four Affected Municipalities. This water will be reserved for the four Affected Municipalities,

throughout the Operational Period, if they desire to execute wholesale water contracts to purchase this water from the JVWCD.

The basis for JVWCD treating and delivering these waters, and making them available to all of its member agencies until the Four Affected Municipalities contract for them, includes the following issues:

- JVWCD owns 79 percent of the currently approved municipal groundwater rights in the Affected Area.
- These JVWCD groundwater rights are assets that belong to all of the member agencies of JVWCD throughout Salt Lake County.
- JVWCD has the existing infrastructure to convey Zone B treated groundwater throughout Salt Lake County to benefit the member agencies that jointly own the JVWCD municipal groundwater rights. These member agencies have paid for the construction of infrastructure to serve Zones A and B.
- JVWCD has contributed valuable information and guidance during Consent Decree negotiations and technical review oversight of the RI/FS process.
- JVWCD is willing to utilize its Utah Lake/Jordan River rights to accomplish the Trust Fund purpose to "replace, restore or provide the equivalent" of the groundwater from the Affected Area lost as concentrate streams from membrane treatment processes in both Zones A and B, by providing Lost Use water.
- JVWCD has the expertise and staff to operate and maintain project facilities in an efficient manner.
- West Jordan, South Jordan and Riverton cities are member agencies of JVWCD, and can receive Zone B water. Herriman is served retail water service by JVWCD.

15.0 MEETING INTENT OF NRD CONSENT DECREE

The following table summarizes the intent of the NRD Consent Decree and delineates the features of this Proposal that meet this intent.

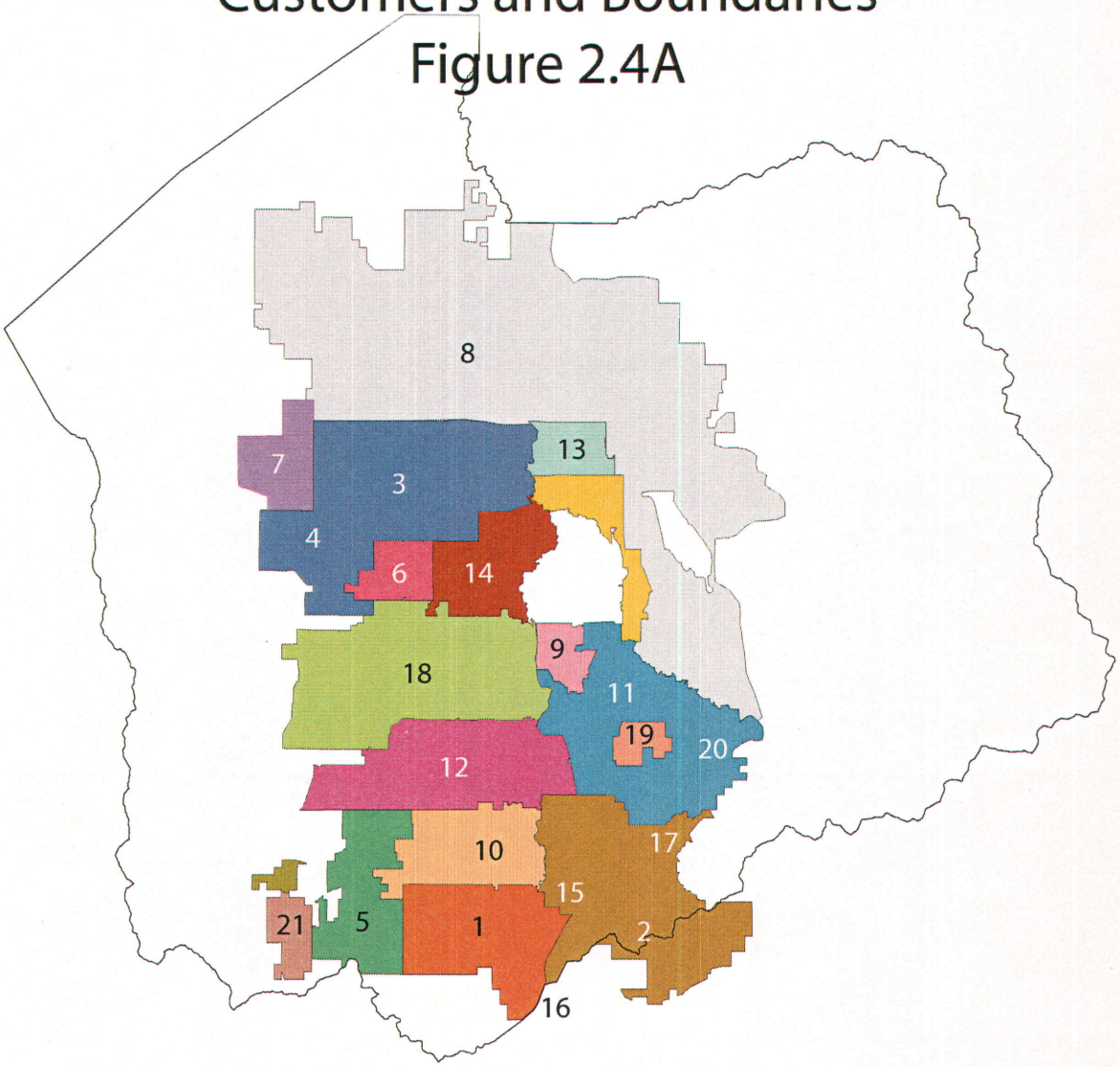
TABLE 15.0A Intent of NRD Consent Decree					
Actions	**CD Sect.**	**Response**	**Date**	**Meets Intent**	**Comments**
RI/FS	V.A.	Completed by KUCC	1998	Yes	Reviewed and approved by USEPA and TRC; ROD issued in 2000.
Acid Well	V.B.	Completed by KUCC	1997	Yes	Currently 1100 AF pumped. Meets pumping criteria.
Source Control	V.C.	Completed by KUCC	1997	Yes	Eastside Collection system permitted under UGWDP.
Trust Fund	V.D.1	Paid by KUCC	1995	Yes	Trust Fund established with $9 million cash and $28 million ILC, (valued at $13 million and $45 million as of September 2002.)
Restoration of aquifer, including solid phase contamination	V.D.1	Extraction of sulfate and acid	1997	Yes	Installed sulfate and acid wells have removed 58,000 tons of sulfate since August 1997; this Proposal will continue process perpetually.
Replace water	V.D.1	This Proposal	2004	Yes	Will produce more than 7000 AF of water annually from Affected Area; and will produce at least 1235 AF/yr to replace lost concentrate, as "Lost Use" portion of the project.
Acquire equivalent	V.D.1	N/A	N/A	N/A	Not necessary; restoration and replacement provide sufficient water.
Treatment	V.D.2b	This Proposal	2004	Yes	Treatment system described.
Accepted by M&I Purveyor- with water right put to beneficial use	V.D.2bi	This Proposal	2004	Yes	3500 afy water to be accepted by JVWCD, a purveyor of M&I water. Both KUCC and JVWCD are supplying water rights for municipal purposes.
Prevent and Replace Spread of Contamination	V.D.2bii	This Proposal	200-2045	Yes	See section 6.3 of Proposal.
Substainable water supply for 40 years	V.D.2biii	This Proposal	2005-2045	Yes	See section 6.1 of Proposal.
Does not materially increase unit cost to produce remainder of 7000 afy	V.D.2biv	This Proposal	2005	Yes	This Proposal will produce all of the 7000 AF/yr, within the Trust Fund amount. Also supplies at least 1,235 afy for Lost Use.
Beneficial Use	V.D.5	This Proposal	2005	Yes	JVWCD agencies benefit; specifically those in affected area. KUCC water rights converted to municipal use.
Restore, Replace, Acquire the Equivalent	V.D.4	This Proposal	2008	Yes	JVWCD jprovides 3500 AF/yr - Zone B

FIGURE

Jordan Valley Water Conservancy District

Customers and Boundaries

Figure 2.4A



Location of Member Agencies

1. Bluffdale City
2. Draper City
3. Granger-Hunter Improvement District
4. Hexcel Corporation
5. Herriman
6. Kearns Improvement District
7. Magna Water Company
8. Metropolitan Water District of Salt Lake & Sandy
9. Midvale City
10. Riverton City
11. Sandy City
12. City of South Jordan
13. City of South Salt Lake
14. Taylorsville-Bennion Improvement District
15. Utah State Department of Corrections
16. Utah State Department of Public Safety
17. WaterPro, Inc.
18. West Jordan City
19. White City Water Improvement District
20. Willow Creek Country Club
21. Hi-Country Estates Phase II

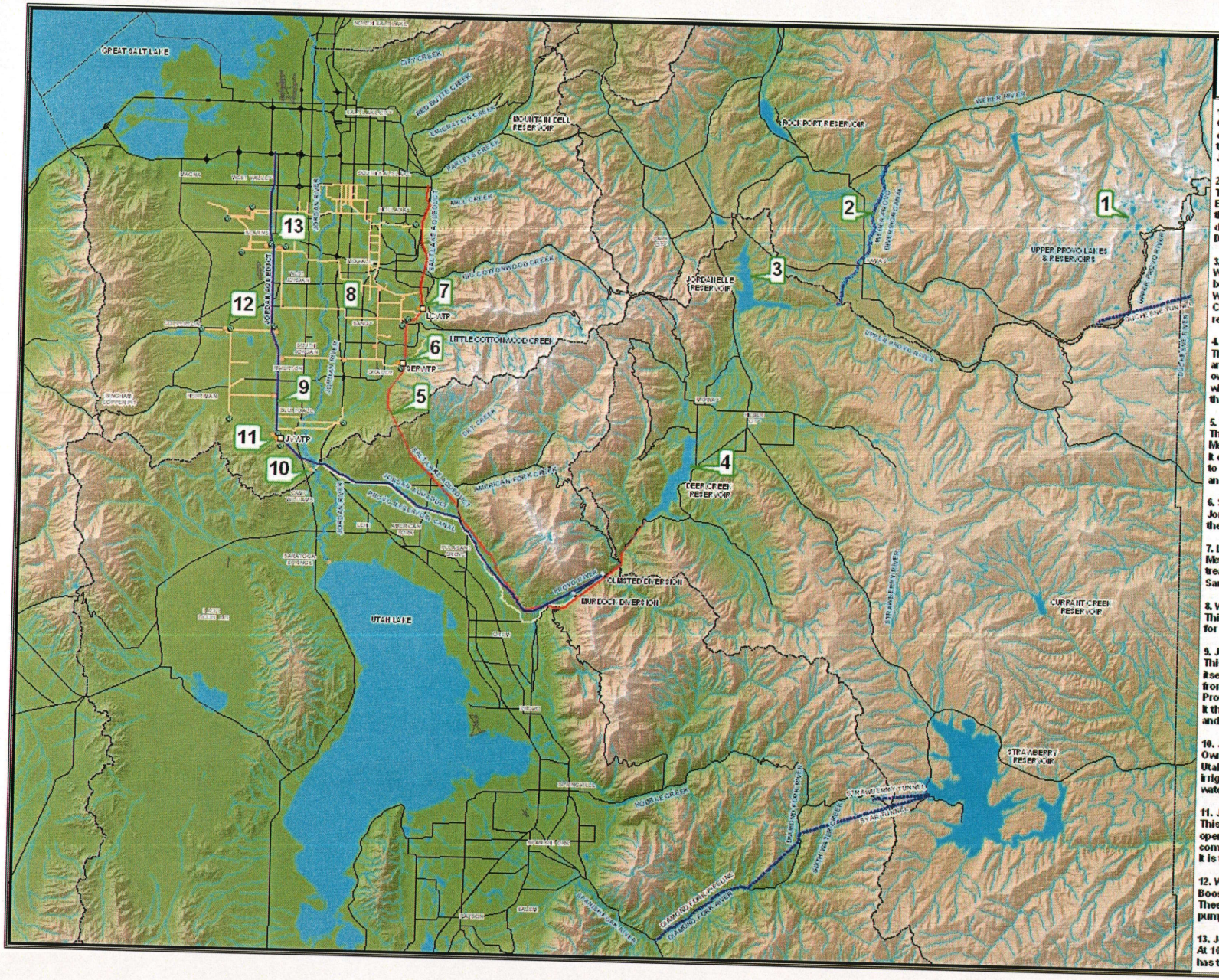


Figure 2.4B

JVWCD WATER RESOURCES AND AVAILABLE INFRASTRUCTURE

1. Upper Provo River Reservoirs.
Once converted to small storage reservoirs, the majority of these Uinta lakes have now been rehabilitated and the storage rights moved to Jordanelle Reservoir. Jordan Valley is a major stockholder in these lakes.

2. Weber/Provo Rivers Diversion Canal.
This canal conveys water from the Weber River and Echo Reservoir to Jordan Valley. It is also used by the Provo River Water Users Association for the diversion of Weber River water to supply Deer Creek Reservoir.

3. Jordanelle Reservoir.
With a capacity of 320,000 AF, this reservoir was built by the Bureau of Reclamation for Central Utah Water Conservancy District and collects and stores CUP water rights on the Provo River. Jordan Valley receives 50,000 AF of CUP water.

4. Deer Creek Reservoir.
This reservoir is a feature of the Provo River Project and has a capacity of 152,000 AF. Jordan Valley owns stock in the Provo River Water Users Association, which entitles it to water stored in this reservoir from the Provo, Weber and Duchesne rivers.

5. Salt Lake Aqueduct.
This 69-inch diameter pipe is operated by Metropolitan Water District of Salt Lake & Sandy. It conveys Provo River water from Deer Creek Reservoir to service areas of Jordan Valley, Salt Lake City and Sandy City.

6. Southeast Regional Water Treatment Plant.
Jordan Valley's 20 MGD facility treats water from the Salt Lake Aqueduct and local mountain streams.

7. Little Cottonwood Treatment Plant.
Metropolitan Water District's 100 MGD plant delivers treated water to Jordan Valley, Salt Lake City and Sandy City service areas.

8. Well Field.
This high-quality aquifer is the source of groundwater for JVWCD and many municipalities.

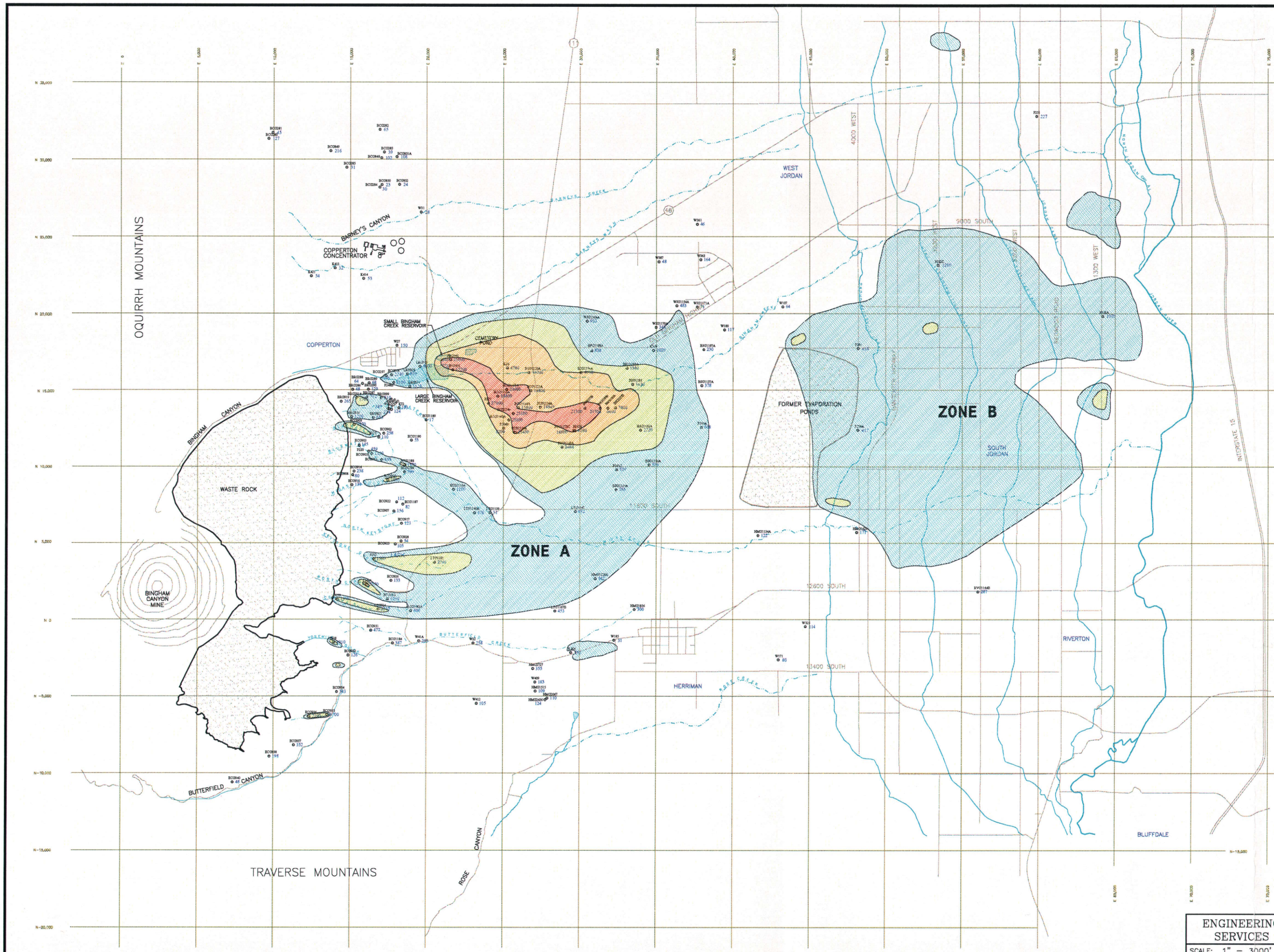
9. Jordan Aqueduct.
This 78-inch pipe is operated by Jordan Valley for itself and Metropolitan Water District. It conveys water from Deer Creek and Jordanelle reservoirs and the Provo River to Jordan Valley Water Treatment Plant. It then transmits treated treated water to Jordan Valley and MWDSLS service areas.

10. Jordan Narrows Pump Station.
Owned an operated by Jordan Valley, this station pumps Utah Lake water into the Welby and Jacob canals for irrigation purposes as part of a large irrigation water exchange.

11. Jordan Valley Water Treatment Plant.
This 180 MGD plant was built by CUWCD and is operated by Jordan Valley. It supplies water to many communities on the west side of the Salt Lake Valley. It is the largest treatment plant in Utah.

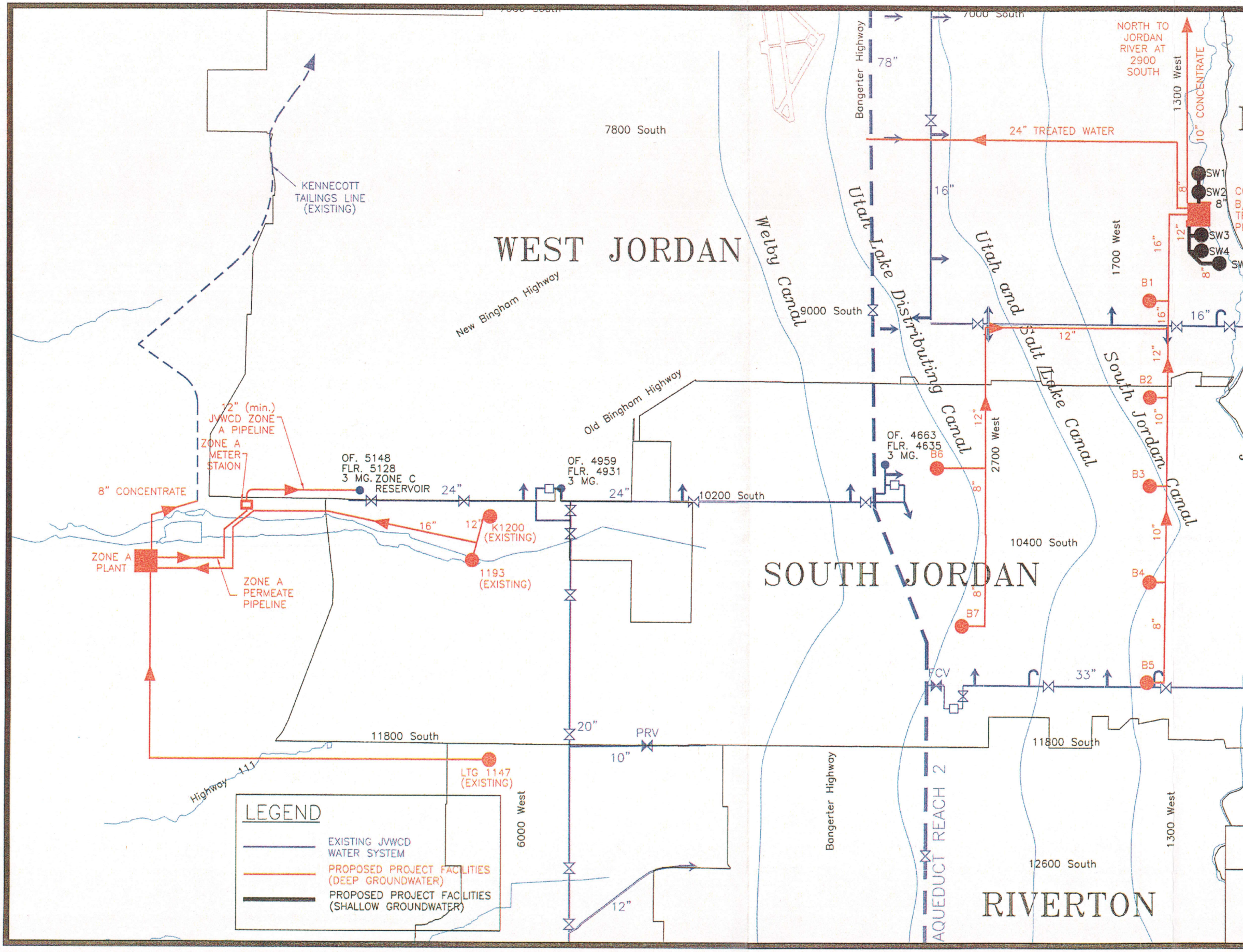
12. Wells, Equalization Reservoirs and Booster Pump Stations.
These widely-dispersed facilities develop, store and pump water to Jordan Valley's customers.

13. Jordan Aqueduct Terminal Reservoir.
At 100 million gallons, this drinking water reservoir has the largest storage capacity in the state.



ENGINEERING SERVICES			
SCALE: 1" = 3000'		DATE	Fl
DESIGNED BY	JKL	1/1/02	
DRAWN BY	MWC	2/7/03	
CHECKED BY			
PROJECT ENGINEER			
PROJECT MANAGER			Job N

4/1/03 KMCOOK 455-T-0043


WEST JORDAN
SOUTH JORDAN
RIVERTON
7800 South
9000 South
10200 South
10400 South
11800 South
12600 South
New Bingham Highway
Old Bingham Highway
Bangerter Highway
Welby Canal
Utah Lake Distributing Canal
Utah and Salt Lake Canal
South Jordan Canal
1300 West
1700 West
2700 West
6000 West
Highway 111
KENNECOTT TAILINGS LINE (EXISTING)
12" (min.) JVWCD ZONE A PIPELINE
ZONE A METER STAION
8" CONCENTRATE
ZONE A PLANT
ZONE A PERMEATE PIPELINE
OF. 5148
FLR. 5128
3 MG. ZONE C RESERVOIR
OF. 4959
FLR. 4931
3 MG.
OF. 4663
FLR. 4635
3 MG.
K1200 (EXISTING)
1193 (EXISTING)
LTG 1147 (EXISTING)
24" TREATED WATER
NORTH TO JORDAN RIVER AT 2900 SOUTH
10" CONCENTRATE
SW1
SW2
SW3
SW4
B1
B2
B3
B4
B5
B6
B7
PRV
FCV
AQUEDUCT REACH 2
LEGEND
EXISTING JVWCD WATER SYSTEM
PROPOSED PROJECT FACILITIES (DEEP GROUNDWATER)
PROPOSED PROJECT FACILITIES (SHALLOW GROUNDWATER)

Zone A Plume-Treatment Flow Chart

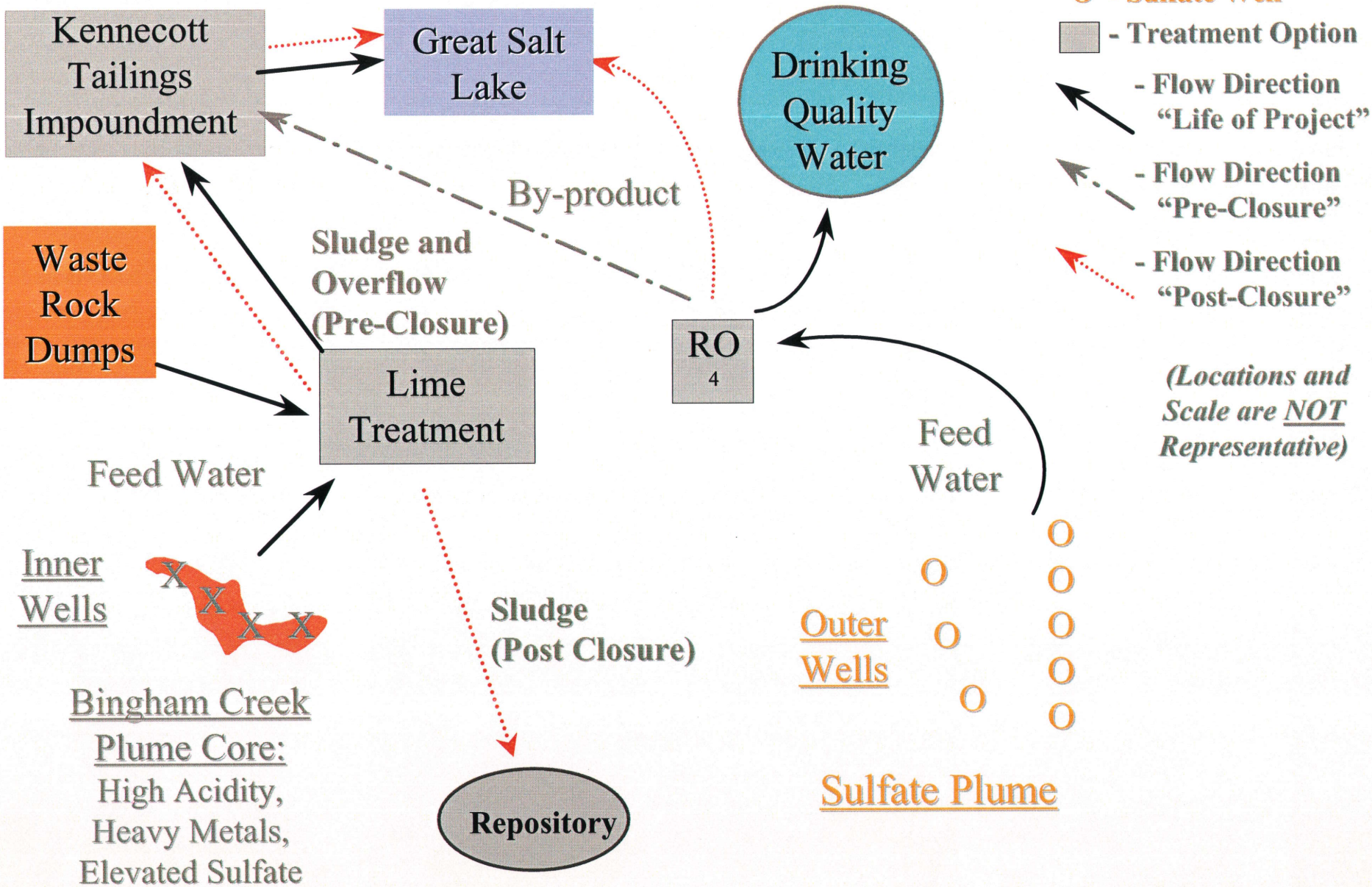
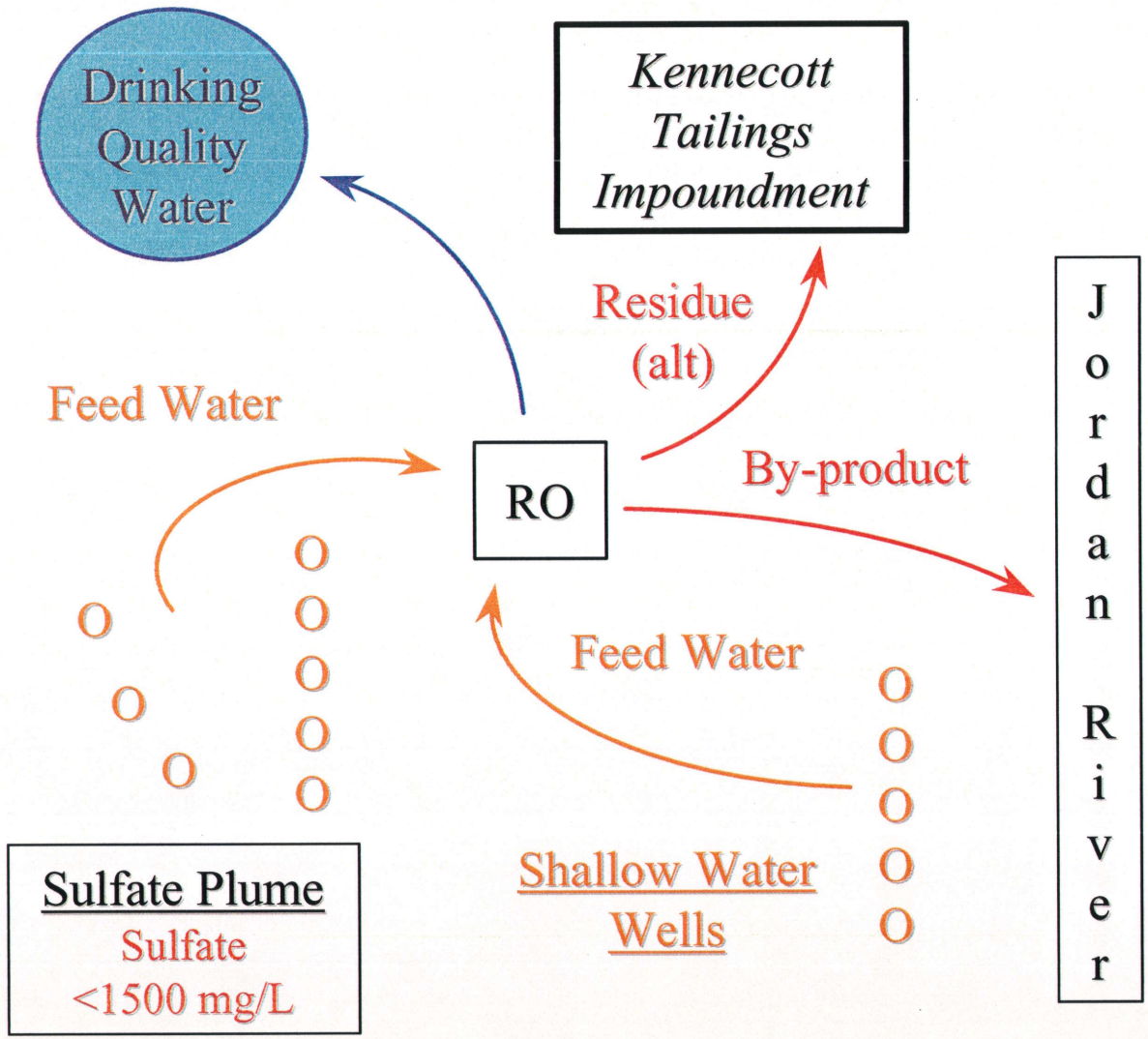


Figure 5-4A

Zone B Plume-Treatment Flow Chart



Schematic
Not to scale

O - Sulfate Well

- Treatment Option

- Alternative Option

Flow Direction Life of Project

RO = Reverse Osmosis Treatment Plant

Figure 5.4B

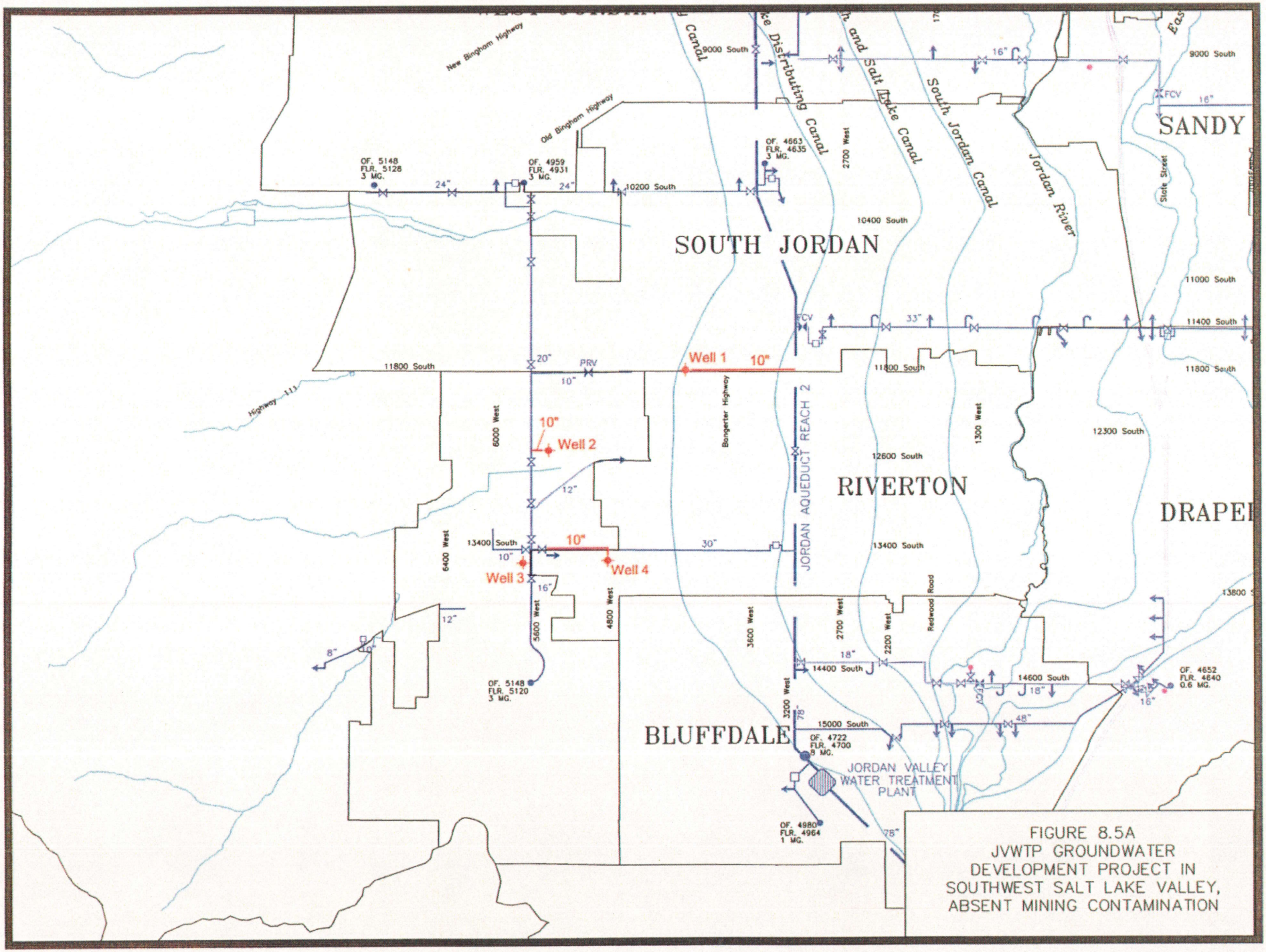


FIGURE 8.5A
JVWTP GROUNDWATER
DEVELOPMENT PROJECT IN
SOUTHWEST SALT LAKE VALLEY,
ABSENT MINING CONTAMINATION

E:\SOURCE\SW SL Valley\97C1167A\WELLSMINING-2 FIG8-5A.dwg

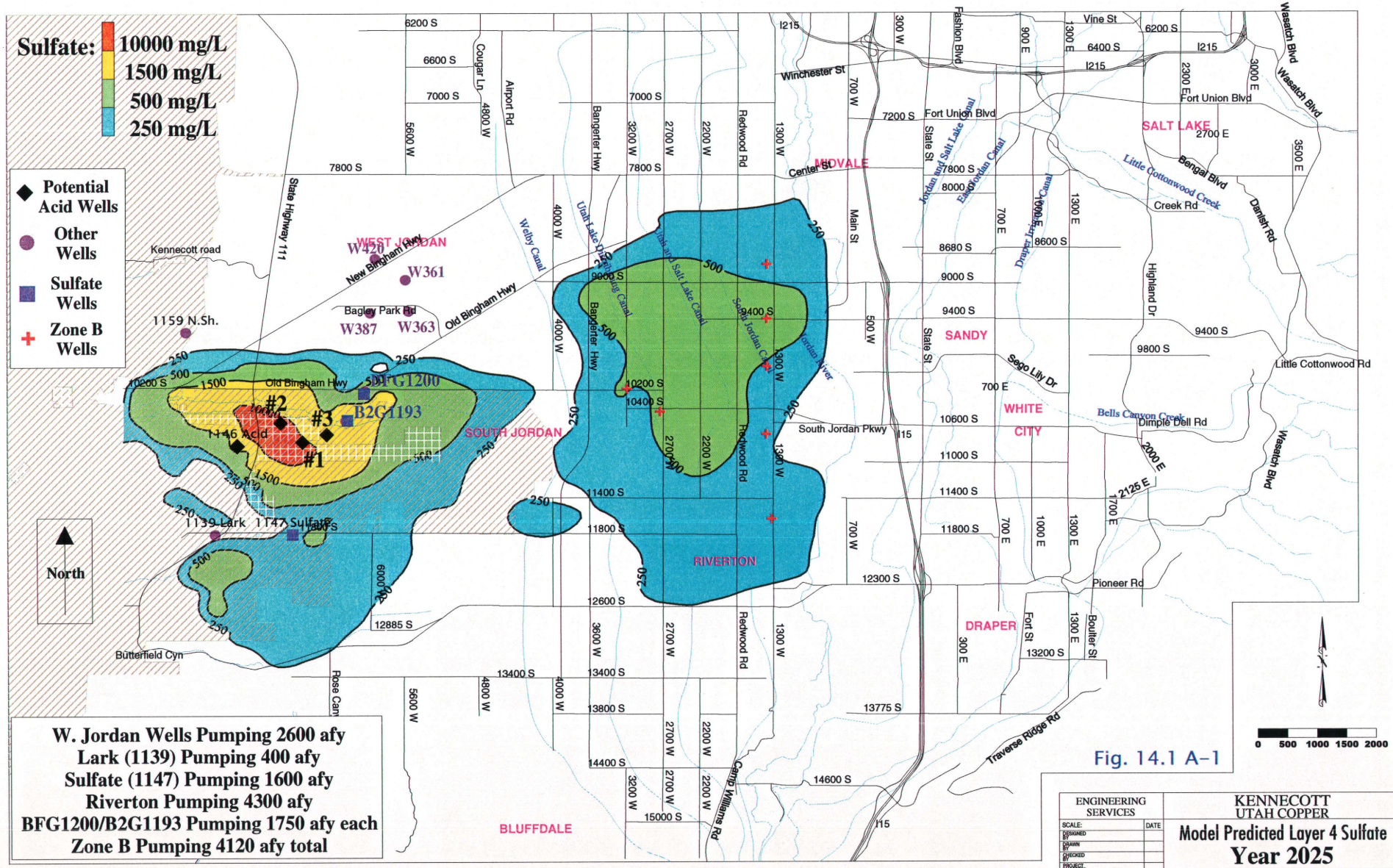
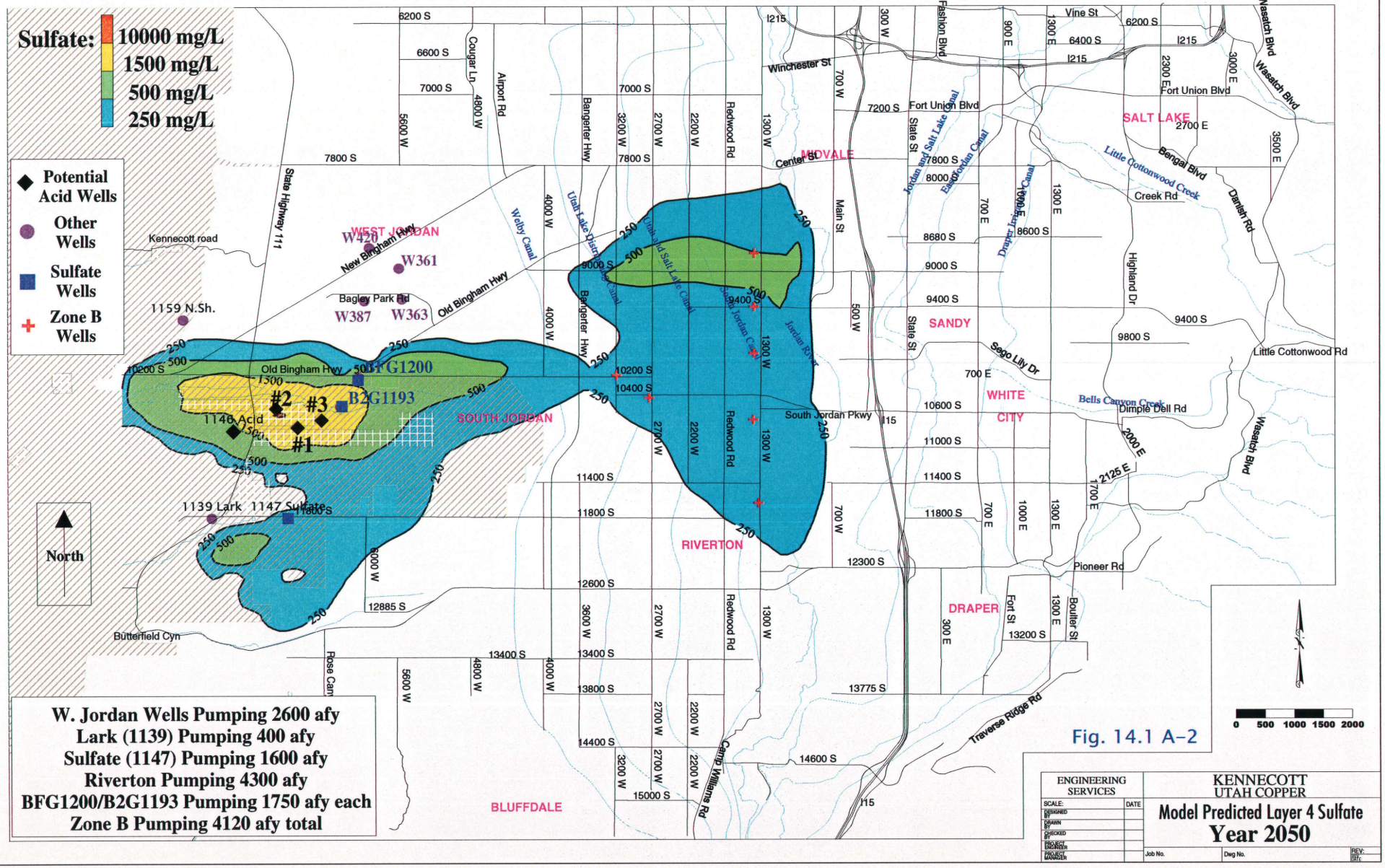

Sulfate:
10000 mg/L
1500 mg/L
500 mg/L
250 mg/L
Potential Acid Wells
Other Wells
Sulfate Wells
Zone B Wells
North
W420
W361
W387
W363
BFG1200
B2G1193
#1
#2
#3
1146 Acid
1139 Lark
1147 Sulfate
1159 N.Sh.
WEST JORDAN
SOUTH JORDAN
RIVERTON
MIDVALE
SALT LAKE
SANDY
WHITE CITY
DRAPER
BLUFFDALE
Kennecott road
Old Bingham Hwy
New Bingham Hwy
Bagley Park Rd
State Highway 111
Welby Canal
Utah Lake Drainage Canal
Utah and Salt Lake Canal
South Jordan Canal
Jordan River
Jordan and Salt Lake Canal
East Jordan Canal
Draper Irrigation Canal
Little Cottonwood Creek
Bells Canyon Creek
Winchester St
Center St
Fort Union Blvd
Vine St
Bengal Blvd
Creek Rd
Danish Rd
Highland Dr
Little Cottonwood Rd
Sego Lily Dr
Dimple Dell Rd
South Jordan Pkwy
Pioneer Rd
Traverse Ridge Rd
Butterfield Cyn
Rose Canyon
Camp Williams Rd
Cougar Ln
Airport Rd
Bangerter Hwy
Redwood Rd
Main St
State St
Fashion Blvd
Wasatch Blvd
Fort St
Boulter St
0 500 1000 1500 2000
W. Jordan Wells Pumping 2600 afy
Lark (1139) Pumping 400 afy
Sulfate (1147) Pumping 1600 afy
Riverton Pumping 4300 afy
BFG1200/B2G1193 Pumping 1750 afy each
Zone B Pumping 4120 afy total
ENGINEERING SERVICES
KENNECOTT
UTAH COPPER
Model Predicted Layer 4 Sulfate
Year 2025
Job No.
Dwg No.

Fig. 14.1 A-1



W. Jordan Wells Pumping 2600 afy
Lark (1139) Pumping 400 afy
Sulfate (1147) Pumping 1600 afy
Riverton Pumping 4300 afy
BFG1200/B2G1193 Pumping 1750 afy each
Zone B Pumping 4120 afy total

Fig. 14.1 A-2

ENGINEERING SERVICES	KENNECOTT UTAH COPPER
SCALE: / DATE	Model Predicted Layer 4 Sulfate Year 2050
DESIGNED BY	
DRAWN BY	
CHECKED BY	
PROJECT ENGINEER	
PROJECT MANAGER	
Job No. / Dwg No.	REV:

APPENDIX A

APPENDIX A

Groundwater Modeling

Flow Model. KUCC developed a groundwater model of the southwestern Jordan Valley (SWJV) as part of the RI/FS to analyze flow paths and groundwater velocities in the principal aquifer and to evaluate remedial options. The model area extends from the bedrock/alluvial interface at the base of the Oquirrh Mountains on the west, to the bedrock/alluvial interface at the base of the Wasatch Mountains on the east, and from approximately 6000 South on the north to the base of the Traverse Mountains on the south. The model has eight sloping layers ranging in thickness from 100 to 400 feet. The model uses a three--dimensional, finite difference, numerical code called MODFLOW (McDonald and Harbaugh 1988) with a typical elemental size of 500 by 500 feet. This code is internationally accepted and was used for the Salt Lake Valley Regional Groundwater Flow Model developed by the United States Geological Survey (Lambert 1995).

Recharge to the principal and shallow unconfined aquifers comes from precipitation, bedrock aquifer, irrigation canals, irrigated fields, lawns and gardens, stream and channel fill, and reservoirs and evaporation ponds.

Water loss comes from well extraction, evapotranspiration and removal at head-dependent boundaries.

The model was calibrated for both steady and transient states. The steady state simulated hydrologic conditions in 1965. The transient state simulated the period between 1966 and 1998 and included annual stress periods. Calibration variables were adjusted within reasonable ranges, as determined from data collected by the RI and other work. KUCC considered the calibration process to be successful when a reasonable match was made between observed and modeled conditions for the years being simulated.

The calibrated transient model closely simulated observed water level declines and vertical hydraulic gradients throughout the SWJV, yielded reasonable groundwater flow to the Jordan River, and accurately computed flows through the northern boundary.

Transport Model. KUCC's calibrated groundwater flow model was then coupled with a contaminant transport code, MT3D, to model historical and future migration of storm and mine waste water that leaked from the former Bingham Creek reservoir.

Transport models attempt to combine groundwater flow with the physical aspects of contaminant transport, including advection, dispersion and chemical reactions. Although a flow model can provide information about contaminant migration through the use of particle tracking techniques, these techniques do not provide information about the concentration of a contaminant at a given point in time and space. Transport modeling is different from particle tracking because it considers dispersion and the effects of chemical reactions and produces a three-dimensional distribution of concentrations with time. The KUCC transport model report is presented in the 1998 South End Groundwater RI, Appendix G.

The transport model was calibrated to observed 1996-1997 sulfate concentrations down gradient of the former Bingham Creek reservoirs. Calibration was achieved by finding a set of transport parameters (i.e., retardation, dispersivity and porosity) within an accepted range that reasonably reproduced field-measured concentrations. The large amount of data available for calibration provided good control for the rate and direction of plume movement. For example, the transport model was able to reproduce the southeast component of the sulfate plume geometry. The model was then expanded to include the sulfate contamination near the former KUCC evaporation ponds.

The transport model uses the following parameters for simulation and calibration:

- Specified concentration cells on the western and southern boundaries to simulate alluvial underflow and flow from the bedrock aquifer to the principal aquifer.

- Specified concentrations for the Large Bingham Creek Reservoir from 1965 to 1991, and for infiltration from precipitation.

- Retardation of sulfate, that was varied as a function of sulfate concentration, and constant porosity, were used for all layers.

The transport model is an approximation of the field environment. Many of the transport parameters are not known absolutely, and change in any of them can affect the results. Other limitations almost certainly include local, but significant variations in the hydrogeology of the principal aquifer, uncertainties in the flow model and boundary conditions, density dependent flow, and the lack of modeling of geochemical reactions, particularly neutralization. However, geochemical reactions are partially mimicked in the transport model through the use of the retardation factor. Nevertheless, the model is probably a reasonable first approximation of the kinematics of the Bingham Creek and former evaporation ponds plumes and allows the feasibility of various remedial strategies to be tested.

Hydrogeology

Groundwater Recharge. The principal aquifer is recharged from surface infiltration of precipitation, irrigation water and canal water, bedrock inflow, and to a limited extent from surface infiltration of waters emanating from Butterfield Creek. The bedrock of the Oquirrh Mountains provides recharge to the groundwater in the western part of the SWJV, and this groundwater then travels eastward into the basin. Aquifer recharge is greater in the eastern part of the SWJV and in the Herriman area due to recharge from surface water.

Groundwater Extraction. Most of the water extracted from the principal aquifer is used for municipal or industrial purposes. The largest extractions in the study area, in or near the Affected Area, are from the West Jordan and Riverton city well fields and KUCC process water wells. West Jordan City extracted an average of 6,012 acre-feet per year (afy) from 1990-1996 (West Jordan City 1996); Riverton City extracted about 3,300 afy (Lambert 1995). Kennecott production wells (1193 and 109) extract about 5,000 to 5,400 afy.

Groundwater Potentiometric Surface. The average depth below ground surface to the potentiometric surface in the principal aquifer of the SWJV is about 235 ft. Groundwater flow is predominantly west to east from the base of the Oquirrh Mountains to the Jordan River. Groundwater in the principal aquifer near the Traverse Mountains generally flows to the northeast, changing to an easterly flow near the center of the basin.

Groundwater Elevation Changes. Groundwater elevations declined substantially throughout the SWJV from 1986 to 1996. Water-level declines observed during this period are as much as 81 feet, depending on location in the aquifer. The largest declines have occurred in the West Jordan City well field area (81 feet) and near KUCC process water wells (72 feet). The rate of decline in this area has averaged 4-8 ft/yr. The rate of decline increased substantially during 1991-1996 due to increased pumping by West Jordan City.

Water-level declines along the eastern boundary of the KUCC waste rock piles have averaged 0.7 ft/yr since 1986. Some of this decline may be associated with the upgraded Eastside collection system, but is more likely due to several years of below-average precipitation during the late 1980s and early 1990s.

The overall average rate of water-level decline for the SWJV was approximately 2.4 ft/yr from 1986 to 1996. The continued decline of groundwater elevations, and the relatively rapid increase in decline in recent years. indicates that more groundwater is being removed from the principal aquifer than is currently supplied by natural recharge.

Hydraulic Gradients. Horizontal hydraulic gradients in the SWJV vary considerably depending on the region. They are generally steeper near the mountains and shallower in the valley. Along a flow line from the Oquirrh Mountains to the Jordan River, the average composite horizontal hydraulic gradient is approximately 0.025.

Upward vertical hydraulic gradients are greatest near the base of the Oquirrh Mountains. Downward vertical gradients are present east of the Bingham Creek reservoir system and near the KUCC production wells. In the center of the western side of the basin (east of 1193 and 109 to the former KUCC evaporation ponds), vertical hydraulic gradients are nearly non-existent. Both upward and downward gradients are found east of the former KUCC evaporation ponds, that reflects infiltration from canals and regional flow of groundwater to the Jordan River, respectively. Near the Jordan River, the vertical gradients are upward. Location variations in vertical gradients are also observed around municipal and KUCC well fields.

Groundwater Velocity. Average horizontal groundwater velocities are based on Darcy's Law, using average gradients and hydraulic conductivity, and an effective porosity of 0.225, which is typical for gravel (Freeze and Cherry 1979). The overall linear groundwater velocity, based on a groundwater flow path from the Oquirrh Mountains to the Jordan River, is about 550 ft/yr (standard deviation of ± 525 ft/yr). This velocity is based on an average gradient of 0.025. In general, the average linear velocity of groundwater between the Oquirrh Mountains and Highway 111 is lower than farther east in the KUCC production well area. The lower velocity near the mountain front is due to lower hydraulic conductivity material (volcanic gravel) than in the production well area, which consists of quartzitic gravel.

Isotopic data, specifically tritium and CFCs (chlorofluorocarbons), also allow an estimate of average linear groundwater velocity. In 1997, six CFC samples were collected along a flow line of the plume extending from the former Bingham Creek reservoir to the eastern edge of the plume (Solomon and Bowman 1997). Monitoring well P190A, located southeast of K60 just down gradient of the former Bingham Creek reservoir sulfate plume, yields a CFC-12 recharge age of 1961, which is consistent with the observed tritium activity in this well. The computed travel time from the Bingham Creek reservoir to P190A is 36 years, which yields an average linear groundwater velocity of about 500 ft/yr. Because dispersion (i.e., mechanical mixing of two fluids in the aquifer) could increase flow rates, this velocity may be in error by about 30 percent, suggesting a range in average groundwater velocity from 500 to 650 ft/yr.

APPENDIX B

EXPLANATION OF SIGNIFICANT DIFFERENCES
KENNECOTT SOUTH ZONE OPERABLE UNIT 2
SOUTHWEST JORDAN RIVER VALLEY GROUND WATER PLUMES

BACKGROUND

In December, 2000, EPA and UDEQ signed a Record of Decision which selected a remedy for the Zone A ground water plumes associated with past mining activity in the Oquirrh Mountains. During the design phase of the project, Kennecott Utah Copper Corp. (KUCC) conducted treatability studies to refine flows and treatment parameters and to combine the infrastructure associated with this project with similar infrastructure needed to manage other contaminated flows at the mine. These new concepts and study results have led to some minor changes in the selected remedy as chosen by the Record of Decision. The overall approach to the problem and ability to meet the stated objectives remain unchanged.

COMPARISION OF SELECTED REMEDY (as given in the Record of Decision) AND THE REMEDIAL DESIGN (as detailed in the Final Design for Remedial Action)

Remedy in Record of Decision	Remedy in Design Phase	Differences, if any
Operations and maintenance of surface source controls	Not specifically mentioned in the Remedial Design. O+M of the source controls is addressed in a State Ground Water Permit.	Surface source controls not addressed in the Remedial Design document. This is required in a State Ground Water Permit.
Integration and use of Institutional Controls, as approved by the State Engineer	Restrictions on use of water from existing wells, restrictions on installation of new wells, moratorium on new water rights will be established through the State Engineer as needed.	The State Ground Water Management Plan issued by the State Engineer in June 2002 addresses issue specific to the remediation effort and needed restrictions in the area of the plumes.
Point of Use Management for private well owners (in-home treatment units, bottled water, deepening of wells, replacement of wells)	Plan for addressing impacts to other well owners was developed. Work with owners to develop best form of reparations.	Same

Plan to deal with consequences of water level drops (new and deeper wells, deeper completions in wells, alternate water sources, purchase or exchange of water rights), well abandonment and compensation.	Options include reduced pumping, replacement water, injection, deeper well installation	Same
Install a barrier well containment system at leading edge of acid plume at points in path of movement (where sulfate is less than 1500 ppm). No water with sulfate concentrations greater than 1500 ppm should move off Kennecott property.	Three wells to serve as an initial barrier well system have already been installed	Same
Install well or wells in core of acid plume	Two wells to operate at any time. Wells moved in response to plume	Same
Pretreatment of acid water using nanofiltration	Acid water sent directly to tailings line without pretreatment. Neuturalization and metals removal takes place in the tailings line. Neutralization by tailing can be augmented with lime if needed.	Nanofiltration step eliminated in final design.
Treatment of pretreated acid waters by RO	Not relevant any more	No pretreatment of acid waters. Treatment of acid waters occurs in tailings lines, not by RO plant.
Treatment of water from barrier wells by RO	Treatment waters from sulfate barrier wells by RO	Same
Treated waters to municipal water purveyor	Treated waters from sulfate wells sent to JVWCD, acid waters kept by Kennecott for use in milling processes.	Acid waters are kept by Kennecott for use in processes, and are not sent to a water purveyor.

Install and maintain a monitoring system to track plume movement	Monitoring system plan presented	Same
Prior to mine closure, dispose of concentrated in the tailings line	Acid water and RO concentrates added to tailings line	Very similar
Post Closure plan should be developed during RD/RA which can be implemented quickly.	Post Closure Conceptual design options presented	Same

EXPLANATION OF DIFFERENCES

In the process of designing the remedy, the approach to treating the waters withdrawn from acid plume was changed. Originally, the waters from the acid plume core were to be pretreated using the nano-filtration technology. The permeate was then to be further treated using reverse osmosis, with the concentrate recycled to the waste rock dumps for use in active leaching of the waste rock. However, since this approach was studied and advocated, Kennecott began experimentation on treatment of the residual leachate and leachates produced with precipitation falls on the dump areas. A study during the design phase indicated that insertion of the acid waters into the tailings pipeline was feasible. The tailings line, therefore, serves as a 13-mile long acid neutralizing facility. Further studies revealed that the neutralization process was actually completed in the first few hundred yards of the pipeline. The experiments further proved that both waste streams, the residual leachate water from the dumps and the acid waters removed from the aquifer, could be treated effectively in this manner. The resulting water with its soluble components is not of drinking water quality and therefore will not be provided to the municipalities. Instead, it would be recycled and used in Kennecott's processing, especially at the Copperton Concentrator. One of the principles in the National Contingency Plan (NCP) indicates that water generated by treatment of contaminated aquifers should be put to beneficial use as industrial water.

In terms of operations of the barrier well reverse osmosis treatment plant in Zone A, Kennecott will construct and operate the plant for the first 5 years at least, perhaps longer. This is to allow time for Kennecott to develop the operational parameters and costs so that long-term management negotiations can proceed. Kennecott may choose to operate the plant indefinitely so that the facility can be expanded and integrated with Kennecott's industrial water management system. As is the original plan, the treated water from the reverse osmosis plant will go to JVWCD and the treatment concentrate to the treatment concentrate to the tailings line.

Scientists agreed very early that effectiveness of source control infrastructure was extremely critical in cleaning up the aquifer. The cut-off walls and pipelines associated with these source control measures were constructed and are now maintained through provisions of a state groundwater protection permit. Because of its importance to the cleanup program, maintenance of these source controls was listed as an element of the ROD of December, 2000. The source control maintenance is not described in the remedial design because this is already included in the groundwater permit. The parties remain committed to this part of the remedy. Maintenance of the source control facilities will continue either under the auspices of the groundwater permit or under terms of the federal RD/RA Consent Decree.

CONCLUSIONS

Although some of the treatment details presented in the Remedial Design are different than detailed in the ROD, the overall approach remains unchanged. Unchanged is the concept of barrier wells which prevent spread of the contamination. Unchanged is the withdrawal of the heavily contaminated waters from the core of the acid plume so that the plume diminishes in size over time. Unchanged is the approach for beneficial use of the waters withdrawn from the plume, a concept which works for both the waters treated in the reverse osmosis plant and in the tailings pipeline.

RECORD OF DECISION

KENNECOTT SOUTH ZONE, OPERABLE UNIT 2

SOUTHWEST JORDAN RIVER VALLEY GROUND WATER PLUMES

U. S. Environmental Protection Agency, Region VIII
Utah Department of Environmental Quality

December 13, 2000

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RECORD OF DECISION
KENNECOTT SOUTH ZONE OPERABLE UNIT 2
SOUTHWEST JORDAN RIVER VALLEY GROUND WATER PLUMES

PART 1: DECLARATION

A. Site Name and Location

This Record of Decision covers Operable Unit 2 (Southwest Jordan River Valley Ground Water Plumes) of the Kennecott South Zone Site, proposed for the NPL in 1994. Operable Unit 2 is located in Salt Lake County, Utah, and encompasses the groundwater beneath all or portions of the municipalities of West Jordan, South Jordan, Riverton, Herriman, and portions of unincorporated Salt Lake County. The CERCLIS ID is UTD000826404.

B. Statement of Basis and Purpose

This decision document presents the Selected Remedy for the Kennecott South Zone Operable Unit 2 Site in Salt Lake County, Utah, which was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), 42 U.S.C. §§ 9601 et. seq, and, to the extent practicable, the National Contingency Plan (NCP), 40 C.F.R. Part 300. This decision is based on the Administrative Record file for this site.

The State of Utah concurs with the Selected Remedy. Their concurrence is based upon the belief that the remedy will benefit the public within the affected area and begin to protect public health and the environment.

C. Assessment of Site

The response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances and pollutants or contaminants into the environment.

D. Description of Selected Remedy

The selected remedy for Operable Unit 2 (Southwest Jordan River Valley Ground Water Plumes) addresses the ground water contamination for this Kennecott South Zone Site. The surface contamination which originally constituted the principal threat at the site has already been addressed in other removal and remedial actions at OU1 (Bingham Creek), OU3 (Butterfield Creek), OU4 (Large Bingham Reservoir), OU5 (ARCO Tails), OU6 (Lark Tailings and Waste Rock), OU7 (South Jordan Evaporation Ponds), OU10 (Copperton Soils), and OU17 (Bastian Area).

For purposes of clarifying agency authority over the cleanup operations of this action, the agencies plan on using a joint CERCLA and State NRD approach. The cleanup strategy presented within the text of this ROD is concerned primarily with the acid plume in Zone A, under CERCLA authority. EPA maintains the right to intervene in the cleanup of the sulfate plume in Zone B, if it is not addressed sufficiently by the State NRD action. The State of Utah will maintain authority of operations, in both Zones A and B, as they are intended to fulfill the requirements of the NRD settlement. (Please refer to the footnote at the bottom of page 28.)

The performance standards for the selected remedy include achieving the primary drinking water standards in the aquifer of Zone A at the Kennecott property line (as of the date of the signing of this document) for all hazardous substances (i.e. metals). Active remediation (pump and treat) is required to achieve the health-based goal of 1500 ppm for sulfate while monitored natural attenuation is used to achieve the State of Utah primary drinking water standard for sulfate at 500 ppm. The water treated and delivered for municipal use must achieve all drinking water standards of the State of Utah, as a requirement of both the CERCLA action and the Natural Resource Damage (NRD) settlement between the State of Utah and Kennecott Utah Copper Corporation. The performance standard for treatment residuals as measured at or before the end of the tailings pipe is demonstration that the tailings/treatment residuals combination meets the characteristics of non-hazardous waste.

The selected remedy involves treatment and containment of contaminated ground water plumes. The principal threats which caused the ground water contamination have been addressed in previous actions or are contained under provisions of a Utah Ground Water Protection Permit.

The selected remedy contains the following elements:

- Continuation of source control measures as administered through the State of Utah Ground Water Protection Program.

- Prevent human exposure to unacceptably high concentrations of hazardous substances and/or pollutants or contaminants by limiting access to the contaminated ground water. Institutional controls include purchases of land, purchases of water rights, limiting drilling of new wells and increased pumping of nearby old wells as approved (on request) and administered through the State of Utah State Engineer (Division of Water Rights).

- Prevent human exposure to unacceptably high concentrations of hazardous substances and/or pollutants or contaminants through point-of-use management which includes providing in-house treatment units to residents with impacted wells, replacement of their water by hooking the properties up to municipal drinking and/or secondary supplies, and/or modifying their

wells to reach uncontaminated waters.

- Contain the acid plume in Zone A by installation of barrier wells at the leading edge of the contamination (1500 ppm sulfate or less), pump and treat the waters to provide a hydraulic barrier to further plume movement while providing treated water for municipal use. The treatment technology for the barrier well waters is reverse osmosis.

- Withdraw the heavily contaminated waters from the core of the acid plume in Zone A and treat these contaminated waters using pretreatment with nanofiltration or equivalent technology, followed by treatment with reverse osmosis to provide drinking quality water for municipal use.

- Monitor the plume to follow the progress of natural attenuation for the portions of the Zone A plume which contain sulfate in excess of the state primary drinking water standard for sulfate (500 ppm sulfate).

- Disposal of treatment concentrates in existing pipeline used to slurry tailings to a tailings impoundment prior to mine closure.

- Development of a post-mine closure plan to handle treatment residuals for use when the mine and mill are no longer operating.

E. Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure the remedy is, or will be, protective of human health and the environment.

F. ROD Data Certification Checklist

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file for this site.

- Chemicals of concern and their respective concentrations, pages 44-45.
- Baseline risk represented by the chemicals of concern, pages 48-49.
- Cleanup levels established for chemicals of concern and the basis for these levels, pages 88-89.
- How source materials constituting principal threats are addressed, page 19.
- Current and reasonable anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the baseline risk assessment and ROD, pages 40-42.
- Potential land and ground water use that will be available at the site as a result of the Selected Remedy, page 42.
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected, pages 83-87.
- Key factor(s) that led to selecting the remedy (i.e., describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision), pages 73-79.

G. Authorizing Signatures

The following authorized officials at EPA Region VIII and the State of Utah approve the selected remedy as described in this Record of Decision:

12/13/00
Date

Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation
U. S. Environmental Protection Agency, Region VIII

12/13/00
Date

Dianne R. Nielson, Ph.D.
Executive Director
Utah Department of Environmental Quality

APPENDIX C

July 8, 2003

Gayle Smith, P.E.
Utah Department of Environmental Quality
Division of Water Quality
150 North 1950 West
Salt Lake City, UT 84114

SUBJECT: Reverse Osmosis Drinking Water Treatment By-Product Discharge Permit Application – Revised Summary Report

Dear Mr. Smith:

Enclosed is a revised summary report to accompany our previously submitted UPDES permit application relating to the Southwest Groundwater Remediation Project. This summary report was revised after meeting with you and your staff to discuss the details of this permit.

The main change in the revised summary report is that discharges at 8300 South will have TDS and selenium limitations that are lower than the concentrations previously discussed. This will be accomplished by always utilizing the discharge at 2900 South for RO by-product discharge and using the 8300 South site for discharges of feed water and treated water that meet the limitations mentioned above. This method allows us to meet our plant start-up and membrane cleaning operations. This change also decreases the blending ratio at 2900 South to 2% of the Jordan River flow rate.

We are grateful to you and your staff for your attention to this permit. We request that this permit be placed on public notice at the next opportunity.

Your consideration of this application is appreciated.

Sincerely,

Richard P. Bay, P.E.
Assistant General Manager and Chief Engineer

UPDES Discharge Permit Application

Southwest Groundwater Treatment Project

JORDAN VALLEY WATER CONSERVANCY DISTRICT

8215 South 1300 West
P.O. Box 70
West Jordan, Utah 84088
Telephone: (801) 565-4300
Fax: (801) 565-4399

Consultation provided by:

CH2M Hill Engineers
4001 South 700 East, Suite 700
Salt Lake City, Utah 84107

Kennecott Utah Copper Corporation
8315 West 3595 South
P.O. Box 6001
Magna, Utah 84044

Carollo Engineers
12592 West Explorer Drive, Suite 200
Boise, Idaho 83713

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UPDES DISCHARGE PERMIT APPLICATION

JORDAN VALLEY WATER CONSERVANCY DISTRICT
SOUTHWEST GROUNDWATER TREATMENT PROJECT

EXECUTIVE SUMMARY

Jordan Valley Water Conservancy District (JVWCD) requests a UPDES permit for the Southwest Groundwater Remediation Project, a remediation project being completed jointly with Kennecott Utah Copper Corporation (KUCC) and under the supervision of the State of Utah Department of Environmental Quality (State). In the permit, JVWCD requests discharges of up to 3.1 cubic feet per second (2.5 million gallons per day) of reverse osmosis by-product (RO by-product) water to the Jordan River at 8300 South or conveyed by pipeline to 2900 South, depending on the flow rate in the Jordan River. The current project schedule anticipates discharges beginning in 2007.

This project is proposed in conjunction with KUCC to serve the following purposes: (1) containment of existing groundwater contamination, (2) remediation of the groundwater aquifer under certain portions of southwest Salt Lake County, Utah, and (3) providing an additional potable water supply to the affected area. This project is outlined in a joint proposal previously submitted to the Department of Environmental Quality.

Water sources for the treatment plant will be deep and shallow wells in West Jordan and South Jordan. The deep groundwater wells are in the known area of elevated sulfate contamination (Zone B supply). The shallow wells are near the Jordan River (Lost Use supply). A reverse osmosis treatment plant will provide advanced treatment removing sulfates and other salts. The water would then be distributed as potable water to JVWCD's customers.

JVWCD has completed pilot testing for the project including demonstration tests with a multi-vessel reverse osmosis system functionally equivalent to the proposed full-scale reverse osmosis plant. JVWCD has a high degree of confidence that the results of the pilot testing will accurately reflect conditions of the full-scale plant. RO by-product, feed water, and treated water quality data from the demonstration scale pilot testing were used in the water quality and aquatic toxicity tests referenced in the supporting information provided with this application. No toxic effects are expected. The results of each test to date have been highly favorable. The reverse osmosis technology is well suited for the application successfully removing the targeted contaminants while producing a high-quality drinking water supply.

This permit application requests discharge at two locations, 8300 South and 2900 South. The RO by-product will be discharged at the 2900 South location. Discharges at 8300 South will consist of storm runoff, feed water, and treated water with a TDS and selenium concentration not causing the standards of the Jordan River to be exceeded.

UPDES DISCHARGE PERMIT APPLICATION

JORDAN VALLEY WATER CONSERVANCY DISTRICT
SOUTHWEST GROUNDWATER TREATMENT PROJECT

SUMMARY REPORT

Project Summary

This report is attached as a supplement to the preceding Jordan Valley Water Conservancy District's (JVWCD) Southwest Groundwater Remediation Project UPDES Discharge Permit Application. The application requests approval from the Utah Department of Environmental Quality (UDEQ) to discharge up to 3.1 cubic feet per second (CFS) (2.1 million gallons per day (MGD), of drinking water reverse osmosis by-product (RO by-product) water from a proposed treatment plant to be located near the JVWCD offices at 8215 South 1300 West, West Jordan, Utah. The RO by-product will be discharged at 2900 South. The application also requests discharge at 8300 South for storm runoff, feed water, and treated water. TDS and selenium limitations are anticipated to be imposed at both locations.

The proposed discharge locations are:

Discharge Point	Discharge Location
JV-001	Jordan River at 8300 South (adjacent to JVWCD offices and proposed RO plant)
JV-002	Jordan River at 2900 South (below confluence with Mill Creek)

The locations are shown in Figure 1, along with a proposed pipeline alignment to convey reverse osmosis (RO) drinking water by-product from the water treatment plant to Discharge Point JV-002. The by-product pipeline will be a 10-inch diameter, 9 mile long pipeline with a booster pump station.

The project is being proposed by JVWCD in association with Kennecott Utah Copper Corporation (KUCC). JVWCD is a Water Conservancy District organized and operating under the Third District Court of the State of Utah. Its service area includes 19 wholesale member agencies with a population of approximately 800,000 people. The project will serve the following purposes:

(1) Containment of existing elevated sulfate groundwater contamination;

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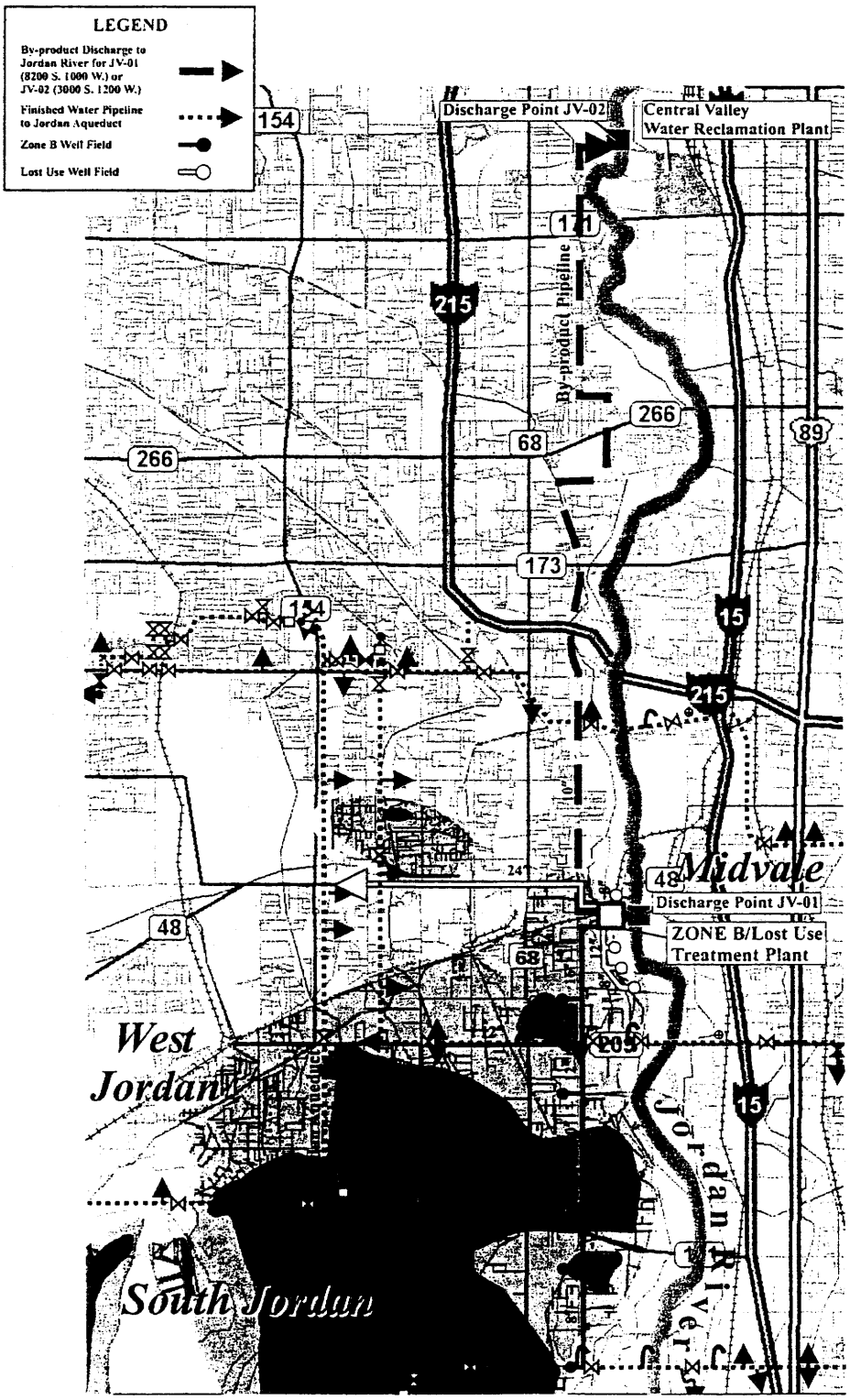

Figure 1
PROJECT SITE MAP
JORDAN VALLEY WATER CONSERVANCY DISTRICT

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The proposed project is the result of a joint effort on the part of KUCC and JVWCD to meet the requirements of a consent decree issued in 1995 requiring remediation of the groundwater aquifer under the southwest portion of the Salt Lake Valley, which contains elevated sulfate contamination as a result of historical mining activities of the KUCC. KUCC benefits by meeting the remediation goals of the court order. JVWCD benefits by providing a water supply to the affected area.

The proposed project will extract groundwater (feedwater) from the principal aquifer in an area bounded roughly by 8800 South and 11400 South and from 1300 West to 3200 West. This area is termed in the consent decree the "Zone B" area. Groundwater will also be withdrawn from the shallow unconfined aquifer near the treatment plant site. This supply is referred to as "Lost Use" in the consent decree. JVWCD owns approved water rights to support this project.

The project will utilize a reverse osmosis treatment process to separate high sulfates and other salts in the feedwater from the product water. The separated salts, referred to as RO by-product, are proposed to be discharged to the Jordan River under this application. The treated water will be distributed by JVWCD in its potable water transmission system.

The treatment plant will consist of separate treatment trains for the Zone B and Lost Use supplies. Due to the salt removal efficiency of reverse osmosis (RO), a portion of the feed flow will bypass the RO process, which will enable stabilization of the RO product water prior to introduction into the JVWCD transmission system. Figure 2 shows a process flow diagram for the reverse osmosis treatment plant.

A separate treatment facility, termed “Zone A”, is being proposed near Bingham Canyon (Copperton) by KUCC as an integral part of this project. This treatment plant will use a similar reverse osmosis treatment technology but will not require discharges to the Jordan River, and hence is not included under this permit application.

Treatment Process and Discharge Flow Rates

Table 1 shows flow rates for operation of the reverse osmosis plant. RO by-product is proposed to be discharged to the Jordan River at a flow rate of 3.1 cfs (2.0 MGD) at 2900 South in a 24 hour 365 days a year mode of operation. Storm water, feed water, and treated water are proposed to be discharged at 8300 South on an as-needed basis.

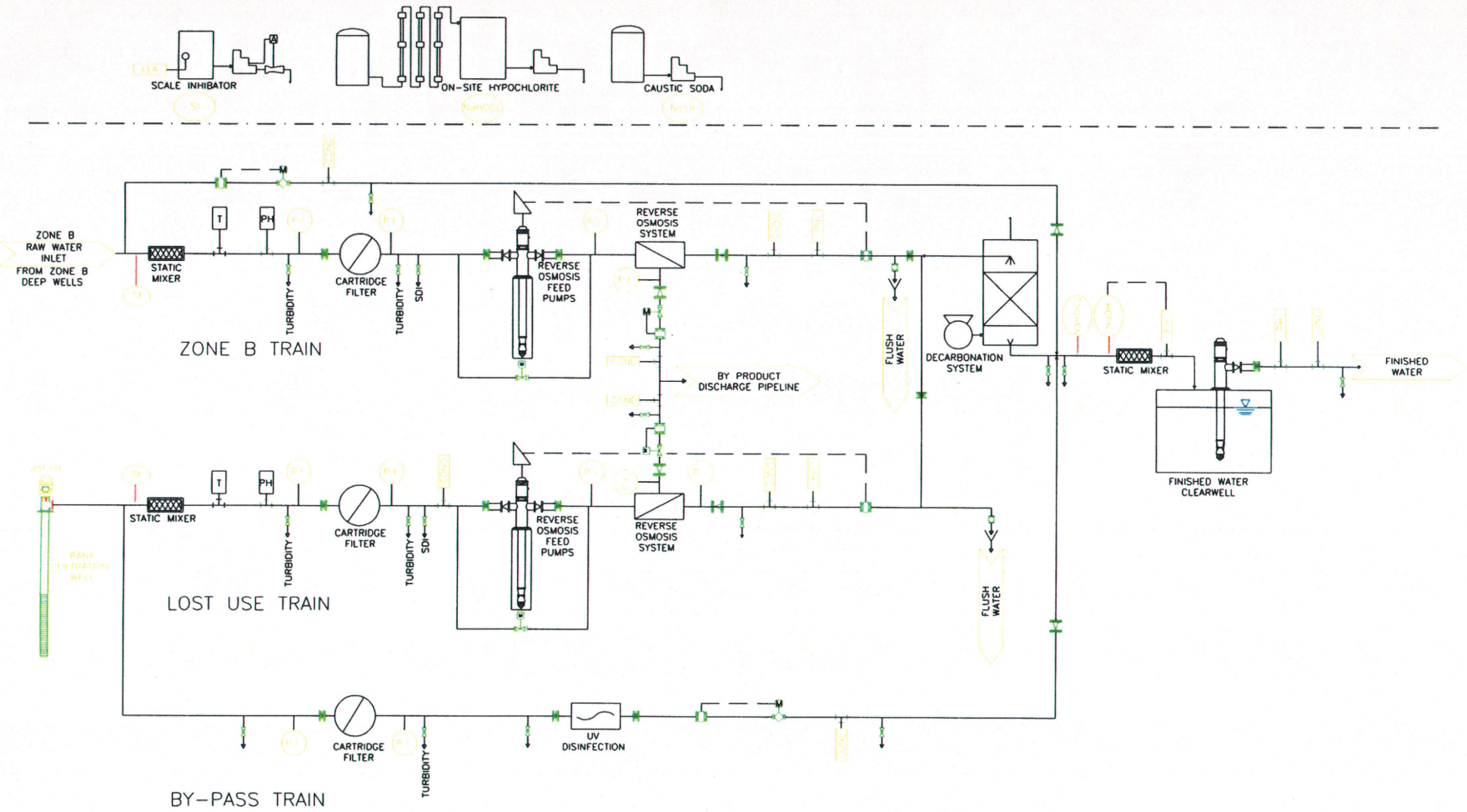

FIGURE 2

WATER TREATMENT PLANT PROCESS FLOW DIAGRAM

ZONE/B LOST USE

I:\WELL. SHALLOW\DISCHARGE PERMIT\PERMIT APPLICATION\FIGURE 2.DWG

July 8, 2003

Gayle Smith, P.E.
Utah Department of Environmental Quality
Division of Water Quality
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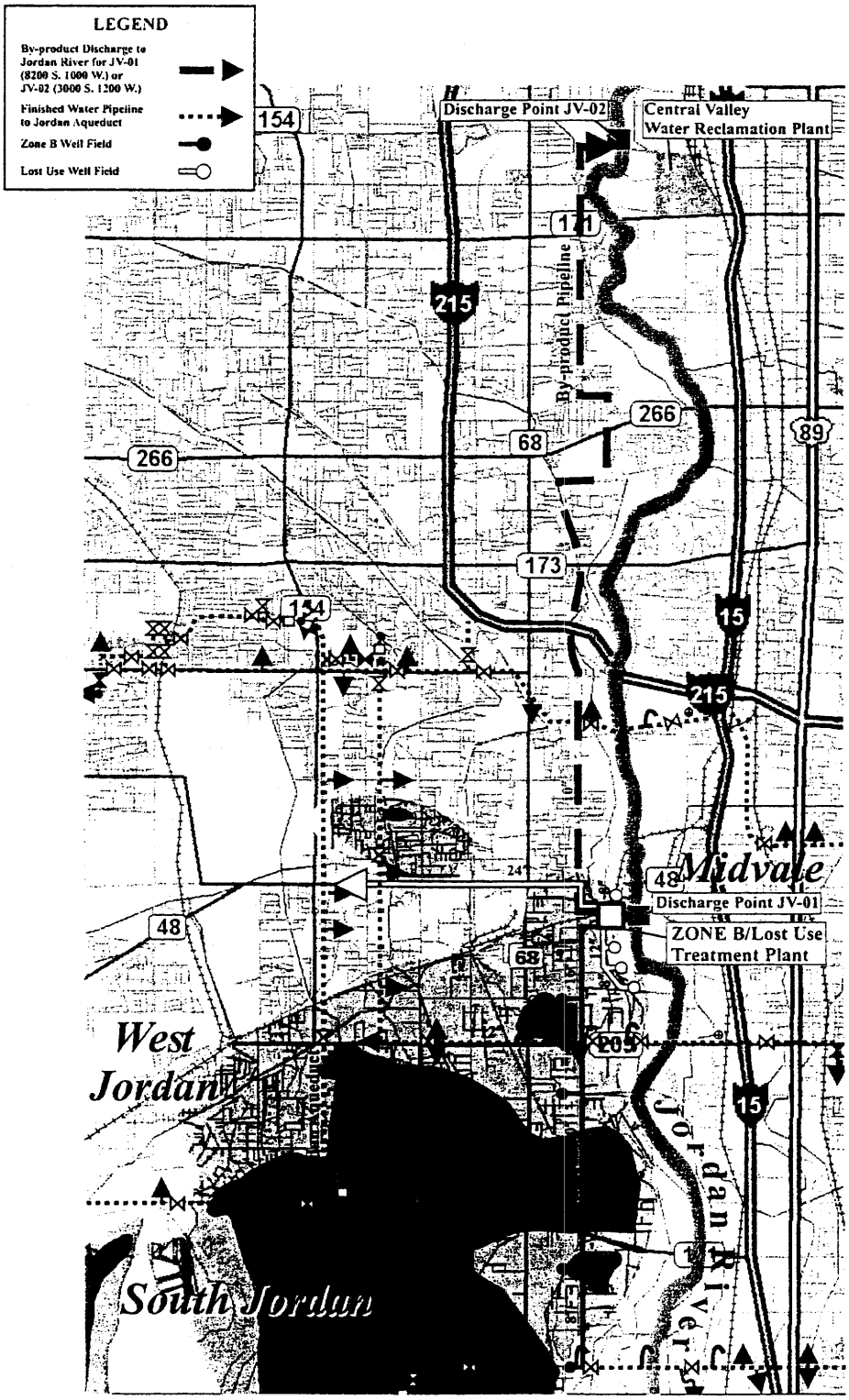

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UPDES Permit Application Southwest Groundwater Remediation Project Table 1 Water Treatment Plant Design Flow Rates			
Water Source	Feed Water (CFS)	Treated Water (CFS)	By-Product (CFS)
Zone B water source supply	6.54	5.33	1.24
Lost Use supply	12.64	10.78	1.86
Total	19.18	16.11	3.10

The RO treatment plant will also produce occasional start-up flows of feed water and treated water when the treatment process is started up. JVWCD proposes to discharge the start-up flows at discharge location JV-001 (8300 South) minus the RO by-product, which will be discharged at 2900 South. Start-up flows will occur whenever new RO membranes are installed and following cleaning of the membranes. Start-up discharge will last for approximately 72 hours when new membranes are installed and for 2 hours following membrane cleaning. This discharge scenario is anticipated to occur infrequently. Membrane replacement is anticipated to be required every five years. Membrane cleaning is anticipated to occur every other month. Because the RO by-product will be discharged at 2900 South, the water quality of start up flows will not exceed the proposed water quality limitations.

As mentioned above, RO membranes must be cleaned periodically to maintain optimal performance. Cleaning operations consist of circulating high or low pH solutions through the RO vessels. Cleaning water will be pH neutralized and temporarily stored on site. Discharge of cleaning water will be accomplished when the process is started up by combining a small amount of feed or product water with cleaning water and discharging the stored cleaning water at a low flow rate. Discharge of cleaning water will not cause the discharges to exceed the limits identified in this permit application.

Alternative Discharge Options

JVWCD considered alternative discharge options besides discharging to the Jordan River. These options included discharge to waste water treatment plants (WWTP), evaporation in lined evaporation ponds, discharging to Great Salt Lake, and deep well injection. Each of these options have physical, economic, and permitting challenges. A discharge to a WWTP would increase the flow rate and the total dissolved solids of the WWTP discharge. Two regional WWTP's were contacted. Each of them indicated that discharge of by-product to a WWTP would increase operational costs of the WWTP without any perceived benefit over direct discharge of by-product to the Jordan River. Evaporation ponds were evaluated using local evaporation characteristics. It was calculated that the ponds must be

sized to be a minimum of 250 acres in size. It was concluded that a suitable site may be available at a location equally distant from the project site as from Great Salt Lake. The water quality of the by-product was compared to Great Salt Lake (GSL) water quality. It was concluded that discharge to GSL is feasible. The constraint of discharging to evaporation ponds or to GSL is the cost of constructing a pipeline and pumping the by-product a longer distance than to the
JV-002 discharge location. The increased pipeline costs are approximately twice that of the JV-002 discharge location. An option to discharge into a deep injection well, at a depth of 3,000 feet or more, may be possible. However, this would be a new type of permit for the State of Utah. In addition, there is a potential for the deep injection well to induce an upward gradient into a high quality drinking water aquifer. This concern may create a permitting impasse. For all of the reasons stated above, JVWCD believes that discharge to the Jordan River, as described herein, is the most viable option for this project.

Pilot Testing

JVWCD has undertaken three separate phases of pilot testing prior to submitting this application. These tests were completed to ascertain the viability of the proposed project for its intended purposes and to quantify the water quality of the product and the by-product. These pilot tests were completed in association with CH2M Hill, Carollo Engineers and Kennecott Utah Copper.

CH2M Hill assisted with the initial bench scale studies (January 2001). Carollo Engineers later assisted in single element pilot scale studies (May - November 2001) and demonstration scale studies (September 2001 - March 2002). Pilot tests were designed to simulate treatment plant operations, quantify treatment parameters, identify cleaning intervals and determine treatment efficiency. Pilot testing took place at two locations near wells representative of each source. The results for each stage of the pilot testing were favorable. This means that the treatment process is expected to be viable over the long term.

Sampling completed during each stage of the pilot testing indicated the supplies were suitable for use as feedwater to the RO process. The groundwater obtained from the deep groundwater wells at the Zone B site exhibited high levels of dissolved salts, especially sulfates, in concurrence with the remediation purposes of the project. The waters from the Lost Use well were lower in salts yet contained small amounts of pollen indicating a source potentially under the influence of surface water. No microbial indicators were detected in either water supply.

Table 2 shows the results from water quality testing at each pilot plant as tested in December 2001. The parameters are categorized as shown in the UPDES permit application. These data represent actual laboratory test results from each water RO by-product source in the project.

When completed, the testing indicated that the water quality of the RO product and by-product was similar to what was expected based on engineering computer model projections. Although the data shown in Table 2 is based on a single exhaustive set of water quality testing during the demonstration scale pilot tests, numerous supplemental

water quality tests were also completed during the piloting efforts. Chart 1 shows the results of 106 supplemental total dissolved solids (TDS or salt) samples taken. These supplemental tests confirm that the RO by-product was consistent during the pilot testing. The data for the Lost Use by-product ranged from 7,525 TDS to 8,853 TDS. The Zone B by-product ranged from 7,999 TDS to 9,167 TDS. If the range of data was larger, there would be a need for more water quality testing. However, the range of data was small for the type of pilot testing that was performed and is expected to be more narrow in the future. Therefore, JVWCD is comfortable that the data presented is representative of water quality to be produced from a full-scale operation.

UPDES Permit Application
Southwest Groundwater Remediation Project
Table 2
DRINKING WATER RO BY-PRODUCT
WATER QUALITY DATA

Parameter	Zone B RO By-Product Demonstration Phase @ 80% Recovery (mg/l)	Lost Use RO By-Product Demonstration Phase @ 85% Recovery (mg/l)
General		
Alkalinity - mg/L as $CaCO_3$	1924	1930
Hardness - mg/L as $CaCO_3$	5898	4515
pH - S.U.	7.57	7.69
Total Dissolved Solids	8304	8232
Inorganics		
Aluminum	< 0.125	< 0.125
Antimony	< 0.005	< 0.005
Arsenic	< 0.020	< 0.020
Asbestos B MFL	< 0.0002	< 0.0002
Barium	0.150	0.180
Beryllium	< 0.005	< 0.005
Boron	0.51	0.68
Cadmium	< 0.0025	< 0.0025
Calcium	1500	970
Chloride	920	1300
Chromium	0.032	0.024
Chromium (VI)	0.042	0.039
Copper	0.022	0.018
Cyanide (as free cyanide)	< 0.01	< 0.025
Fluoride	0.29	1.3
Iron	< 1.0	< 1.0
Lead	< 0.0025	< 0.0025
Magnesium	540	390
Manganese	< 0.01	< 0.01
Mercury	< 0.0002	< 0.0002
Nickel	.033	< 0.025
Nitrate (as N)	14	15
Nitrite (as N)	< 0.2	< 0.2
Total Nitrate and Nitrite (as N)	14	15
Perchlorate	< 0.02	< 0.02
Orthophosphate	0.24	0.19
Potassium	18	46
Selenium	0.020	0.020
Silica (Reactive) (Total)	210 220	220 255
Silver	< 0.0025	0.020
Sodium	500	860
Strontium	4.7	4.5

UPDES Permit Application
Southwest Groundwater Remediation Project
Table 2
DRINKING WATER RO BY-PRODUCT
WATER QUALITY DATA

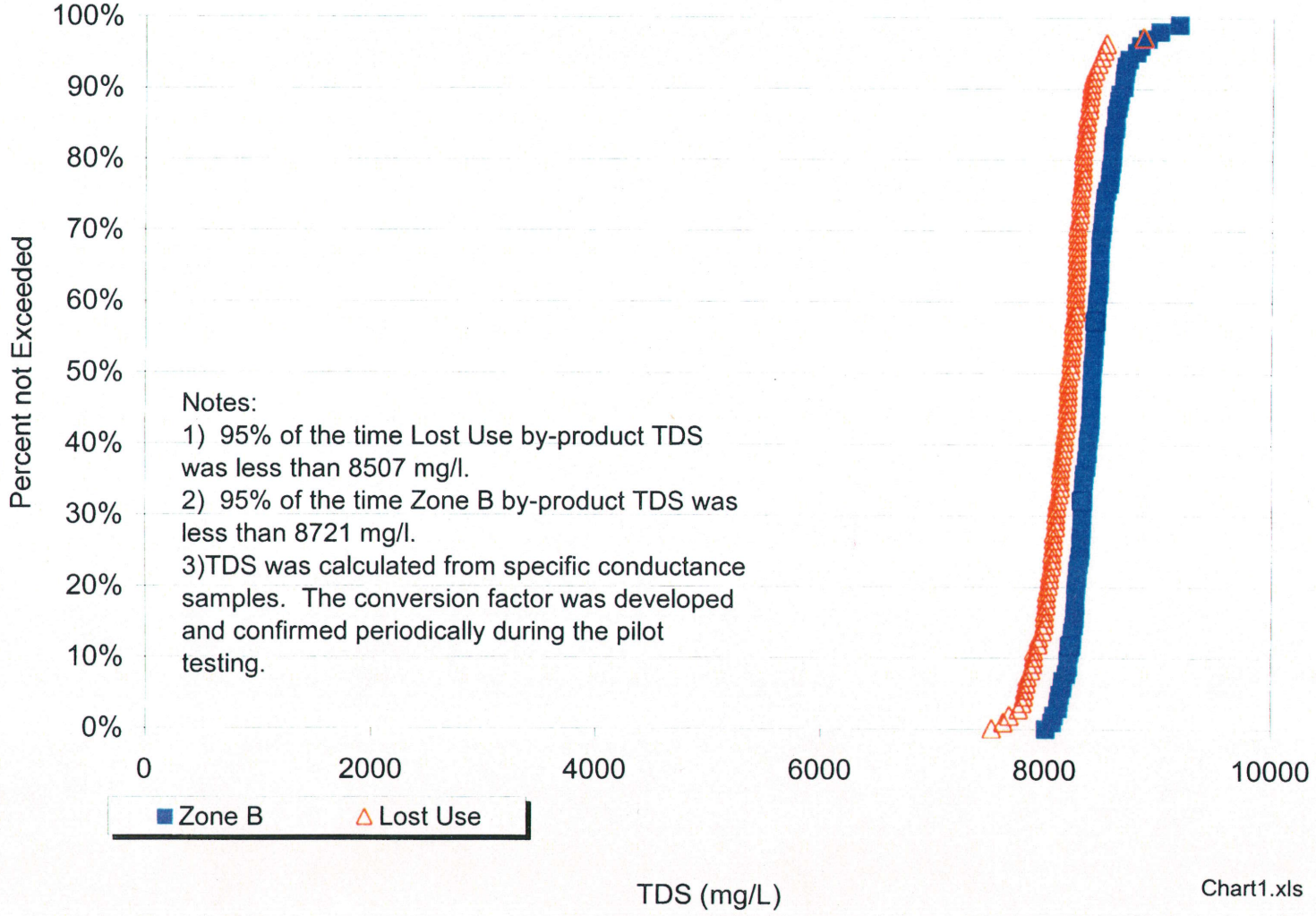
Parameter	Zone B RO By-Product Demonstration Phase @ 80% Recovery (mg/l)	Lost Use RO By-Product Demonstration Phase @ 85% Recovery (mg/l)
Sulfate	3100	1800
Thallium	< 0.005	< 0.005
Zinc	< 0.025	< 0.025
Volatile Organic Contaminants		
1,1-Dichloroethylene	< 0.0005	< 0.0005
1,1,1-Trichloroethane	< 0.0005	< 0.0005
1,1,2-Tricholoroethane	< 0.0005	< 0.0005
1,2-Dichloroethane	< 0.0005	< 0.0005
1,2-Dichloropropane	< 0.0005	< 0.0005
1,2,4-Trichlorobenzene	< 0.0005	< 0.0005
Benzene	< 0.0005	< 0.0005
Carbon Tetrachloride	< 0.0005	< 0.0005
cis-1,2-Dichloroethylene	< 0.0005	< 0.0005
Dichloromethane	< 0.0005	< 0.0005
Ethylbenzene	< 0.0005	< 0.0005
Monochlorobenzene	< 0.0005	< 0.0005
0-Dichlorobenzene	< 0.0005	< 0.0005
para-Dichlorobenzene	< 0.0005	< 0.0005
Styrene	< 0.0005	< 0.0005
Tetrachloroethylene (PCE)	< 0.0005	< 0.0005
Toluene	< 0.0005	< 0.0005
trans-1,2-Dichloroethylene	< 0.0005	< 0.0005
Trichloroethylene	< 0.0005	< 0.0005
Vinyl chloride	< 0.0003	< 0.0003
Xlylenes (total)	< 0.0005	< 0.0005
Methyl tert-Butyl Ether (MTBE)	< 0.003	< 0.003
Synthetic Organic Contaminants		
2,3,7,8-TCDD (Dioxin)	$< 2.9 \times 10^{-12}$	$< 2.9 \times 10^{-12}$
2,4-D	< 0.0001	< 0.0001
2,4,5-TP (Silvex)	< 0.0002	< 0.0002
Alachlor	< 0.00005	< 0.0001
Aldicarb	< 0.001	< 0.001
Aldicarb Sulfoxide	< 0.001	< 0.001
Aldicarb Sulfone	< 0.0014	< 0.0014
Atrazine	0.003	< 0.0001
Benzo(a) Pyrene	< 0.00002	< 0.00004
Carbofuran	< 0.0018	< 0.0018

UPDES Permit Application
Southwest Groundwater Remediation Project
Table 2
DRINKING WATER RO BY-PRODUCT
WATER QUALITY DATA

Parameter	Zone B RO By-Product Demonstration Phase @ 80% Recovery (mg/l)	Lost Use RO By-Product Demonstration Phase @ 85% Recovery (mg/l)
Chlordane	< 0.0001	< 0.0001
Dalapon	< 0.001	< 0.001
Di(2- ethylhexyl) Adipate	< 0.0006	< 0.0012
Di(2-ethylhexyl) Phthalate	< 0.0006	< 0.0012
Dibromochloropropane (DBCP)	< 0.00001	< 0.00001
Dinoseb	< 0.0002	< 0.0002
Diquat	< 0.0008	< 0.0004
Endothall	< 0.02	< 0.02
Endrin	< 0.0001	< 0.0002
Ethylene Dibromide	< 0.00001	< 0.00001
Glyphosate	< 0.006	< 0.006
Heptachlor	< 0.00004	< 0.0008
Heptchlor Epoxide	< 0.00002	< 0.00004
Hexachlorobenzene	< 0.00005	< 0.0001
Hexachlorocyclopentadiene	< 0.00005	< 0.0001
Lindane	< 0.00002	< 0.00004
Methoxychlor	< 0.00005	< 0.0001
Oxamyl (vydate)	< 0.004	< 0.0004
Pentachlorophenol	< 0.00004	< 0.00004
Picloram	< 0.0001	< 0.0001
Polychlorinated Byphenyl (PCB)	< 0.0001	< 0.0001
Simazine	< 0.00005	< 0.0001
Toxaphene	< 0.0005	< 0.0005
Radiological		
Gross Alpha - pCi/L	46	15
Gross Beta - pCi/L	< 12.1	45
Radon - pCi/L	720	760
Microbiological		
Assimilable Organic Carbon	NA	NA

Notes:
(1) Water quality testing data from grab sample testing completed by Montgomery Watson Laboratories, December 2001.
(2) Water quality testing was completed for the individual by-product streams.
(3) Values denoted by A<A indicate the concentrations were below the laboratory test detection limit.

Chart 1
RO By-Product TDS
Frequency Exceedance Diagram



Notes:
1) 95% of the time Lost Use by-product TDS was less than 8507 mg/l.
2) 95% of the time Zone B by-product TDS was less than 8721 mg/l.
3)TDS was calculated from specific conductance samples. The conversion factor was developed and confirmed periodically during the pilot testing.

Chart1.xls

Aquatic Toxicity Testing

Aquatic toxicity testing of the RO by-product was completed as required by the permit application. This testing was completed from samples taken from both sources during the demonstration scale testing. Samples were collected on the same day as samples used for the water quality testing, which results are shown in Table 2 of this report. Testing was completed with a range of dilution rates using standard laboratory dilution water.

Testing was completed using three organisms including *Daphnia Magna*, *Ceriodaphnia* and *Fathead Minnows.* Testing was completed by W.E.T. Laboratories of Orem, Utah, using established procedures. Chronic (long-term) and acute (short-term) exposure tests were performed. Tests were completed for each source separately. In addition, a 50% - 50% blend of each source was prepared and tested. A 50% - 50% blend was used because the flowrate proportion of each source had not been determined at the time. In reality, the proportion of RO by-product by source will be Lost Use 60% / Zone B 40%. Results are shown in Table 3.

UPDES Permit Application
Southwest Groundwater Remediation Project
Table 3
Aquatic Toxicity Testing Results

Sample Site	Test Type	Species	Test Endpoint	Data % Solution
Lost Use	Acute	Daphnia Magna	LC50	36.0(1)
	Chronic (survival)	Fathead Minnow	LC50	70.4
	Chronic (growth)	Fathead Minnow	IC25	62.5(2)
	Chronic (survival)	Ceriodaphnia	LC50	19.3
	Chronic (reproduction)	Ceriodaphnia	IC25	14.9
Zone B	Acute	Daphnia Magna	LC50	36.9
	Chronic (survival)	Fathead Minnow	LC50	60.0
	Chronic (growth)	Fathead Minnow	IC25	63.6
	Chronic (survival)	Ceriodaphnia	LC50	17.0
	Chronic (reproduction)	Ceriodaphnia	IC25	8.3
50% - 50% Blend	Acute	Daphnia Magna	LC50	37.9
	Chronic (survival)	Fathead Minnow	LC50	87.2
	Chronic (growth)	Fathead Minnow	IC25	92.5
	Chronic (survival)	Ceriodaphnia	LC50	17.7
	Chronic (reproduction)	Ceriodaphnia	IC25	6.1

Notes:
(1) LC 50%-By-product dilution which would result in lethal effects for 50% of the organisms (i.e., 50% of organisms die with a 36% solution of RO by-product [64% lab water]).
(2) IC 25%-By-product dilution which would result in inhibitory effects for 25% of the organisms (i.e., 25% of the organisms have inhibitory effects [limited reproduction] with a 62% solution of RO by-product [38% lab water]).

Fathead Minnows appeared to be the least affected of the three organisms. This was expected since Fathead Minnows are usually more tolerant of brackish waters. Fathead Minnows did not show an LC50 on the blended by-product until exposed to an 87.2% solution strength. See the notes in Table 3 for an explanation of LC50 and IC25.

Ceriodaphnia appeared to be the most affected of the three organisms. These organisms showed an IC25 at levels as low as 6.1% solution strength.

To minimize acute biologic affects, JVWCD will construct an energy dissipation structure at JV-001 (8300 South) where the TDS limitation matches the standard of the Jordan River and a discharge diffuser at JV-002 (2900 South) where the TDS concentration and potential toxic effects are much greater. The diffuser is proposed to be constructed in a submerged condition, with discharge openings spaced across the full width of the river channel. The design of the openings will focus on distributing the discharge flow rate uniformly across the river channel. The diffuser will promote quick mixing with the receiving water. JVWCD has assumed immediate mixing due to the use of the diffuser. The diffuser should minimize any acute biological impacts in the immediate vicinity of the JV-001 discharge point.

Discharge of RO by-product will not exceed a blending rate of 2% (3.1 cfs/189.7 cfs) at the JV-002 discharge location. The toxicity testing conducted during pilot testing indicated that the worst case Ceriodaphnia IC25 was 6.1%. The toxicity testing showed that the Zone B source had a lower IC25 result than the Lost Use source. This situation is likely due to a higher sulfate concentration in the Zone B source, which tends to be more toxic than the sodium chloride type of salts in the Lost Use source. The sulfate concentration will decrease over time as water is pumped from the Zone B source. The RO plant will be expanded to treat more of the Lost Use source as the Zone B sulfate concentration decreases. For these reasons, JVWCD is confident that aquatic toxicity tests can be passed on the proposed discharge.

Toxicity testing was not performed on the feed and product waters to be discharged at JV-002 (8300 South). However, the water quality of the JV-001 discharge has a TDS limitation that is seven times lower than the JV-002 limit and will not be any where near toxic TDS levels. Discharge from JV-001 does not require toxicity testing.

Jordan River Hydrology

Previous UPDES permits on the Jordan River have relied on hydrologic studies completed by Mr. Brett Borup, Ph. D. These studies quantified the 7-Q-10 flow rate of the river; the lowest expected flow rate for 7 days for a given season, for a 10-year period. The 7-Q-10 flow rates for the JV-001 (8300 South) and JV-002 (2900 South) locations and seasons are presented in Table 4. This data was collected by UDEQ for the most recent 10 year period of time.

Table 4
7-Q-10 Jordan River Flow Rates

LOCATION	Non-Irrigation Season Oct. – Apr. (CFS)	Irrigation Season Apr. – Oct. (CFS)
JV-001	43.7	31.7
JV-002	214.0	189.7

Jordan River Water Quality

Drinking water RO by-product discharges requested under this application may have the potential to affect the water quality in the Jordan River. JVWCD desires to prevent the discharge herein from causing the Jordan River to exceed its water quality regulatory standards.

The Utah Department of Environmental Quality – Division of Water Quality (UDEQ) sets regulatory standards for several water quality parameters in the Jordan River. The regulatory standards are outlined in AStandards of Water Quality for the State (R317-2)@. This publication reserves the area of the Jordan River containing discharge point JV-001 as a cold water fishery (class 3-A). The area containing discharge point JV-002 is reserved as a warm water fishery (class 3-B). Both reaches are also reserved for secondary contact such as wading and for agricultural uses. Each of the regulatory standards pertaining to this application is the same for both reaches. A comparison of the Jordan River standards to the RO by-product water quality is shown in Table 5.

Data for analysis was obtained from published data at the United States Geological Survey (USGS) monitoring station located at Jordan River at State Canal crossing (approximately 1900 South) and 14600 South sampling locations. UDEQ used ten years of Jordan River TDS data to calculate the 85% percentile. Typically, UDEQ would calculate the effects of proposed discharges utilizing water quality and flowrate data from the same time frame in each year or season. This relationship is not available for the Jordan River. UDEQ indicated that the 85% percentile of data would be representative of poor quality water at a low flowrate scenario.

Analysis of Potential Effects

UDEQ performed analyses to quantify the impact of the discharge of RO by-product on the Jordan River. Tables 5 and 6 summarize the effects of the RO by-product discharge on the Jordan River. Table 5 shows data from the RO pilot testing compared with the Jordan River standard for regulated parameters. As shown in this table there are three parameters in the RO by-product that exceed Jordan River water quality standards: total dissolved solids (TDS), mercury and selenium. Mercury in the RO by-product was analyzed using a sample from bench scale pilot testing. The tested value is quite low and near the standard. Because the regulatory limit is so low and samples are often contaminated from the air, UDEQ indicated that mercury should not be a

Table 5
Water Quality of Jordan River Standards and RO By-product

Water Quality Parameter	Jordan River Regulatory Standard (mg/L)	RO By-product Water Quality From Pilot Testing (mg/L)
PHYSICAL		
Dissolved Oxygen	5.5	
pH	6.5-9	7.64
Total Dissolved Solids (TDS)	1200	8,260
METALS		
Aluminum	0.75	0.13
Arsenic	0.19	0.0200
Cadmium	0.0044	0.0025
Chromium	0.011	0.0272
Copper	0.012	0.0196
Cyanide	0.052	0.0190
Iron	1.00	1.00
Lead	0.0286	0.0025
Mercury	1.20E-05	1.25E-05
Nickel	0.679	0.0282
Selenium	5.00E-03	2.40E-02
Silver	0.0041	0.0130
Zinc	0.4570	0.0250

concern when the tested value was so close to the standards. As a result, TDS and selenium are the two parameters that will be regulated in this permit. All other water quality parameters in the RO by-product, feed water, and treated water do not exceed Jordan River water quality standards.

At JV-001 (8300 South) TDS and selenium are both limiting. The proposed limit for TDS is the standard of the Jordan River, 1,200 mg/L. The feed water TDS for the Lost Use supply is 1,200 mg/L. The feed water from the Zone B supply is 1,630 mg/L. Zone B feed water will not be discharged at JV-001. JVWCD will be able to meet the limitations of the JV-001 discharge location by discharging the much higher TDS by-product at JV-002 under all conditions, including plant start-up and membrane cleaning. The proposed selenium limit is 7 ug/L, based upon calculations performed by UDEQ. The highest selenium value expected in the Lost Use feed water is 6 ug/L. JVWCD will be able to meet the proposed limitations of JV-001 under all operating conditions.

At JV-002 (2900 South) TDS is more limiting than Selenium. The proposed Selenium limit at this location in the permit is 48 ug/L. The concentration in the RO by-product during pilot testing was 25 ug/L. The proposed limit on TDS is 8,350 mg/L. The TDS concentration during pilot testing was 8,305 mg/L. JVWCD will be able to meet the proposed limitations of JV-002 under all operating conditions.

Table 6 shows the effect of the RO by-product on TDS concentration in the Jordan River. This table uses ten years of TDS data for the Jordan River at the 85% percentile of data. The TDS data is from UDEQ. This table shows the effect of mixing the RO by-product with the Jordan River at a 7-Q-10 flow rate. As can be seen in the column titled "Mixed Jordan River TDS", a scenario with a statistically high Jordan River TDS concentration and statistically low flow rate, the effect on Jordan River water quality is that the mixed TDS concentration is less than the standard. Similar calculations have been performed by UDEQ for TDS and selenium at both discharge locations.

TABLE 6

RO By-product Discharge Analysis
at JV-002 (2900 South)

Season	Jordan River 7-Q-10 Flowrate (cfs)	Jordan River 85th Percentile TDS (1992-2002) (mg/L)	RO By-product Flowrate (cfs)	RO By-product TDS (mg/L)	Mixed Jordan River TDS (mg/L)	Jordan River TDS Standard (mg/L)
Non-Irrigation	189.7	1,081	3.10	8,350	1,198	1,200
Irrigation	214	981	3.10	8,350	1,086	1,200

Discussion of Impacts

As previously described, the proposed limitations of this permit are TDS, selenium, and biotoxicity. All other water quality parameters of the proposed discharge meet the regulators standards of the Jordan River. By discharging the lower TDS waters at JV-001 (8300 South) and the higher TDS waters at JV-002 (2900 South), JVWCD will be able to meet the proposed limitations of the permit.

It should be noted that the RO process does not add impurities to the RO by-product. Each of the constituents discharged from the treatment process, with the exception of a small amount of NSF approved anti-scalant, were present in the groundwater and would have eventually reached the Jordan River.

The proposed discharge will not have a biological oxygen demand (BOD), as might be typical with other wastewater treatment plant discharges. This is a result of the feedwater to the plant being exclusively groundwater. Discharges from the RO plant might actually improve the biologic condition of the river, with respect to BOD. The toxicity testing results indicate the most sensitive aquatic species tested was the Ceriodaphnia organism. This species has known sensitivity to brackish water. The limiting result (IC25) was at a 6.1% solution strength. The initial discharge is proposed at 2% of the Jordan River flow rate.

The discharges proposed in this permit will not exceed the limitations proposed by UDEQ. These limitations have been conservatively structured to ensure that the water quality in the Jordan River does not exceed its standards. Therefore, the discharges proposed in this permit should not cause the Jordan River to exceed its water quality standards.

Compliance Monitoring

JVWCD proposes to collect samples at the RO treatment plant for compliance monitoring purposes. Because the dissolved salt concentrations will not change when being transported in a pipeline, the treatment plant is the proposed compliance sampling point for both discharge points. For the quarterly biotoxicity testing, JVWCD requests that the IC25 method be used for compliance monitoring. This test uses more dilution points and tends to be more precise than the standard double dilution single point test. At the low dilution rate proposed in this permit, the IC25 test should produce more reliable results.

Conclusion

This project is proposed as a groundwater remediation project to remediate existing groundwater contamination. Because of this, the RO by-product will have high dissolved salt concentrations. Through appropriate engineering, JVWCD proposes to mitigate these effects by providing in-channel diffusers, constructing energy dissipation structures, and by discharging at a location that matches the hydrology, Jordan River water quality, and meets the water quality standards of the Jordan River.

The project will provide multiple public benefits including containment of groundwater contamination, remediation of the underground aquifer and providing 9,200 acre feet of potable water supply annually to the public in the affected area.

JVWCD, in association with KUCC, respectfully requests approval of the accompanying UPDES permit application to allow discharges of RO by-product, storm flows, feed water, and treated water from its planned Southwest Groundwater Remediation Project.

STATEMENT OF BASIS
JORDAN VALLEY WATER CONSERVANCY DISTRICT
UTAH POLLUTION DISCHARGE ELIMINATION SYSTEM
PERMIT NO. UT0025551

FACILITY CONTACT:

Person:	Richard P. Bay, P.E.	Person:	Mark Atencio, P.E.
Position:	Asst. General Manager and Chief Engineer	Position:	Senior Supervising Engineer
Address:	8215 S. 1300 W. West Jordan, Utah 84088-0700	Telephone: Fax:	(801) 565-4300 (801) 565-4399

DESCRIPTION OF FACILITY:

Elevated sulfate concentrations in the ground water aquifer under the south west portion of the Salt Lake valley have been identified as a result of historical mining activities by Kennecott Utah Copper Corporation (KUCC). The Southwest Groundwater Remediation Project is a combined effort on the part of KUCC and the Jordan Valley Water Conservancy District (JVWCD) to meet the requirements of a 1995 Consent Decree requiring the remediation of the ground water aquifer. A reverse osmosis (RO) membrane treatment facility (facility) will be constructed on JVWCD property to meet these responsibilities, and is scheduled to start discharging in early 2007. When fully operational, this facility is expected to provide containment of known ground water contamination, the remediation of the principle ground water aquifer under the area, and will provide additional potable water supplies to the JVWCD service area.

There are two major areas of ground water contamination identified in the 1995 Consent Decree, one of which the facility will treat under this permit. Area one (Zone B supply) is a relatively large area that utilizes multiple deep ground water extraction wells and is bounded by 8800 S. to about 11400 S., and from 1300 W. to about 3200 W.. Area two (Zone A supply) is a relatively smaller area, to the west of Zone B. Zone A is not addressed by this permit. When this facility is fully operational, discharge of RO by-product is estimated to be approximately 2 million gallons per day (MGD). JVWCD has completed extensive pilot and demonstration testing with a multi-vessel RO system that is functionally equivalent to the proposed full scale RO facility. The results of these demonstrations provide a high degree of confidence that the facility will perform as expected. The RO technology has proven successful at removing the sulfates and other salts at other locations in order to provide a high quality drinking water supply.

The RO treatment process is expected to separate sulfates and other salts from the product water (potable water). The RO by-product and groundwater from an area termed "lost-use supply" (located outside the area of known contamination) will be discharged to the Jordan River under this permit. The remediation project facilities will consist of deep and shallow ground water extraction wells, 10 miles of pipelines, a booster pump station, and the RO facility itself.

SIGNIFICANT CHANGES FROM PREVIOUS PERMIT:
This is a new UPDES permit. Therefore, there are no changes.

DESCRIPTION OF DISCHARGE:
Discharges covered under this permit will be comprised of RO by-product. The purpose of this permit is to ensure Jordan River water quality standards will be met when the discharge occurs.

Discharge will be to the Jordan River at one of two locations:

Outfall	Description of Discharge Point
001	Located at latitude 40° 35' 35" and longitude 111° 54' 38" with STORET Number 499421. Discharge is located at approximately 8300 South, near the JVWCD offices and proposed RO facility.
002	Located at latitude 40° 42' 33" and longitude 111° 55' 24" and STORET Number 499282. Discharge is located at approximately 2900 South below the confluence with Mill Creek.

RECEIVING WATERS AND STREAM CLASSIFICATION:
The receiving water is the Jordan River. Above Big Cottonwood Creek the Jordan River is classified 2B, 3A, 3B, and 4, and below Big Cottonwood Creek the Jordan River is classified 2B, 3B, and 4 according to *Utah Administrative Code (UAC) R317-2-6*. The use designations are as follows:

2B	Protected for secondary contact recreation such as boating, wading, or similar uses.
3A	Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.
3B	Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.
4	Protected for agricultural uses including irrigation of crops and stock watering.

BASIS FOR EFFLUENT LIMITATIONS:
UAC R317-1-3 lists State secondary treatment standards for five-day biochemical oxygen demand (BOD5), total suspended solids (TSS), fecal coliforms, total coliforms, and pH. Based on data provided in the original permit application, and because the effluent is composed only of ground water, BOD5, TSS, and total/fecal coliform limitations are not warranted. However, pH is applicable to this discharge permit and will be limited to between 6.5 and 9.0.

The Wasteload Analysis (WLA) (see ADDENDUM) indicates that flow limitations are needed for total dissolved solids (TDS) concentrations at Outfall 002, and selenium concentrations at both Outfalls. These limitations are based on critical low flows and existing concentrations of TDS and selenium (calculated at the 85th percentile of available data) in the receiving stream. Also, seasonal effluent concentration limits are required for selenium at Outfall 001. The effluent limitations for selenium and TDS were derived using very conservative calculations. Current rule states that TDS may be adjusted up to concentrations greater than 1200 mg/l if such adjustment does not impair the beneficial use of the receiving water. In winter, the Jordan River could assimilate concentrations of up to 2000 mg/l without impacting the designated beneficial uses, but only 1200 mg/l is being

allocated to this discharge. Similarly, the WLA indicates that the Jordan River could also assimilate concentrations for selenium of up to 97.0 mg/l, but only 48.5 ug/l is being allocated for this permit.

Although higher concentrations of certain metals were found to be present in the groundwater identified as Zone A, and in an acid plume close to the area termed "lost-use supply", the pumping of Zone B is not expected to impact Zone A or the acid plume. Nevertheless, quarterly metals monitoring will be required under this permit, without specific metals limitations, to discover if migration of Zone A or the acid plume occurs. JVWCD is also required to submit yearly evaluation reports describing, in detail, trends of such metals concentrations in the influent, and if migration of metals is suspected at any time, is required to notify this office in writing. If migration of either of these areas is suspected, the permit may be re-opened and specific metals limitations included.

EFFLUENT LIMITATIONS:

Total Dissolved Solids:

Discharge location	Flow (not to exceed)	Permit Season Requirement	Concentration (not to exceed)
Outfall 001	N.A.	All	1,200 mg/l
Outfall 002	2.0 MGD	All	8,350 mg/l

Selenium:

Discharge location	Flow (not to exceed)	Permit Season Requirement	Concentration (not to exceed)
Outfall 001	17.2 MGD	Spring (April-June)	7.0 ug/l
	17.2 MGD	Summer (July-September)	9.1 ug/l
	17.2 MGD	Fall (October-December)	8.3 ug/l
	17.2 MGD	Winter (January-March)	7.8 ug/l
Outfall 002	2.0 MGD	All	48.5 ug/l

pH and Wet:

Parameter, units	Daily Minimum	Daily Maximum
*pH, standard units	6.5	9.0
**WET, chronic biomonitoring	N.A.	Pass

N.A. Not applicable

* pH testing shall be conducted at Outfall 001 and Outfall 002.

** WET testing will be required to be monitored at Outfall 002.

SELF-MONITORING AND REPORTING REQUIREMENTS:

Monitoring and Reporting requirements for both Outfalls are summarized below:

Parameter	Sampling Frequency	Sample Type	Units
TDS	Continuous	Recorded	mg/l
Selenium	Monthly	Grab	ug/l
Flow, Influent Effluent	Continuous	Recorded	MGD
pH	Continuous	Recorded	S.U.
WET, chronic testing	Quarterly	Composite	Pass/Fail
Metals, Influent Effluent	Quarterly	Grab	mg/l

Effluent monitoring will be conducted at the JVWCD RO facility before it enters the pipeline to discharge through either Outfall. Real time monitoring at the RO facility will enable continuous monitoring of flow of the Jordan River, as well as continuous monitoring of influent and effluent flow, TDS and pH. Since none of the effluent parameters covered under this permit will change over time through the effluent pipeline except for flow, monitoring at the RO facility itself will provide for representative sampling. Although flow rates may change, limitations on total flow will remain in effect as outlined above.

WHOLE EFFLUENT TOXICITY (WET) TESTING REQUIREMENTS:

As part of a nationwide effort to control toxic discharges, biomonitoring requirements are being included in permits for facilities where effluent toxicity is an existing or potential concern. In Utah, this is done in accordance with the *State of Utah Permitting and Enforcement Guidance Document for Whole Effluent Toxicity Control (Biomonitoring)*. Authority to require effluent biomonitoring is provided in *Permit Conditions, UAC R317-8-4.2*, *Permit Provisions, UAC R317-8-5.3* and *Water Quality Standards, UAC R317-2-5 and R317-2-7.2*.

This facility will be required to conduct chronic short-term toxicity tests on a composite sample of the final effluent at Outfall 002 on a quarterly basis using Ceriodaphnia dubia and Pimephales promelas (fathead minnow). It is acknowledged that the permittee is only discharging groundwater, not process wastewater. Chronic testing shall be required quarterly but no toxicity limits will be imposed at this time. This permit will however contain a reopener provision to include additional WET testing requirements and/or limits if warranted in the future.

BIOSOLIDS DISPOSAL REQUIREMENTS:

As required by the 1987 amendments to the Federal *Clean Water Act*, EPA has established toxic contaminant criteria and other requirements for sewage sludge use and disposal by works treating domestic sewage. These regulations are found in *Title 40* of the *Code of Federal Regulations, Part*

503. The biosolids (sludge) management program was delegated to the State of Utah on June 14, 1996. The 503 regulations are implemented by the issuance of permits, as needed and appropriate.

This facility will have no regular biosolids production. Therefore, the requirements of 503 do not apply to this permit.

STORM WATER REQUIREMENTS:
The JVWCD plant has a Standard Industrial Classification (SIC) of 4941, (Water Supply). Facilities under this classification are not required to obtain coverage under the UPDES Multi-Sector General Permit for Storm Water Discharges from Industrial Activity, Permit Number UTR000000. The permit contains a storm water re-opener provision if requirements are needed in the future.

This facility will be constructed in approximately 3 years. Coverage under the UPDES Storm Water Permit for Construction Activities, Permit Number UTR00000, is required during the course of construction. The permit requires the development and implementation of a storm water pollution prevention plan. The permit is required from the commencement of grading until final stabilization of the site.

PERMIT DURATION:
It is recommended that this permit be effective for a duration of five (5) years.

Drafted by Chris Imbrogno
Environmental Scientist
Utah Division of Water Quality
Drafted July 10, 2003

Reviewed by the Permitting and Compliance Section Manager
Reviewed by the Water Quality Section

Permit No. UT0025551
Major Industrial

STATE OF UTAH
DIVISION OF WATER QUALITY
DEPARTMENT OF ENVIRONMENTAL QUALITY
SALT LAKE CITY, UTAH

AUTHORIZATION TO DISCHARGE UNDER THE
UTAH POLLUTANT DISCHARGE ELIMINATION SYSTEM (UPDES)

In compliance with provisions of the Utah *Water Quality Act, Title 19, Chapter 5, Utah Code Annotated ("UCA") 1953, as amended* (the *"Act"*),

THE JORDAN VALLEY WATER CONSERVANCY DISTRICT

is hereby authorized to discharge from Outfall 001 located at 8300 S. with latitude 40^0 35' 35" and longitude 111^0 54' 38", and Outfall 002 located at 2900 S. at latitude 40^0 42' 33" and longitude 111^0 55' 24"to receiving waters named

THE JORDAN RIVER

in accordance with the discharge points, effluent limitations, monitoring requirements and other conditions set forth herein.

This permit shall become effective on August xx, 2003

This permit and the authorization to discharge shall expire at midnight July xx, 2008

Signed this xx day of July

_____
Don A. Ostler, P.E.
Executive Secretary
Utah Water Quality Board

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I. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

A. Description of Discharge Points

The authorization to discharge provided under this permit is limited to those outfalls specifically designated below as discharge locations. Discharges at any location not authorized under a UPDES permit is a violation of the *Act* and may be subject to penalties under the *Act*. Knowingly discharging from an unauthorized location or failing to report an unauthorized discharge may be subject to criminal penalties as provided under the *Act*.

Outfall Number	Location of Discharge Point
001	Discharge to the Jordan River at 8300 S. in West Jordan adjacent to the facility. This discharge is located at latitude 40^0 35' 35" and longitude 111^0 54' 38"
002	Discharge to the Jordan River at 2900 S. below the confluence with Mill Creek. This discharge is located at a latitude of 40^0 42' 33" and a longitude of 111^0 55' 24".

B. Narrative Standard

It shall be unlawful, and a violation of this permit, for the permittee to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural deposits, floating debris, oil, scum or other nuisances such as color, odor or taste, or conditions which produce undesirable aquatic life or which produces objectionable tastes in edible aquatic organisms; or concentrations or combinations of substances which produce undesirable physiological responses in desirable resident fish, or other desirable aquatic life, or undesirable human health effects, as determined by bioassay or other tests performed in accordance with standard procedures.

C. Specific Limitations and Self-monitoring Requirements

1. Effective immediately and lasting the duration of this permit, the permittee is authorized to discharge from Outfalls 001 and 002.

   Permit effluent limitations for flow, total dissolved solids (TDS), and selenium are summarized below:

TDS:

Discharge location	**Flow (not to exceed)**	**Permit Season Requirement**	**Concentration (not to exceed)**
Outfall 001	N.A.	All	1,200 mg/l
Outfall 002	2.0 MGD	All	8,350 mg/l

Selenium:

Discharge location	Flow (not to exceed)	Permit Season Requirement	Concentration (not to exceed)
Outfall 001	17.2 MGD	Spring (April-June)	7.0 ug/l
	17.2 MGD	Summer (July-September)	9.1 ug/l
	17.2 MGD	Fall (October-December)	8.3 ug/l
	17.2 MGD	Winter (January-March)	7.8 ug/l
Outfall 002	2.0 MGD	All	48.5 ug/l

Other permit effluent limitations and all monitoring frequencies are summarized below:

Parameter	Units	Daily Minimum	Daily Maximum	30-Day Average	Sampling Frequency	Sample Type
TDS,	mg/l	N.A.	a/	N.A.	Continuous	Recorder
Selenium,	ug/l	N.A.	a/	N.A.	Monthly	Grab
Flow, Influent	MGD	N.A.	N.A.	N.A.	Continuous	Recorder
Effluent	MGD	a/	a/	a/	Continuous	Recorder
pH,	S.U.	6.5	9.0	N.A.	Continuous	Recorder
WET	Pass/ Fail	N.A.	N.A.	N.A.	Quarterly	Composite

a/ Specific effluent limitations are outlined in the permit effluent limitations for total dissolved solids and selenium tables above.

N.A. Not Applicable.

There shall be no visible sheen or floating solids or visible foam in other than trace amounts.

There shall be no discharge of sanitary wastes.

2. Additional Self-Monitoring and Reporting Requirements.

The permittee shall sample and analyze both the influent and effluent quarterly, for the following parameters. In addition, an evaluation report describing, in detail, trends of such metals concentrations in the influent is required to be submitted yearly.

Parameter	Frequency	Sample Type	Units
Total Arsenic	Quarterly	Composite	mg/L
Total Cadmium	Quarterly	Composite	mg/L

Total Chromium	Quarterly	Composite	mg/L
Total Copper	Quarterly	Composite	mg/L
Total Cyanide	Quarterly	Composite	mg/L
Total Lead	Quarterly	Composite	mg/L
Total Mercury	Quarterly	Composite	mg/L
Total Molybdenum	Quarterly	Composite	mg/L
Total Nickel	Quarterly	Composite	mg/L
Total Silver	Quarterly	Composite	mg/L
Total Zinc	Quarterly	Composite	mg/L

3. Samples taken in compliance with the monitoring requirements specified above shall be taken at Outfall 001 and Outfall 002 before mixing with the receiving water with the exception of WET and metals samples which shall be taken at Outfall 002.

4. Whole Effluent Testing - Chronic Toxicity.
The permittee shall conduct chronic short-term toxicity tests on a composite sample of the final effluent using Ceriodaphnia dubia and twice per year using Pimephales promelas (fathead minnow). The sample shall be collected at Outfall 002.

The monitoring frequency shall be quarterly for Ceriodaphnia dubia and semi-annually for Pimephales promelas. Samples shall be collected on a two day progression; i.e., if the first sample is on a Monday, during the next sampling period, sampling shall be on a Wednesday. If chronic toxicity is detected, the test shall be repeated in less than four weeks from the date the initial sample was taken. The need for any additional samples, and/or a Toxicity Reduction Evaluation (TRE, see Part I.D.4.) shall be determined by the Executive Secretary. If the second test shows no chronic toxicity, routine monitoring shall be resumed.

The chronic toxicity tests shall be conducted in general accordance with the procedures set out in the latest revision of *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Freshwater Organisms. Third Edition. July 1994, EPA-600-4-91-002* as per *40 CFR 136.3(a) TABLE IA-LIST OF APPROVED BIOLOGICAL METHODS*, and the *Region VIII EPA NPDES Chronic Test Conditions - Static Renewal Whole Effluent Toxicity Test (August, 1997)*. In case of conflicts, the Region VIII procedure will prevail.

Chronic toxicity occurs when the IC_{25} is less than or equal to an effluent concentration of 5%. If any of the acceptable control performance criteria are not met, the test shall be considered invalid.

Quarterly and semi-annual test results shall be reported along with the Discharge Monitoring Report (DMR) submitted for the end of the reporting calendar year (e.g., biomonitoring results for the calendar year ending March 31st shall be reported with the DMR due April 28th). The format for the report shall be consistent with the latest revision of the *Region VIII Guidance for Chronic Whole Effluent Reporting (August, 1997)* and shall include all the physical testing as specified.

The current Utah whole effluent toxicity (WET) policy is in the process of being updated and revised to assure its consistency with the Environmental Protection Agency's national and regional WET policy. When said revised WET policy has been finalized and officially adopted, this permit will be reopened and modified to incorporate satisfactory follow-up chronic toxicity language (chronic pattern of toxicity, PTI and/or TIE/TRE, etc.) without a public notice, as warranted and appropriate.

5. Toxicity Reduction Evaluation.
If toxicity is detected and it is determined by the Executive Secretary that a Toxicity Reduction Evaluation (TRE) is necessary, the permittee shall be so notified and shall initiate a TRE immediately thereafter. The purpose of the TRE will be establish the cause of the toxicity, locate the source(s) of the toxicity, and control or provide treatment for the toxicity.

A TRE may include but is not limited to one, all, or a combination of the following:

a. Phase I - Toxicity Characterization
b. Phase II - Toxicity Identification Procedures
c. Phase III - Toxicity Control Procedures
d. Any other appropriate procedures for toxicity source elimination and control

If the TRE establishes that the toxicity cannot be immediately eliminated the permittee shall submit a proposed compliance plan to the Executive Secretary. The plan shall include the proposed approach to control toxicity and a proposed compliance schedule for achieving control. If the approach and schedule are acceptable to the Executive Secretary, this permit may be reopened and modified.

If the TRE shows that the toxicity is caused by a toxicant(s) that may be controlled with specific numerical limitations, the permittee may:

a. Submit an alternative control program for compliance with the numerical requirements.

b. If necessary, provide a modified biomonitoring protocol which compensates for the pollutant(s) being controlled numerically.

If acceptable to the Executive Secretary, this permit may be reopened and modified to incorporate any additional numerical limitations, a modified compliance schedule if judged necessary by the Executive Secretary, and/or a modified biomonitoring protocol.

Failure to conduct an adequate TRE, or failure to submit a plan or program as described above, or the submittal of a plan or program judged inadequate by the Executive Secretary, shall be considered a violation of this permit.

II. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling Samples taken in compliance with the monitoring requirements established under *Part I* shall be collected from the effluent stream prior to discharge into the receiving waters. Samples and measurements shall be representative of the volume and nature of the monitored discharge. Sludge samples shall be collected at a location representative of the quality of sludge immediately prior to the use-disposal practice.

B. Monitoring Procedures Monitoring must be conducted according to test procedures approved under *Utah Administrative Code ("UAC") R317-2-10*, unless other test procedures have been specified in this permit.

C. Penalties for Tampering The *Act* provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

D. Reporting of Monitoring Results Monitoring results obtained during the previous month shall be summarized for each month and reported monthly on a Discharge Monitoring Report Form (EPA No. 3320-1), post-marked no later than the 28th day of the month following the completed reporting period. The first report is due on March 28, 1998. If no discharge occurs during the reporting period, "no discharge" shall be reported. Legible copies of these, and all other reports including whole effluent toxicity (WET) test reports required herein, shall be signed and certified in accordance with the requirements of *Signatory Requirements (see Part IV.G)*, and submitted to the Director, Division of Water Quality at the following addressee:

original to: Department of Environmental Quality
Division of Water Quality
288 North 1460 West
PO Box 144870
Salt Lake City, Utah 84114-4870

E. Compliance Schedules Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any Compliance Schedule of this permit shall be submitted no later than 14 days following each schedule date.

F. Additional Monitoring by the Permittee If the permittee monitors any parameter more frequently than required by this permit, using test procedures approved under *UAC R317-2-10* or as otherwise specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased frequency shall also be indicated. Only those parameters required by the permit need to be reported.

G. Records Contents Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements:

2. The individual(s) who performed the sampling or measurements;
3. The date(s) and time(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and,
6. The results of such analyses.

H. Retention of Records The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the Executive Secretary at any time. A copy of this UPDES permit must be maintained on site during the duration of activity at the permitted location.

I. Twenty-four Hour Notice of Noncompliance Reporting

1. The permittee shall (orally) report any noncompliance which may seriously endanger health or environment as soon as possible, but no later than twenty-four (24) hours from the time the permittee first became aware of circumstances. The report shall be made to the Division of Water Quality, (801) 538-6146, or 24 hour answering service (801) 536-4123.

2. The following occurrences of noncompliance shall be reported by telephone (801) 536-4123 as soon as possible but no later than 24 hours from the time the permittee becomes aware of the circumstances:

   a. Any noncompliance which may endanger health or the environment;

   b. Any unanticipated bypass which exceeds any effluent limitation in the permit;

   c. Any upset which exceeds any effluent limitation in the permit (See *Part III.H, Upset Conditions.*); or,

   d. Violation of a maximum daily discharge limitation for any of the pollutants listed in the permit.

3. A written submission shall also be provided within five days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected; and,

d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance;

e. Steps taken, if any, to mitigate the adverse impacts on the environment and human health during the noncompliance period.

4. The Executive Secretary may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the Division of Water Quality, (801) 538-6146.

5. Reports shall be submitted to the addresses in *Part II.D, Reporting of Monitoring Results*.

J. Other Noncompliance Reporting Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for *Part II.D* are submitted. The reports shall contain the information listed in *Part II.I.3*.

K. Inspection and Entry The permittee shall allow the Executive Secretary, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permitee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the *Act*, any substances or parameters at any location.

III. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give advance notice to the Executive Secretary of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

B. Penalties for Violations of Permit Conditions The *Act* provides that any person who violates a permit condition implementing provisions of the *Act* is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions of the Act is subject to a fine not exceeding $25,000 per day of violation; Any person convicted under *UCA 19-5-115(2)* a second time shall be punished by a fine not exceeding $50,000 per day. Except as provided at *Part III.G, Bypass of Treatment Facilities* and *Part III.H, Upset Conditions*, nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

F. Removed Substances Collected screening, grit, solids, sludges, or other pollutants removed in the course of treatment shall be buried or disposed of in such a manner so as to prevent any pollutant from entering any waters of the state or creating a health hazard. Sludge/digester supernatant and filter backwash shall not directly enter either the final effluent or waters of the state by any other direct route.

G. Bypass of Treatment Facilities

1. Bypass Not Exceeding Limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to 2. and 3. of this section.

2. Prohibition of Bypass.

a. Bypass is prohibited, and the Executive Secretary may taken enforcement action against a permittee for bypass, unless:

(1) Bypass was unavoidable to prevent loss of human life, personal injury, or severe property damage;

(2) There were no feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance, and

(3) The permittee submitted notices as required below under section G.3.

b. The Executive Secretary may approve an anticipated bypass, after considering its adverse effects, if the Executive Secretary determines that it will meet the three conditions listed in sections G.2a. (1), (2) and (3).

3. Notice.

a. Anticipated bypass. Except as provided above in section G.2. and below in section G. 3.b, if the permittee knows in advance of the need for a bypass, it shall submit prior notice, at least 90 days before the date of bypass. The prior notice shall include the following unless otherwise waived by the Executive Secretary:

(1) Evaluation of alternative to bypass, including cost-benefit analysis containing an assessment of anticipated resource damages:

(2) A specific bypass plan describing the work to be performed including scheduled dates and times. The permittee must notify the Executive Secretary in advance of any changes to the bypass schedule;

(3) Description of specific measures to be taken to minimize environmental and public health impacts;

(4) A notification plan sufficient to alert all downstream users, the public and others reasonably expected to be impacted by the bypass;

(5) A water quality assessment plan to include sufficient monitoring of the receiving water before, during and following the bypass to enable evaluation of public health risks and environmental impacts; and

(6) Any additional information requested by the Executive Secretary.

b. Emergency Bypass. Where 90 days advance notice is not possible, the permittee must notify the Executive Secretary, and the Director of the Department of Natural Resources, as soon as it becomes aware of the need to bypass and provide to the Executive Secretary the information in section G.3.a.(1) through (6) to the extent practicable.

c. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass to the Executive Secretary as required under Part II.I., *Twenty Four Hour Notice of Noncompliance Reporting*. The permittee shall also immediately notify the Director of the Department of Natural Resources, the public and downstream users and shall implement measures to minimize impacts to public health and environment to the extent practicable.

H. Upset Conditions

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with technology based permit effluent limitations if the requirements of Paragraph 2. of this section are met. Executive Secretary's administrative determination regarding a claim of upset cannot be judiciously challenged by the permittee until such time as an action is initiated for noncompliance.

2. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

a. An upset occurred and that the permittee can identify the cause(s) of the upset;

b. The permitted facility was at the time being properly operated;

c. The permittee submitted notice of the upset as required under *Part II.I, Twenty-four Hour Notice of Noncompliance Reporting*; and,

d. The permittee complied with any remedial measures required under *Part III.D, Duty to Mitigate.*

3. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

I. Toxic Pollutants The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of *The Water Quality Act of 1987* for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

J. Changes in Discharge of Toxic Substances Notification shall be provided to the Executive Secretary as soon as the permittee knows of, or has reason to believe:

1. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

   a. One hundred micrograms per liter (100 ug/L);

   b. Two hundred micrograms per liter (200 ug/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/L) for 2,4-dinitrophenol and for 2-methyl-4, 6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;

   c. Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with *UAC R317-8-3.4(7)* or (10); or,

   d. The level established by the Executive Secretary in accordance with *UAC R317-8-4.2(6)*.

2. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

   a. Five hundred micrograms per liter (500 ug/L);

   b. One milligram per liter (1 mg/L) for antimony:

   c. Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with *UAC R317-8-3.4(9)*; or,

   d. The level established by the Executive Secretary in accordance with *UAC R317-8-4.2(6)*.

IV. GENERAL REQUIREMENTS

A. Planned Changes The permittee shall give notice to the Executive Secretary as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when the alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are not subject to effluent limitations in the permit. In addition, if there are any planned substantial changes to the permitee's existing sludge facilities or their manner of operation or to current sludge management practices of storage and disposal, the permittee shall give notice to the Executive Secretary of any planned changes at least 30 days prior to their implementation.

B. Anticipated Noncompliance The permittee shall give advance notice to the Executive Secretary of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

C. Permit Actions This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. Duty to Reapply If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee shall apply for and obtain a new permit. The application shall be submitted at least 180 days before the expiration date of this permit.

E. Duty to Provide Information The permittee shall furnish to the Executive Secretary, within a reasonable time, any information which the Executive Secretary may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Executive Secretary, upon request, copies of records required to be kept by this permit.

F. Other Information When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Executive Secretary, it shall promptly submit such facts or information.

G. Signatory Requirements All applications, reports or information submitted to the Executive Secretary shall be signed and certified.

1. All permit applications shall be signed by either a principal executive officer or ranking elected official

2. All reports required by the permit and other information requested by the Executive Secretary shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to

the Executive Secretary, and,

b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

c. Changes to authorization. If an authorization under paragraph *IV.G.2* is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph *IV.G.2* must be submitted to the Executive Secretary prior to or together with any reports, information, or applications to be signed by an authorized representative.

d. Certification. Any person signing a document under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. Penalties for Falsification of Reports The *Act* provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $10,000.00 per violation, or by imprisonment for not more than six months per violation, or by both.

I. Availability of Reports Except for data determined to be confidential under *UAC R317-8-3.2*, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the office of Executive Secretary. As required by the *Act*, permit applications, permits and effluent data shall not be considered confidential

J. Oil and Hazardous Substance Liability Nothing in this permit shall be construed to preclude the permittee of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under the *Act*.

K. Property Rights The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

L. Severability The provisions of this permit are severable, and if any provisions of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

M. Transfers This permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Executive Secretary at least 20 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and,

3. The Executive Secretary does not notify the existing permittee and the proposed new permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in Paragraph 2 above.

N. State Laws Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by *UCA 19-5-117*.

O. Water Quality-Reopener Provision This permit may be reopened and modified (following proper administrative procedures) to include the appropriate effluent limitations and compliance schedule, if necessary, if one or more of the following events occurs:

1. Water Quality Standards for the receiving water(s) to which the permittee discharges are modified in such a manner as to require different effluent limits than contained in this permit.

2. A final wasteload allocation is developed and approved by the State and/or EPA for incorporation in this permit.

3. A revision to the current Water Quality Management Plan is approved and adopted which calls for different effluent limitations than contained in this permit.

P. Toxicity Limitation - Reopener Provision This permit may be reopened and modified (following proper administrative procedures) to include, whole effluent toxicity (WET) limitations, a compliance date, a compliance schedule, a change in the whole effluent toxicity (biomonitoring) protocol, additional or modified numerical limitations, or any other conditions related to the control of toxicants if one or more of the following events occur;

1. Toxicity is detected, as per Part I, D.3 and/or 4 of this permit, during the duration of this permit.

2. The TRE results indicate that compliance with the toxic limits will require an implementation schedule past the date for compliance and the Executive Secretary agrees with the conclusion.

3. The TRE results indicate that the toxicant(s) represent pollutant(s) that may be controlled with specific numerical limits, and the Executive Secretary agrees that numerical controls are the most appropriate course of action.

4. Following the implementation of numerical control(s) of toxicant(s), the Executive Secretary agrees that a modified biomonitoring protocol is necessary to compensate for those toxicants that are controlled numerically.

5. The TRE reveals other unique conditions or characteristics which, in the opinion of the Executive Secretary, justify the incorporation of unanticipated special conditions in the permit.

Q. Storm Water-Reopener Provision At any time during the duration (life) of this permit, this permit may be reopened and modified (following proper administrative procedures) as per *UAC R317.8*, to include, any applicable storm water provisions and requirements, a storm water pollution prevention plan, a compliance schedule, a compliance date, monitoring and/or reporting requirements, or any other conditions related to the control of storm water discharges to "waters-of-State".

V. Definitions

1. The "30-day (and monthly) average" is the arithmetic average of all samples collected during a consecutive 30-day period or calendar month, whichever is applicable. The calendar month shall be used for purposes of reporting self-monitoring data on discharge monitoring report forms.

2. The "7-day (and weekly) average" is the arithmetic average of all samples collected during a consecutive 7-day period or calendar week, whichever is applicable. The 7-day and weekly averages are applicable only to those effluent characteristics for which there are 7-day average effluent limitations. The calendar week which begins on Sunday and ends on Saturday, shall be used for purposes of reporting self- monitoring data on discharge monitoring report forms. Weekly averages shall be calculated for all calendar weeks with Saturdays in the month. If a calendar week overlaps two months (i.e., the Sunday is in one month and the Saturday in the following month), the weekly average calculated for that calendar week shall be included in the data for the month that contains the Saturday.

3. "Daily Maximum" ("Daily Max.") is the maximum value allowable in any single sample or instantaneous measurement.

4. "Composite samples" shall be flow proportioned. The composite sample shall, as a minimum, contain at least four (4) samples collected over the composite sample period. Unless otherwise specified, the time between the collection of the first sample and the last sample shall not be less than six (6) hours nor more than 24 hours. Acceptable methods for preparation of composite samples are as follows:

   a. Constant time interval between samples, sample volume proportional to flow rate at time of sampling;

   b. Constant time interval between samples, sample volume proportional to total flow (volume) since last sample. For the first sample, the flow rate at the time the sample was collected may be used;

   c. Constant sample volume, time interval between samples proportional to flow (i.e., sample taken every "X" gallons of flow); and,

   d. Continuous collection of sample, with sample collection rate proportional to flow.

5. A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

6. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the

extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

7. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

8. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

9. "Executive Secretary" means Executive Secretary of the Utah Water Quality Board.

10. "EPA" means the United States Environmental Protection Agency.

11. "Act" means the "*Utah Water Quality Act*".

12. "*CWA*" means *The Federal Water Pollution Control Act*, as amended, by *The Clean Water Act of 1987*.

13. "Flow-weighted composite sample" means a composite sample consisting of a mixture of aliquots collected at a constant time interval, where the volume of each aliquot is proportional to the flow rate of the discharge.

14. "Point Source" means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharges. This term does not include return flows from irrigated agriculture or agriculture storm water runoff.

15. "Storm water" means storm water runoff, snow melt runoff, and surface runoff and drainage.

Evaluation of RO Concentrate Discharge on Jordan River Water Quality

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This Technical Memorandum provides a summary of the data, methods, and results of an evaluation to estimate the impacts of reverse osmosis (RO) concentrate discharge on water quality of the Jordan River. The results are summarized for RO concentrate discharge above the South Valley Water Reclamation Facility (SVWRF) and below the Central Valley Water Reclamation Facility (CVWRF). As part of the study, water quality data was collected from Kennecott sampling wells and the Jordan Valley Water Conservancy District's (JVWCD) well located near their offices at 8215 South 1300 West. The water quality data from these wells was used to predict the concentrate water quality for the RO facility. Water quality data was also collected for the Jordan River from the historical records maintained by the Utah Division of Water Quality (UDWQ). The Jordan River water quality was predicted based on the average of the analytical results from the monitoring station closest to the discharge points. The calculated impacts to the Jordan River water quality suggest the concentrate could be discharged to the Jordan River below the CVWRF without exceeding the regulatory requirements at all times and above the SVWRF at certain Jordan River flow rates.

Additional sampling performed by the JVWCD was completed to fill data gaps or to use an analytical method with a lower detection limit. The results of those tests were compared to the historical data. The new data collected did not differ significantly from the historical data.

Problem Statement

The Jordan Valley Water Conservancy District (JVWCD) is working with Kennecott Utah Copper (KUC) to construct and operate a Reverse Osmosis (RO) treatment facility. The facility will treat 4 MGD of groundwater contaminated with sulfate by past mining operations. This contaminated groundwater will be referred to as the KUC Zone B source. In addition, the facility will treat 4 MGD of shallow groundwater near the District's headquarters. This shallow groundwater will be referred to as the JVWCD shallow groundwater source.

The historical water quality was obtained and reviewed to determine the viability of discharging the RO concentrate to the Jordan River. The UDWQ ultimately sets the requirements for the

Utah Pollution Discharge Elimination System Permit (UPDES) and provided the current Jordan River flow model used in setting UPDES limits. In addition, the UDWQ provided the existing water quality data for three sites along the Jordan River as discussed later.

To assess the viability of obtaining a discharge permit, a compilation and analysis of existing Jordan River water quality data and an evaluation of the impacts of the concentrate on the Jordan River water quality was necessary. The current UDWQ permitting model of the Jordan River flows is based on the 7-Q-10 flow or lowest 7-day average in the most recent 10-year period. The model provides the predicted 7-Q-10 flows in the Jordan River at various locations, and this information was used to assess water quality in the Jordan River after concentrate discharge and mixing. The final constituent concentration in the Jordan River after concentrate mixing was assumed as the sum of the masses of the contaminants in the concentrate and the Jordan River added together divided by the total flow rates. This means the final constituent concentration (regulated contaminant level) in the Jordan River was based solely on mixing and dilution of the concentrate by the Jordan River flow. No uptake by vegetation or aquatic biota was considered.

Regulatory Requirements

Discharge of waste streams to surface waters in Utah is regulated under UAC R317-2, *Standards of Quality for Water of the State.* Surface waters are classified into one or more categories, based on use. In-stream water quality criteria are specified for each use category. The water quality criteria of interest for RO concentrate discharge to the Jordan River was developed by comparing the existing water quality data for the Jordan River and groundwater sources to the regulatory list for the categories of the Jordan River in the reaches where discharges would occur Table 1). For this study the current, most conservative regulatory levels of contamination were used. The full list of regulated contaminants includes physical and biological parameters, inorganics (metals), and organics such as pesticides. Many of the regulated parameters have multiple regulated levels of contamination depending on sampling technique (i.e., 4-hour average, 1-hour average, maximum). Since the RO concentrate will be essentially discharged continuously to the Jordan River, it was assumed the lowest (most conservative) regulatory standards would apply.

Raw Water Quality

JVWCD Shallow Groundwater. Raw water quality for the shallow groundwater source was estimated using analytical results for the existing on-site test well at JVWCD headquarters. The actual water quality for a series of future production wells could vary from the results of the single test well. The analytical data used was collected during the test pumping of the on-site test well between September 28-30, 1998. The higher of the two concentrations as determined from samples collected was used to calculate the concentrate water quality. Additional well samples were collected from the well on August 10th and September 8, 2000. The results of the analytical tests were consistent with the data collected during the test pumping (Table 2).

KUC Zone B Groundwater. Raw water quality for the KUC Zone B source was estimated using the analytical results from eight existing monitoring wells. The actual water quality for a series of future production wells could vary from the monitoring wells. KUC provided a

spreadsheet that contained all the analytical results to date from the eight wells. Because many of the reported results were below the detection limit or only a few samples were collected and analyzed, a consistent method for analyzing the data was needed. Therefore, if more than one laboratory result was reported, the analytical results for that parameter were averaged. A single result was reported as the average. For the eight wells, if four or more analytical results above the detection limit were provided, an average of the results above the detection limit was taken. If less than four results above the detection limit were available, the results were averaged with half the detection limit of all other samples analyzed. The raw water quality data used to calculate the concentrate concentrations for the KUC Zone B source water is presented for reference (Table 3). Although not reported here, there is a strong correlation between the calculated averages and the CDM data previously published.

As part of the initial well development for the pilot plant study, JVWCD has collected water quality data from three test wells numbered VWP252A, VWP252B, and VWP252C. These wells will be used for the pilot plant study because they are representative of the overall source water quality. For well VWP252A, samples were collected 23 times between 1986 and 1997 and tested for various water quality parameters. However, not all of the same parameters were analyzed each time a sample was collected. For wells VWP252B and VWP252C, only one sample was collected and analyzed for various water quality parameters. Although this data could not be incorporated into the full data set because the few data points for the new wells would not effect the overall average used to calculate the impacts to the Jordan River, the laboratory results were reviewed and compared to the existing data.

During review, it was noted that for selenium in particular the new data did not match the concentrations determined in the full data set. Knowing selenium would be a parameter of concern, the average concentration, predicted by samples from the specific wells that will be used for the pilot test, was used to predict the concentration of selenium in the Jordan River (Table 3). Additionally, no mercury was detected in any of the samples collected. A laboratory method with a lower detection limit was not used to quantify the mercury concentrations in KUC wells. Since mercury contamination in the KUC wells is not suspected, the mercury levels found in JVWCD's well was used to predict the mercury concentration in the concentrate from RO treatment of the KUC wells.

None of the water quality parameters for the three wells were shown to be higher than the data used in the analysis of the impact on the Jordan River. Ten of the water quality parameters of interest had lower concentrations in the well samples analyzed including aluminum, arsenic, cadmium, chromium, iron, lead, manganese, nickel, selenium, and zinc. Barium and silver concentrations were higher in one of the three wells. Based on a comparison with the new data, it is expected that the current calculations will not be exceeded by future data collected. Therefore, the current data analysis is a conservative estimate of the impacts of the concentrate discharge on the Jordan River.

Concentrate Characteristics

The exact composition of the RO concentrate cannot be predicted without pilot studies or full-scale operations on a given source water. However, general trends and concentrations can be estimated. For some of the common ions that either cause scaling problems or are commonly used to characterize water quality (i.e., calcium and magnesium for hardness), the ROPRO software package produced by Koch/Fluid Systems was used to determine the resultant concentrations

based on the raw water quality presented. For the remaining regulated contaminants a concentration factor of 5.0 was used. The raw water concentration is multiplied by the concentration factor to determine the concentrate concentration. A factor of 5.0 was used because it correlates to 100% rejection of the contaminant during RO treatment, assuming an 80% recovery. The RO concentrate characteristics presented for both the KUC Zone B and JVWCD shallow groundwater sources were calculated using this method and are included in a Table to be presented later.

Jordan River Water Quality

The Jordan River water quality data were obtained from the database maintained by the State of Utah's DWQ. Data were obtained for three sites: Jordan River at State Canal Road Crossing (Storet Number: 499088), Jordan River at Cudahy Lane AB South Davis WWTP (Storet Number: 499182), and Jordan River at Bluffdale Road Crossing (Storet Number: 499460). These sites are listed by location from north to south. The State Canal Crossing site is almost to the Great Salt Lake. The Cudahy Lane site is in North Salt Lake. The Bluffdale Road Crossing site is near 14400 South. These are the only three long-term sites on the Jordan River where samples are collected and analyzed for metals. The sites are sampled every 8 weeks and tested for a number of general water quality parameters and on a quarterly basis the samples are analyzed for metals.

All the data for the last 15 years were obtained from the DWQ. In subsequent conversation with the DWQ database manager, it was determined that during the 1980s and early 1990s, a sampling and analysis technique not approved by the EPA was used for metals. The analytical results for this sampling and analysis program were called H+ in the database and differentiated from the true dissolved metals analyses.. The H+ results reported were considered the acid soluble portion of the sample collected. This result is neither a true dissolved metals nor a true total metals results. A review of graphs of the analysis showed in some cases that the H+ metals were higher and in other cases lower. Utah discharge regulations are based on the dissolved concentration of the metals. Therefore, it was concluded that this study would use only the data for the dissolved metals. The dissolved metals sampling and analyses procedures were begun for all the metals maintained in the database in June 1992. The only exception was that the dissolved metals sampling and analysis procedure for aluminum was begun in August of 1994. There is no record of the aluminum concentrations prior to that date. The 7.5 most recent years of data were analyzed to estimate the background concentration of the metals found in the Jordan River.

A statistical analysis of the data was done to determine the applicability of using the mean of the data as the Jordan River background concentration. Although not presented here, boxplots were completed for each of the parameters included in the data set. The data set consists of 12900 records from three locations over the period January 1985 through December 1999. Limiting records to a subset of dissolved metals and records with non-zero values resulted in a file of 4350 records. Twenty-three parameters were evaluated and reported and converted NPDES water quality critical values applied in summary of the data. Record counts for each location and the pooled data were calculated. Sample sizes differ among the three locations. While differences over the specific interval from which monitoring data are available from the three locations could effect estimates and/or pooling of data from the three locations, the evaluation was limited to a preliminary summary. The boxplots were generated using the 4350 records of data and a statistical software package.

The boxplots provide a graphical representation of the data integrity and anomalies. For the regulated parameters, the boxplots show that no statistical anomalies exist for the two sample sites used to calculate the river background concentrations.

After discussion with the DWQ on October 24, 2000, additional data analysis was completed to deal with some issue brought up during the meeting. Two main issues were addressed. The increase of a given parameter due to the discharge of the concentrate was initially compared to the regulatory level. The DWQ thought that the change in the concentration of the contaminant should be compared to the background concentration found in the Jordan River. However, it was noted that for some parameters, where no data exists or no concentration has been quantified, a comparison of the change in concentration could not be calculated. To resolve this issue the DWQ indicated the background concentration in the Jordan River would be equal to 25% of the regulated value where no data exists. In addition, for samples that had non-detected levels for a given parameters a value of 25% of the regulated value would be assigned to calculate the average background concentrations. The DWQ also indicated the adjustment for hardness should be made to the published baseline regulatory limits. The baseline limits assume a raw water hardness of 100 mg/L as C_aCO_3. The equations used to adjust the baseline regulatory limit for hardness were taken from a spreadsheet provided by the DWEQ. The mean values were used in the subsequent calculations to predict the river water quality. It is assumed the mean value represents the concentrations during 7-Q-10 flows.

Since the historical data showed some variation along the length of the Jordan River and sampling did not occur near the intended discharge points, JVWCD has collected Jordan River water samples to develop water quality data at 2100 South and 7800 South. To date three samples have been collected and analyzed. (Table 4). The data collected and analyzed is consistent with the historical data. Although some variation in the data is seen, the average analytical results are within an order-of-magnitude of the historical means.

Jordan River 7-Q-10 Flow Rates

The UDWQ stated due to variations in the Jordan River flow rate that the UPDES permit for the RO concentrate will be seasonal. Previous work completed by Borup was used to determine the base flows for the SVWRF and CVWRF discharge permits. The flows were determined for upstream of each facility. The upstream flow plus the minimum average daily flow for each month from each facility would be the 7-Q-10 for the Jordan River at the two points of concentrate discharge. The flow data from SVWRF and CVWRF was obtain from personnel at each facility and added to the flows given to the author in a phone conversation with Bill Moellmer on January 22, 2001 (Table 5). The combined flow was assumed to be the 7-Q-10 flows for the Jordan River at each location.

Predicted Impacts of Concentrate Disposal

The impacts of concentrate discharge were evaluated using three pieces of data; the 7-Q-10 flow rate for the Jordan River, the mean contaminant concentration in the Jordan River from existing analytical data calculated with the method presented, and the RO concentrate concentrations at a 1.6 MGD flow rate. This assumes a 0.8 MGD concentrate flow from each treatment train. The actual flow rate will be determined during pilot plant testing and is expected to be between 1.2 and 1.6 MGD. These data were used in an Excel spreadsheet to estimate the Jordan River water quality

parameter concentrations. Discharge scenarios were evaluated for both above the South Valley Water Reclamation Facility outfall and below the Central Valley Water Reclamation Facility outfall near Mill Creek (Figure 1). The resulting Jordan River water concentration was compared to the regulatory limit. Three levels were considered more than an order of magnitude below the regulatory limit, within an order of magnitude of the regulatory limit, or above the regulatory limit. In addition, the relative impact of the concentrate addition was compared to the background levels in the Jordan River on a percentage basis.

Due to the variability of the river water quality, the data for the river water quality closest to the discharge point was used to determine the background concentrations. For discharge below the SVWRF, the Bluffdale Road Crossing water quality data was used to predict the maximum concentrations of the regulated parameters in the Jordan River. For discharge below the CVWRF, data from the site labeled Cudahy Lane AB South Davis WWTP was used. This resulted in slight variations of the background concentrations in the Jordan River between the two discharge locations.

Summaries of the predicted Jordan River water quality after discharge and mixing of RO concentrate from the JVWCD shallow groundwater and the KUC Zone B sources above the SVWRF and below the CVWRF are presented in eight Tables. Tables 6, 7, 8, and 9 present the estimated impacts downstream of the SVWRF for each season. Tables 10, 11, 12, and 13 present the estimated impacts downstream of CVWRF for each season. The results indicate a majority of the regulated water quality parameters evaluated should not exceed regulatory levels in the Jordan River after discharge of the RO concentrate. The critical season for downstream of the SVWRF is spring but the critical season for downstream of the CVWRF is fall.

Conclusions

- Discharging the concentrate below CVWRF versus above the SVWRF generally results in a lower contaminant concentration in River by about a factor of three for summer and fall and by about a factor of four for winter and spring. In other words, downstream of CVWRF generally three to four times as much concentrate can be discharged for the same impact as discharge upstream of SVWRF.

- Cadmium and chromium are parameters of concern because the Jordan River data set does not provide a good estimate of the actual concentration. Most of the Jordan River data for these parameters are reported as non-detectable levels. The preliminary testing performed by the JVWCD with analytical methods using lower detection limits indicated these parameters may not be a concern (Table 4). However, the State should consider using alternate test methods to quantify the concentration of these two contaminants in the Jordan River.

- The impact of mercury on the water quality depends on the data from which the conclusions are drawn. The full data set from the KUC Zone B wells suggests there may be a regulatory impact. However, the samples collected from the pilot wells did not show detectable levels of mercury. Samples of the river and shallow well water completed by JVWCD reported an average mercury level of 3.25 ng/L for the river and 2.5 ng/L for the shallow well (Table 6). These levels appear more reasonable and if they prove to be accurate, the concentrate would have a mercury concentration around 12.5 ng/L and after mixing with the river water would

result in a mercury concentration below the regulatory limit.

- The TDS levels in the Jordan River vary significantly over time based on the seasonal and long-term climate changes (i.e., droughts or wet cycles). The spreadsheet, developed as part of this project, was used to calculate the maximum background levels of TDS in the Jordan River before the addition of the concentrate (assuming a total flow rate of 1.6 MGD for both RO treatment facilities) would cause the TDS to exceed the 1200 mg/L limit. Based on the spreadsheet calculations, when the TDS level in the Jordan River exceeds 575 mg/L at a flow rate of 47.8 cfs the combined concentrate could not be added above the SVWRF. Similarly, the combined concentrate could not be discharged downstream of the CVWRF outfall when the Jordan River TDS concentration exceeds 1045 mg/L at a flow rate of 202.4 cfs.

- It has been documented that the Jordan River between the Jordan Narrows gage station and the discharge point above SVWRF is a gaining reach. Therefore, if the state imposed a flow based restriction for discharge using the 7-Q-10 flow rate and TDS level at the Jordan Narrows gage station, it would not accurately reflect the actual site constraints at the above SVWRF discharge point. The spreadsheet used to develop Tables 6 through 13 was used to back calculate the river flow rate for a given TDS background concentration that could be discharged into the Jordan River without exceeding 1200 mg/L. For the 1.6 MGD concentrate flow rate and quality shown in Table 6 and a TDS concentration of 937 mg/L (average of the data collected at the Bluffdale Road Crossing sample site), a flow rate of 120 cfs would produce a TDS concentration of 1193 mg/L. JVWCD is currently in the process of developing a historical record of the flow rate of the Jordan River near the anticipated discharge point south of 7800 South. An initial flow rate estimate was completed in late October 2000 near the end of the irrigation season and was reported to be 123 cfs. This flow rate is higher than the flow rate needed to discharge the anticipated concentrate to the Jordan River. The flow rate was measured at one of the historically low times of the year.

- In general, the preliminary analytical results from samples collected from the wells being used for the pilot plant study show lower concentrations of contaminants of concern then used in the initial water quality impact calculations.

Table 1
Water Quality Criteria of Interest to JVWCD for the Jordan River

Parameter	Basis	Units	2B	3A	3B	3D	4	*
Microbiological								
Fecal Coliforms	max. 30-day geom. mean	#/100 mL	200					
Total Coliforms	max. 30-day geom. mean	#/100 mL	5,000					
General Chemistry								
BCD	maximum	mg/L	5	5	5	5		
Dissolved Oxygen	min. 30 day avg	mg/L		6.5	5.5	5.0		(h)
pH			6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	
TDS	maximum	mg/L					1,200	
Temperature	maximum	deg C		20	27			
Temperature	maximum change	deg C		2	4			
Total Dissolved Gases	maximum	% saturation		110%	110%			
TSS	maximum	mg/L	90	35	90			
Turbidity	Allowable increase	ntu	10	10	10	15		
Pollutants								
Ammonia, Total	4-day average	mg/L as N		(e)	(e)			
Ammonia, Total	1-hr average	mg/L as N		(e)	(e)	(e)		
Ammonia, Total	30-day consecutive days	mg/L as N						(e)
Chlorine, Total	4-day average	mg/L		0.011	0.011			
Hydrogen Sulfide	Maximum undissociated	µg/L		2.0	2.0	2.0		
Nitrates	maximum	mg/L as N	4	4.0	4.0			
Total Phosphorus	maximum	mg/L as P	0.05	0.05	0.05			
Gross Alpha	maximum	pCi/L		15	15	15	15	
Gross Beta	maximum	pCi/L		50	50	50	50	

(b) Higher number applicable when early life stages are present; lower number when all other life stages are present
(e) Temperature and pH dependent
(h) Seasonal dependence

Metals								
Aluminum	4-day avg., dissolved	µg/L		87	87	87		
Arsenic	Maximum, dissolved	mg/L					0.10	
Arsenic	4-day avg., dissolved	µg/L		190	190	190		
Barium	Maximum, dissolved	mg/L						
Boron	maximum	mg/L					0.75	
Cadmium	4-day avg., dissolved	µg/L		1.1[c]	1.1[c]	1.1[c]		
Chromium, hexavalent	4-day avg., dissolved	µg/L		11[d]	11[d]	11[d]		
Chromium, trivalent	4-day avg., dissolved	µg/L		210[c]	210[c]	210[c]		
Copper	4-day avg., dissolved	µg/L		12[c]	12[c]			
Cyanide (Free)	4-day avg., dissolved	µg/L		5.2	5.2			
Fluoride	maximum	mg/L						
Iron	maximum	µg/L		1,000	1,000	1,000		
Lead	Maximum, dissolved	mg/L					0.10	
Lead	4-day avg., dissolved	µg/L		3.2[c]	3.2[c]	3.2[c]		
Mercury	4-day avg., dissolved	µg/L		0.012	0.012	0.012		
Nickel	4-day avg., dissolved	µg/L		160[c]	160[c]	160[c]		
Selenium	4-day avg., dissolved	µg/L		5	5	5		
Silver	1-hour avg., dissolved	µg/L		41[c]	41[c]	41[c]		
Zinc	4-day avg., dissolved	µg/L		110[c]	110[c]	110[c]		

(a) Depends on daily maximum mean air temperature
(c) Hardness dependent criteria. Value at 100 mg/L hardness shown. Value at other hardness must be calculated
(d) Conversion factor must be applied to total species analysis to determine dissolved species value
* Site Specific Criteria for Ammonia and Dissolved Oxygen

(cont) Table 1 Water Quality Criteria of Interest to JVWCD for the Jordan River

Organics								
2.4.5-TP	maximum	µg/L						
2.4-D	maximum	µg/L						
Aldrin	maximum	µg/L		1.5	1.5	1.5		
Chlordane	4-day average	µg/L		0.0043	0.0043	0.0043		
DDT and metabolites	4-day average	µg/L		0.001	0.001	0.001		
Dieldrin	4-day average	µg/L		0.0019	0.0019	0.0019		
Endosulfan	4-day average	µg/L		0.056	0.056	0.056		
Endrin	4-day average	µg/L		0.0023	0.0023	0.0023		
Guthion	Maximum	µg/L		0.01	0.01	0.01		
Heptachlor	4-day average	µg/L		0.0038	0.0038	0.0038		
Lindane	4-day average	µg/L		0.08	0.08	0.08		
Methoychlor	maximum	µg/L		0.03	0.03	0.03		
Mirex	maximum	µg/L		0.001	0.001	0.001		
Parathion	maximum	µg/L		0.04	0.04	0.04		
PCBs	4-day average	µg/L		0.014	0.014	0.014		
Pentachlorophenol	4-day average	µg/L		13[g]	13[g]	13[g]		
Phenol	maximum	mg/L		0.01	0.01	0.01		
Toxaphene	4-day average	µg/L		0.0002	0.0002	0.0002		

(g) pH dependent

Table 2
Laboratory Results for the Main Office Well Samples

Parameter**	units	Minimum Reporting Limit	Date 09/30/1998*	09/08/2000	08/10/2000
Alkalinity	mg/L	1	257	296	289
Aluminum	mg/L	0.03	0.06	0.07	0.09
Antimony	mg/L	0.0005	NA	< 0.0005	< 0.0005
Arsenic	mg/L	0.0005	0.012	0.0085	0.009
Barium	mg/L	0.005	0.025	0.029	0.028
Beryllium	mg/L	0.001	NA	< 0.001	< 0.001
Boron	mg/L	0.05	0.19	0.27	0.25
Cadmium	mg/L	0.0005	< 0.001	< 0.0005	< 0.0005
Calcium	mg/L	0.2	128	150	150
Chloride	mg/L	1	221	238	236
Chromium, hex	mg/L	0.02	< 0.005	< 0.02	< 0.02
Color	CU			5	10
Conductivity	umhos/cm		NA	1760	1760
Copper	mg/L	0.01	NA	< 0.01	< 0.01
Fluoride	mg/L	0.1	0.2	0.2	0.2
Gross Alpha	piC/L		< 13		
Gross Beta	piC/L		< 15		
Hardness as CaCO3	mg/L		NA	630	630
Iron	mg/L	0.02	0.06	< 0.02	< 0.02
Lead	ug/L	0.0005	< 0.005	< 0.0005	< 0.0005
Magnesium	mg/L	0.2	50.2	62	62
Manganese	mg/L	0.01	0.01	< 0.01	< 0.01
Mercury	ug/L	0.0002	0.3	< 0.0002	< 0.0002
Molybdenum	mg/L		< 0.01		
Nickel	ug/L	10	< 10	< 10	< 10
Nitrate as N	mg/L	1	3.1	2	3
Nitrite as N	mg/L	0.005	NA	< 0.005	< 0.005
pH			7.1	7.2	6.9
Phophorus, Ortho	mg/L	0.01	0.03	0.03	0.03
Potassium	mg/L	0.2	7.2	7.7	7.3
Selenium	mg/L	0.0005	0.004	0.0074	0.0092
Silica as SiO2	mg/L	0.2	36.1	36	34
Silver	mg/L	0.0005	< 0.0005	< 0.0005	< 0.0005
Sodium	mg/L	0.2	123	150	150
Strontium	mg/L		0.68		
Sulfate	mg/L	100	298	335	334
TDS	mg/L	10	1110	1260	1220
Thallium	mg/L	0.0005	NA	< 0.0005	< 0.005
Turbidity	NTU	0.01		0.11	< 1
Zinc	ug/L	10	30	< 10	< 10

* The concentration is the higher of the two analysis determined from samples collected during the the test pumping of the well from 9/29/98 through 9/30/98. These values were used to determine the concentration of the various parameters in the concentrate.
NA – Not Applicable

Table 3
KUC Zone B
Raw and Concentrate Water Quality

Parameter	Units	Kennecott Water Quality Raw	Concentrate	Calc*
Alkalinity	mg/L	275	1375	Y
Aluminum	mg/L	0.070	0.35	Y
Arsenic	mg/L	0.019	0.096	Y
Barium	mg/L	0.022	0.090	
Bicarbonate	mg/L	244	814	
Boron	mg/L	0.153	0.76	Y
Cadmium	mg/L	0.0026	0.0129	Y
Calcium	mg/L	368	1612	
Chloride	mg/L	266	951	
Chromium	mg/L	0.013	0.067	Y
Copper	mg/L	0.012	0.061	Y
Fluoride	mg/L	0.417	1.810	
Gross Alpha	pCi/L	NA^		
Gross Beta	pCi/L	NA^		
Hydrogen Sulfide	ug/L	NA^		
Iron	mg/L	1.48	6.48	
Lead	ug/L	9.3	46.5	Y
Lithium	mg/L	0.063	0.31	Y
Magnesium	mg/L	108	473	
Manganese	mg/L	0.131	0.43	
Mercury	ug/L	0.0025	0.0125	Y
Molybdenum	ug/L	9.7	48.5	Y
Nickel	mg/L	0.024	0.120	Y
Nitrate as N	mg/L	4.26	10.43	
pH		7.06		
Phophhorus, Ortho	mg/L	NA^		
Potassium	mg/L	8.87	30.50	
Selenium	ug/L	4	20.5	Y
Silica as SiO2	mg/L	27.6	113	
Silver	ug/L	1.8	9	Y
Sodium	mg/L	173	599	
Strontium	mg/L	0.24	1.05	
Sulfate	mg/L	953	4231	
TDS	mg/L	2209	8521	
Temp	degree C	15.1		
TSS	mg/L	7.57		
Zinc	ug/L	65	325	Y

* Calculated versus model generated
** Not Detected
^ No Data Available

Table 4
Jordan River Water Quality Data

Parameter	Minimum Reporting Limit	Concentration, mg/L @ 7800 South Sample Date 08/22/00	08/28/00	08/31/00	Average*	Concentration, mg/L @ 2100 South Sample Date 08/22/00	08/28/00	08/31/00	Average*	Overall Average*
Aluminum	0.03	0.04	0.07	0.06	0.057	0.04	0.07	0.05	0.053	0.055
Arsenic	0.0005	0.0172	0.0159	0.014	0.016	0.0316	0.0143	0.011	0.019	0.017
Barium	0.005	0.066	0.062	0.068	0.065	0.061	0.061	0.05	0.057	0.061
Boron	0.05	0.35	0.37	0.28	0.333	0.35	0.35	0.22	0.307	0.320
Cadmium	0.0005	< 0.0005	0.0005	< 0.0005	0.0003	< 0.0005	< 0.0005	< 0.0005	0.0003	0.0003
Chromium, hex	0.02	< 0.02	0.02	< 0.02	0.010	< 0.02	< 0.02	< 0.02	0.010	0.010
Chromium, tot	0.0005	0.003	0.003	0.003	0.003	0.0028	0.002	0.003	0.003	0.003
Copper	0.0005	0.006	0.005	0.005	0.005	0.004	0.008	0.005	0.006	0.006
Cyanide	0.002	< 0.003	0.002	< 0.002	0.002	< 0.002	< 0.002	< 0.002	0.001	0.001
Fluoride	0.1	0.6	0.6	0.5	0.567	0.8	1	0.5	0.767	0.667
Iron	0.02	< 0.02	0.02	< 0.02	0.010	< 0.02	< 0.02	0.02	0.013	0.012
Lead	0.0005	< 0.0006	0.0005	< 0.0005	0.0004	0.0009	0.0008	0.0008	0.0008	0.0006
Mercury	0.0002	< 0.0002	0.0002	< 0.0002	0.0001	< 0.0002	< 0.0002	< 0.0002	0.0001	0.0001
Nickel	0.0005	0.0041	0.0174	0.005	0.009	0.0037	0.0048	0.004	0.004	0.007
Nitrate as N	0.1	0.8	1.2	1.1	1.033	3	2	2	2.333	1.683
Nitrite as N	0.005	0.019	0.024	0.028	0.024	0.17	0.203	0.109	0.161	0.092
Phophorus, Total	0.01	0.17	0.11	0.45	0.243	0.92	0.9	0.61	0.810	0.527
Selenium	0.0005	0.0036	0.0041	0.003	0.004	0.0029	0.0031	0.0019	0.003	0.003
Silver	0.0005	< 0.0005	0.0005	< 0.0005	0.0003	< 0.0005	< 0.0005	< 0.0005	0.0003	0.0003
Zinc	0.01	< 0.01	0.01	< 0.01	0.007	0.02	0.02	0.01	0.017	0.012
Field Data Collected										
Conductivity		2003	2112	1610	1908	1828	1798	635	1420	1664
Dissolved Oxygen		7.2	6.3	6.4	6.6	6.3	5.9	5.8	6.0	6.3
pH		7.74	7.68	7.45	7.62	7.61	7.64	7.35	7.53	7.58
TDS#		1000	1050	792	947	906	886	309	700	824
Temp		18.8	18.8	17.3	18.3	20	19.3	18.3	19.2	18.8
Turbidity		42	22.3	361	142	26.4	20.3	82.5	43.1	92.4

All field blanks were below detection limit for all parameters.
* All averages use half the Minimum Reporting Limit for parameters not quantified.
# The field TDS is typically lower than lab results according to JVWCD personnel.

Table 5 7-Q-10 Flow Rates for the Jordan River

Location	Seasonal Flow Rate			
	Winter Flow, cfs	Seasonal Spring Flow, cfs	Summer Flow, cfs	Fall Flow, cfs
Downstream of SVWRF	57.8	47.8	77.8	79.5
Downstream of CVWRF	224.4	228.0	234.1	202.4

'able 6 Predicted Jordan River Water Quality – Winter
Vith 1.6 MGD of Concentrate (JVWCD Shallow Groundwater & KUC Zone B)
)ischarged Above the SVWRF
'ordan River 57.8 cfs

	Jordan River Data[1]			Concentrate			Jordan River With Concentrate				Regulatory Compliance		
Parameter	Min mg/L	Average mg/L	Max. mg/L	JVWCD Shallow GW Source Concentration	KUC Zone B Source Concentration	Units	Added Concentration mg/L	Added River Load lbs/Day	Total River Concentration, mg/L	Total River Load, lbs/Day	Percent of Increase Over Back-ground, %	Regulatory Standard[2], mg/L	Comments
Alkalinity				1285	1375	mg/L	109.3	71029	109.3	0	NA		No Regulatory Limit
Aluminum	ND	0.030	1.4	0.3	0.35	mg/L	0.0266	4.01	0.0567	9.4	88.6%	0.75	Within an Order of Magnitude of the Regulatory Limit
Arsenic	0.006	0.0403	0.014	0.06	0.096	mg/L	0.0064	0.801	0.0467	12.56	15.9%	0.19	Within an Order of Magnitude of the Regulatory Limit
Barium	0.059	0.0794	0.12	0.13	0.09	mg/L	0.0090	1.74	0.0884	24.7	11.4%		No Regulatory Limit
Bicarbonate				1133	814	mg/L	80.0	15127	80.0	0	NA		No Regulatory Limit
Boron				0.95	0.76	mg/L	0.0704	12.68	0.0704	0	NA	0.75	Order of Magnitude Below Regulatory Limit
Cadmium	ND	0.001	ND	0	0.0129	mg/L	0.0006	0.0334	0.0016	0.312	63.1%	0.00440	Within an Order of Magnitude of the Regulatory Limit
Calcium		78.7		545	1612	mg/L	88.6	7276	167	24522	112.6%		No Regulatory Limit
Chloride		213		847	951	mg/L	73.9	11308	287	66372	34.7%		No Regulatory Limit
Chromium	ND	0.0028	0.008	0	0.067	mg/L	0.0027	0	0.0055	0.87	98.2%	0.011	Within an Order of Magnitude of the Regulatory Limit
Copper	ND	0.0118	ND	0	0.061	mg/L	0.0025	0	0.0143	3.68	21.2%	0.0516	Within an Order of Magnitude of the Regulatory Limit
Fluoride				0.89	1.81	mg/L	0.1109	11.88	0.1109	0	NA		No Regulatory Limit
Gross Alpha				0	0	pCi/L					NA	0.015	Order of Magnitude Below Regulatory Limit
Gross Beta				0	0	pCi/L					NA	0.05	Order of Magnitude Below Regulatory Limit
Hydrogen Sulfide				0	0	ug/L	0	0	0	0	NA	0.000002	Order of Magnitude Below Regulatory Limit
Iron	ND	0.114	1.7	0.26	6.48	mg/L	0.277	3.47	0.391	35.6	242.3%	1	Within an Order of Magnitude of the Regulatory Limit
Lead	ND	0.0061	0.008	0	46.5	ug/L	0.0019	0	0.0080	0.0019	31.2%	0.0286	Within an Order of Magnitude of the Regulatory Limit
Lithium				0	0.31	mg/L	0.0128	0	0.0128	0	NA		No Regulatory Limit
Magnesium				214	473	mg/L	28.2	2857	28.2	0	NA		No Regulatory Limit
Manganese	ND	0.0135	0.085	0.04	0.43	mg/L	0.0193	0.534	0.0328	4.21	143.1%		No Regulatory Limit
Mercury[3]	0.000002	0.000003	0.000004	0.0125	0.0125	ug/L	1.02714E-06	0.0003	4.02714E-06	0.0003	34.2%	0.000012	Within an Order of Magnitude of the Regulatory Limit
Molybdenum				0	48.5	ug/L	0.0020	0	0.0020	0	NA		No Regulatory Limit
Nickel				0	0.12	mg/L	0.0049	0	0.0049	0	NA	0.679	Order of Magnitude Below Regulatory Limit
Nitrate as N		0.833		15.5	10.43	mg/L	1.065	207	1.90	260	127.9%	4	Within an Order of Magnitude of the Regulatory Limit
pH				7.6	0						NA		No Regulatory Limit
Phophorus, Ortho		0.0672		0.15	0	mg/L	0.0018	0.587	0.0690	20.9	2.7%	50	Order of Magnitude Below Regulatory Limit
Potassium		14.7		23.18	30.5	mg/L	2.21	309	16.9	4579	15.0%		No Regulatory Limit
Selenium	ND	0.0013	0.003	20	20.5	ug/L	0.0017	0.267	0.0030	0.0004	125.2%	0.005	Within an Order of Magnitude of the Regulatory Limit
Silica as SiO2				149	113	mg/L	10.76	1989	10.76	0	NA		No Regulatory Limit
Silver	ND	0.002	0.002	0	9	ug/L	0.0004	0	0.0024	0.0006	18.5%	0.0041	Within an Order of Magnitude of the Regulatory Limit
Sodium				398	599	mg/L	41.0	5314	41.0	0	NA		No Regulatory Limit
Strontium				2.89	1.05	mg/L	0.1619	38.6	0.1619	0	NA		No Regulatory Limit
Sulfate				1361	4231	mg/L	230	18171	230	0	NA		No Regulatory Limit
TDS	118	937	1380	4156	8521	mg/L	521	55487	1458	292092	55.6%	1200	EXCEEDS REGULATORY LIMIT FOR THE RIVER
Zinc	ND	0.0956	0.025	150	325	ug/L	0.0195	2.00	0.1152	0.0298	20.4%	0.457	Within an Order of Magnitude of the Regulatory Limit

(1) The river water quality is the average of the analytical data from the Bluffdale Road Crossing sampling site (Storet Number 499460). The averages are calculated by assigning a value of 25% of the regulatory limit when a sample was analyzed and the analyte was not detected.

(2) For some of the metals, the regulatory standard varies with the hardness of the receiving water. The regulatory standard presented is based on a hardness of 400 mg/L. The regulatory limit was calculated using a spreadsheet obtained from the DEQ.

(3) For the Kennecott wells no mercury data with a low detection limit was obtained. It was assumed the background mercury concentration would be similar to the JVWCD's well

ND = Not Detected
NA = Not Applicable

Table 7 Predicted Jordan River Water Quality – Spring
With 1.6 MGD of Concentrate (JVWCD Shallow Groundwater & KUC Zone B)
Discharged Above the SVWRF
Jordan River 47.8 cfs

	Jordan River Data[1]			Concentrate			Jordan River With Concentrate				Regulatory Compliance		
Parameter	Min mg/L	Average mg/L	Max. mg/L	JVWCD Shallow GW Source Concentration	KUC Zone B Source Concentration	Units	Added Concentration mg/L	Added River Load lbs/Day	Total River Concentration, mg/L	Total River Load, lbs/Day	Percent of Increase Over Back-ground, %	Regulatory Standard[2], mg/L	Comments
Alkalinity				1285	1375	mg/L	131.0	71029	131.0	0	NA		No Regulatory Limit
Aluminum	ND	0.030	1.4	0.3	0.35	mg/L	0.0319	4.01	0.0620	7.7	106.2%	0.75	Within an Order of Magnitude of the Regulatory Limit
Arsenic	0.006	0.0403	0.014	0.06	0.096	mg/L	0.0077	0.801	0.0480	10.39	19.1%	0.19	Within an Order of Magnitude of the Regulatory Limit
Barium	0.059	0.0794	0.12	0.13	0.09	mg/L	0.0108	1.74	0.0902	20.5	13.7%		No Regulatory Limit
Bicarbonate				1133	814	mg/L	95.9	15127	95.9	0	NA		No Regulatory Limit
Boron				0.95	0.76	mg/L	0.0844	12.68	0.0844	0	NA	0.75	Within an Order of Magnitude of the Regulatory Limit
Cadmium	ND	0.001	ND	0	0.0129	mg/L	0.0008	0.0334	0.0018	0.258	75.7%	0.00440	Within an Order of Magnitude of the Regulatory Limit
Calcium		78.7		545	1612	mg/L	106.3	7276	185	20277	135.0%		No Regulatory Limit
Chloride		213		847	951	mg/L	88.6	11308	302	54883	41.6%		No Regulatory Limit
Chromium	ND	0.0028	0.008	0	0.067	mg/L	0.0033	0	0.0061	0.72	117.8%	0.011	Within an Order of Magnitude of the Regulatory Limit
Copper	ND	0.0118	ND	0	0.061	mg/L	0.0030	0	0.0148	3.05	25.4%	0.0516	Within an Order of Magnitude of the Regulatory Limit
Fluoride				0.89	1.81	mg/L	0.1330	11.88	0.1330	0	NA		No Regulatory Limit
Gross Alpha				0	0	pCi/L					NA	0.015	Order of Magnitude Below Regulatory Limit
Gross Beta				0	0	pCi/L					NA	0.05	Order of Magnitude Below Regulatory Limit
Hydrogen Sulfide				0	0	ug/L	0	0	0	0	NA	0.000002	Order of Magnitude Below Regulatory Limit
Iron	ND	0.114	1.7	0.26	6.48	mg/L	0.332	3.47	0.446	29.4	290.6%	1	Within an Order of Magnitude of the Regulatory Limit
Lead	ND	0.0061	0.008	0	46.5	ug/L	0.0023	0	0.0084	0.0016	37.4%	0.0286	Within an Order of Magnitude of the Regulatory Limit
Lithium				0	0.31	mg/L	0.0154	0	0.0154	0	NA		No Regulatory Limit
Magnesium				214	473	mg/L	33.8	2857	33.8	0	NA		No Regulatory Limit
Manganese	ND	0.0135	0.085	0.04	0.43	mg/L	0.0232	0.534	0.0366	3.48	171.6%		No Regulatory Limit
Mercury[3]	0.000002	0.000003	0.000004	0.0125	0.0125	ug/L	1.23156E-06	0.0003	4.23156E-06	0.0003	41.1%	0.000012	Within an Order of Magnitude of the Regulatory Limit
Molybdenum				0	48.5	ug/L	0.0024	0	0.0024	0	NA		No Regulatory Limit
Nickel				0	0.12	mg/L	0.0059	0	0.0059	0	NA	0.679	Order of Magnitude Below Regulatory Limit
Nitrate as N		0.833		15.5	10.43	mg/L	1.277	207	2.11	215	153.3%	4	Within an Order of Magnitude of the Regulatory Limit
pH				7.6	0						NA		No Regulatory Limit
Phophorus, Ortho		0.0672		0.15	0	mg/L	0.0022	0.587	0.0694	17.3	3.2%	50	Order of Magnitude Below Regulatory Limit
Potassium		14.7		23.18	30.5	mg/L	2.64	309	17.3	3786	18.0%		No Regulatory Limit
Selenium	ND	0.0013	0.003	20	20.5	ug/L	0.0020	0.267	0.0033	0.0003	150.1%	0.005	Within an Order of Magnitude of the Regulatory Limit
Silica as SiO2				149	113	mg/L	12.91	1989	12.91	0	NA		No Regulatory Limit
Silver	ND	0.002	0.002	0	9	ug/L	0.0004	0	0.0024	0.0005	22.2%	0.0041	Within an Order of Magnitude of the Regulatory Limit
Sodium				398	599	mg/L	49.1	5314	49.1	0	NA		No Regulatory Limit
Strontium				2.89	1.05	mg/L	0.1941	38.6	0.1941	0	NA		No Regulatory Limit
Sulfate				1361	4231	mg/L	275	18171	275	0	NA		No Regulatory Limit
TDS	118	937	1380	4156	8521	mg/L	624	55487	1562	241531	66.6%	1200	EXCEEDS REGULATORY LIMIT FOR THE RIVER
Zinc	ND	0.0956	0.025	150	325	ug/L	0.0234	2.00	0.1190	0.0246	24.5%	0.457	Within an Order of Magnitude of the Regulatory Limit

(1) The river water quality is the average of the analytical data from the Bluffdale Road Crossing sampling site (Storet Number 499460). The averages are calculated by assigning a value of 25% of the regulatory limit when a sample was analyzed and the analyte was not detected.

(2) For some of the metals, the regulatory standard varies with the hardness of the receiving water. The regulatory standard presented is based on a hardness of 400 mg/L. The regulatory limit was calculated using a spreadsheet obtained from the DEQ.

(3) For the Kennecott wells no mercury data with a low detection limit was obtained. It was assumed the background mercury concentration would be similar to the JVWCD's well

ND = Not Detected
NA = Not Applicable

Table 8 Predicted Jordan River Water Quality – Summer
With 1.6 MGD of Concentrate (JVWCD Shallow Groundwater & KUC Zone B)
Discharged Above the SVWRF
Jordan River 77.8 cfs

	Jordan River Data[1]			Concentrate			Jordan River With Concentrate				Regulatory Compliance		
Parameter	Min mg/L	Average mg/L	Max. mg/L	JVWCD Shallow GW Source Concentration	KUC Zone B Source Concentration	Units	Added Concentration mg/L	Added River Load lbs/Day	Total River Concentration, mg/L	Total River Load, lbs/Day	Percent of Increase Over Back-ground, %	Regulatory Standard[2], mg/L	Comments
Alkalinity				1285	1375	mg/L	82.1	71029	82.1	0	NA		No Regulatory Limit
Aluminum	ND	0.030	1.4	0.3	0.35	mg/L	0.0200	4.01	0.0501	12.6	66.5%	0.75	Within an Order of Magnitude of the Regulatory Limit
Arsenic	0.006	0.0403	0.014	0.06	0.096	mg/L	0.0048	0.801	0.0451	16.91	12.0%	0.19	Within an Order of Magnitude of the Regulatory Limit
Barium	0.059	0.0794	0.12	0.13	0.09	mg/L	0.0068	1.74	0.0862	33.3	8.6%		No Regulatory Limit
Bicarbonate				1133	814	mg/L	60.1	15127	60.1	0	NA		No Regulatory Limit
Boron				0.95	0.76	mg/L	0.0528	12.68	0.0528	0	NA	0.75	Within an Order of Magnitude of the Regulatory Limit
Cadmium	ND	0.001	ND	0	0.0129	mg/L	0.0005	0.0334	0.0015	0.419	47.4%	0.00440	Within an Order of Magnitude of the Regulatory Limit
Calcium		78.7		545	1612	mg/L	66.6	7276	145	33003	84.6%		No Regulatory Limit
Chloride		213		847	951	mg/L	55.5	11308	268	89327	26.0%		No Regulatory Limit
Chromium	ND	0.0028	0.008	0	0.067	mg/L	0.0021	0	0.0048	1.17	73.8%	0.011	Within an Order of Magnitude of the Regulatory Limit
Copper	ND	0.0118	ND	0	0.061	mg/L	0.0019	0	0.0137	4.96	15.9%	0.0516	Within an Order of Magnitude of the Regulatory Limit
Fluoride				0.89	1.81	mg/L	0.0833	11.88	0.0833	0	NA		No Regulatory Limit
Gross Alpha				0	0	pCi/L					NA	0.015	Order of Magnitude Below Regulatory Limit
Gross Beta				0	0	pCi/L					NA	0.05	Order of Magnitude Below Regulatory Limit
Hydrogen Sulfide				0	0	ug/L	0	0	0	0	NA	0.000002	Order of Magnitude Below Regulatory Limit
Iron	ND	0.114	1.7	0.26	6.48	mg/L	0.208	3.47	0.322	47.9	182.0%	1	Within an Order of Magnitude of the Regulatory Limit
Lead	ND	0.0061	0.008	0	46.5	ug/L	0.0014	0	0.0076	0.0026	23.4%	0.0286	Within an Order of Magnitude of the Regulatory Limit
Lithium				0	0.31	mg/L	0.0096	0	0.0096	0	NA		No Regulatory Limit
Magnesium				214	473	mg/L	21.2	2857	21.2	0	NA		No Regulatory Limit
Manganese	ND	0.0135	0.085	0.04	0.43	mg/L	0.0145	0.534	0.0280	5.66	107.4%		No Regulatory Limit
Mercury[3]	0.000002	0.000003	0.000004	0.0125	0.0125	ug/L	7.71329E-07	0.0003	3.77133E-06	0.0003	25.7%	0.000012	Within an Order of Magnitude of the Regulatory Limit
Molybdenum				0	48.5	ug/L	0.0015	0	0.0015	0	NA		No Regulatory Limit
Nickel				0	0.12	mg/L	0.0037	0	0.0037	0	NA	0.679	Order of Magnitude Below Regulatory Limit
Nitrate as N		0.833		15.5	10.43	mg/L	0.800	207	1.63	349	96.0%	4	Within an Order of Magnitude of the Regulatory Limit
pH				7.6	0						NA		No Regulatory Limit
Phophorus, Ortho		0.0672		0.15	0	mg/L	0.0014	0.587	0.0686	28.2	2.0%	50	Order of Magnitude Below Regulatory Limit
Potassium		14.7		23.18	30.5	mg/L	1.66	309	16.4	6162	11.3%		No Regulatory Limit
Selenium	ND	0.0013	0.003	20	20.5	ug/L	0.0012	0.267	0.0026	0.0006	94.0%	0.005	Within an Order of Magnitude of the Regulatory Limit
Silica as SiO2				149	113	mg/L	8.08	1989	8.08	0	NA		No Regulatory Limit
Silver	ND	0.002	0.002	0	9	ug/L	0.0003	0	0.0023	0.0008	13.9%	0.0041	Within an Order of Magnitude of the Regulatory Limit
Sodium				398	599	mg/L	30.8	5314	30.8	0	NA		No Regulatory Limit
Strontium				2.89	1.05	mg/L	0.1216	38.6	0.1216	0	NA		No Regulatory Limit
Sulfate				1361	4231	mg/L	173	18171	173	0	NA		No Regulatory Limit
TDS	118	937	1380	4156	8521	mg/L	391	55487	1329	393113	41.7%	1200	EXCEEDS REGULATORY LIMIT FOR THE RIVER
Zinc	ND	0.0956	0.025	150	325	ug/L	0.0147	2.00	0.1103	0.0401	15.3%	0.457	Within an Order of Magnitude of the Regulatory Limit

(1) The river water quality is the average of the analytical data from the Bluffdale Road Crossing sampling site (Storet Number 499460). The averages are calculated by assigning a value of 25% of the regulatory limit when a sample was analyzed and the analyte was not detected.

(2) For some of the metals, the regulatory standard varies with the hardness of the receiving water. The regulatory standard presented is based on a hardness of 400 mg/L. The regulatory limit was calculated using a spreadsheet obtained from the DEQ.

(3) For the Kennecott wells no mercury data with a low detection limit was obtained. It was assumed the background mercury concentration would be similar to the JVWCD's well

ND = Not Detected
NA = Not Applicable

Table 9 Predicted Jordan River Water Quality – Fall
With 1.6 MGD of Concentrate (JVWCD Shallow Groundwater & KUC Zone B)
Discharged Above the SVWRF
Jordan River 79.5 cfs

	Jordan River Data[1]			Concentrate			Jordan River With Concentrate				Regulatory Compliance		
Parameter	Min mg/L	Average mg/L	Max. mg/L	JVWCD Shallow GW Source Concentration	KUC Zone B Source Concentration	Units	Added Concentration mg/L	Added River Load lbs/Day	Total River Concentration, mg/L	Total River Load, lbs/Day	Percent of Increase Over Back-ground, %	Regulatory Standard[2], mg/L	Comments
Alkalinity				1285	1375	mg/L	80.3	71029	80.3	0	NA		No Regulatory Limit
Aluminum	ND	0.030	1.4	0.3	0.35	mg/L	0.0196	4.01	0.0496	12.9	65.1%	0.75	Within an Order of Magnitude of the Regulatory Limit
Arsenic	0.006	0.0403	0.014	0.06	0.096	mg/L	0.0047	0.801	0.0450	17.29	11.7%	0.19	Within an Order of Magnitude of the Regulatory Limit
Barium	0.059	0.0794	0.12	0.13	0.09	mg/L	0.0066	1.74	0.0860	34.0	8.4%		No Regulatory Limit
Bicarbonate				1133	814	mg/L	58.8	15127	58.8	0	NA		No Regulatory Limit
Boron				0.95	0.76	mg/L	0.0517	12.68	0.0517	0	NA	0.75	Within an Order of Magnitude of the Regulatory Limit
Cadmium	ND	0.001	ND	0	0.0129	mg/L	0.0005	0.0334	0.0015	0.429	46.4%	0.00440	Within an Order of Magnitude of the Regulatory Limit
Calcium		78.7		545	1612	mg/L	65.1	7276	144	33750	82.8%		No Regulatory Limit
Chloride		213		847	951	mg/L	54.3	11308	267	91349	25.5%		No Regulatory Limit
Chromium	ND	0.0028	0.008	0	0.067	mg/L	0.0020	0	0.0048	1.20	72.2%	0.011	Within an Order of Magnitude of the Regulatory Limit
Copper	ND	0.0118	ND	0	0.061	mg/L	0.0018	0	0.0137	5.07	15.6%	0.0516	Within an Order of Magnitude of the Regulatory Limit
Fluoride				0.89	1.81	mg/L	0.0815	11.88	0.0815	0	NA		No Regulatory Limit
Gross Alpha				0	0	pCi/L					NA	0.015	Order of Magnitude Below Regulatory Limit
Gross Beta				0	0	pCi/L					NA	0.05	Order of Magnitude Below Regulatory Limit
Hydrogen Sulfide				0	0	ug/L	0	0	0	0	NA	0.000002	Order of Magnitude Below Regulatory Limit
Iron	ND	0.114	1.7	0.26	6.48	mg/L	0.203	3.47	0.318	49.0	178.1%	1	Within an Order of Magnitude of the Regulatory Limit
Lead	ND	0.0061	0.008	0	46.5	ug/L	0.0014	0	0.0075	0.0026	22.9%	0.0286	Within an Order of Magnitude of the Regulatory Limit
Lithium				0	0.31	mg/L	0.0094	0	0.0094	0	NA		No Regulatory Limit
Magnesium				214	473	mg/L	20.7	2857	20.7	0	NA		No Regulatory Limit
Manganese	ND	0.0135	0.085	0.04	0.43	mg/L	0.0142	0.534	0.0277	5.79	105.1%		No Regulatory Limit
Mercury[3]	0.000002	0.000003	0.000004	0.0125	0.0125	ug/L	7.5477E-07	0.0003	3.75477E-06	0.0003	25.2%	0.000012	Within an Order of Magnitude of the Regulatory Limit
Molybdenum				0	48.5	ug/L	0.0015	0	0.0015	0	NA		No Regulatory Limit
Nickel				0	0.12	mg/L	0.0036	0	0.0036	0	NA	0.679	Order of Magnitude Below Regulatory Limit
Nitrate as N		0.833		15.5	10.43	mg/L	0.783	207	1.62	357	94.0%	4	Within an Order of Magnitude of the Regulatory Limit
pH				7.6	0						NA		No Regulatory Limit
Phophorus, Ortho		0.0672		0.15	0	mg/L	0.0013	0.587	0.0686	28.8	2.0%	50	Order of Magnitude Below Regulatory Limit
Potassium		14.7		23.18	30.5	mg/L	1.62	309	16.3	6302	11.0%		No Regulatory Limit
Selenium	ND	0.0013	0.003	20	20.5	ug/L	0.0012	0.267	0.0026	0.0006	92.0%	0.005	Within an Order of Magnitude of the Regulatory Limit
Silica as SiO2				149	113	mg/L	7.91	1989	7.91	0	NA		No Regulatory Limit
Silver	ND	0.002	0.002	0	9	ug/L	0.0003	0	0.0023	0.0009	13.6%	0.0041	Within an Order of Magnitude of the Regulatory Limit
Sodium				398	599	mg/L	30.1	5314	30.1	0	NA		No Regulatory Limit
Strontium				2.89	1.05	mg/L	0.1190	38.6	0.1190	0	NA		No Regulatory Limit
Sulfate				1361	4231	mg/L	169	18171	169	0	NA		No Regulatory Limit
TDS	118	937	1380	4156	8521	mg/L	383	55487	1320	402012	40.8%	1200	EXCEEDS REGULATORY LIMIT FOR THE RIVER
Zinc	ND	0.0956	0.025	150	325	ug/L	0.0143	2.00	0.1100	0.0410	15.0%	0.457	Within an Order of Magnitude of the Regulatory Limit

(1) The river water quality is the average of the analytical data from the Bluffdale Road Crossing sampling site (Storet Number 499460). The averages are calculated by assigning a value of 25% of the regulatory limit when a sample was analyzed and the analyte was not detected.

(2) For some of the metals, the regulatory standard varies with the hardness of the receiving water. The regulatory standard presented is based on a hardness of 400 mg/L. The regulatory limit was calculated using a spreadsheet obtained from the DEQ.

(3) For the Kennecott wells no mercury data with a low detection limit was obtained. It was assumed the background mercury concentration would be similar to the JVWCD's well

ND = Not Detected
NA = Not Applicable

Table 10 Predicted Jordan River Water Quality – Winter
With 1.6 MGD of Concentrate (JVWCD Shallow Groundwater & KUC Zone B)
Discharged Below the CVWRF
Jordan River 224.4 cfs

Parameter	Jordan River Data[1]			Concentrate			Jordan River With Concentrate				Regulatory Compliance		
	Min mg/L	Average mg/L	Max. mg/L	JVWCD Shallow GW Source Concentration	KUC Zone B Source Concentration	Units	Added Concentration mg/L	Added River Load lbs/Day	Total River Concentration, mg/L	Total River Load, lbs/Day	Percent of Increase Over Back-ground, %	Regulatory Standard[2], mg/L	Comments
Alkalinity				1285	1375	mg/L	29.0	17156	29.0	0	NA		No Regulatory Limit
Aluminum	ND	0.0214	0.115	0.3	0.35	mg/L	0.0071	4.01	0.0285	25.9	33.1%	0.75	Within an Order of Magnitude of the Regulatory Limit
Arsenic	ND	0.0357	0.015	0.06	0.096	mg/L	0.0017	0.801	0.0374	43.2	4.8%	0.19	Within an Order of Magnitude of the Regulatory Limit
Barium	0.050	0.0635	0.078	0.13	0.09	mg/L	0.0024	1.74	0.0659	77	3.8%		No Regulatory Limit
Bicarbonate				1133	814	mg/L	21.24	15127	21.24	0	NA		No Regulatory Limit
Boron	ND			0.95	0.76	mg/L	0.0187	12.68	0.0187	0	NA	0.75	Order of Magnitude Below Regulatory Limit
Cadmium		0.001	0.001	0	0.0129	mg/L	0.000167561	0.0334	0.0012	1.21	16.8%	0.00440	Within an Order of Magnitude of the Regulatory Limit
Calcium		93.2		545	1612	mg/L	23.5	7276	117	112816	25.2%		No Regulatory Limit
Chloride	ND	213		847	951	mg/L	19.62	11308	233	257790	9.2%		No Regulatory Limit
Chromium	ND	0.0028	0.011	0	0.067	mg/L	0.0007	0	0.0035	3.34	26.3%	0.011	Within an Order of Magnitude of the Regulatory Limit
Copper		0.0114	ND	0	0.061	mg/L	0.0007	0	0.0121	13.8	5.8%	0.0516	Within an Order of Magnitude of the Regulatory Limit
Fluoride				0.89	1.81	mg/L	0.0295	11.88	0.0295	0	NA		No Regulatory Limit
Gross Alpha				0	0	pCi/L					NA	0.015	Order of Magnitude Below Regulatory Limit
Gross Beta				0	0	pCi/L					NA	0.05	Order of Magnitude Below Regulatory Limit
Hydrogen Sulfide				0	0	ug/L	0	0	0	0	NA	0.000002	Order of Magnitude Below Regulatory Limit
Iron	ND	0.097	0.45	0.26	6.48	mg/L	0.0735	3.47	0.1710	117.9	75.5%	1	Within an Order of Magnitude of the Regulatory Limit
Lead	ND	0.0056	0.01	0	46.5	ug/L	0.0005	0	0.0061	0.0067	9.1%	0.0286	Within an Order of Magnitude of the Regulatory Limit
Lithium				0	0.31	mg/L	0.0034	0	0.0034	0	NA		No Regulatory Limit
Magnesium				214	473	mg/L	7.50	2857	7.50	0	NA		No Regulatory Limit
Manganese	0.012	0.0282	0.075	0.04	0.43	mg/L	0.0051	0.534	0.0333	34.1	18.2%		No Regulatory Limit
Mercury[3]	0.000002	0.000003	0.000004	0.0125	0.0125	ug/L	2.73E-07	0.0003	0.00	0.0003	9.1%	0.000012	Within an Order of Magnitude of the Regulatory Limit
Molybdenum				0	48.5	ug/L	0.0005	0	0.0005	0	NA		No Regulatory Limit
Nickel				0	0.12	mg/L	0.0013	0	0.0013	0	NA	0.679	Order of Magnitude Below Regulatory Limit
Nitrate as N		2.65		15.5	10.43	mg/L	0.283	207	2.93	3201	10.7%	4	Within an Order of Magnitude of the Regulatory Limit
pH				7.6	0						NA		No Regulatory Limit
Phophorus, Ortho		0.948		0.15	0	mg/L	0.0154	18.8	0.964	1148	1.6%	50	Order of Magnitude Below Regulatory Limit
Potassium		11.8		23.18	30.5	mg/L	0.586	309	12.4	14327	4.9%		No Regulatory Limit
Selenium	ND	0.0014	0.005	20	20.5	ug/L	0.0004	0.267	0.0018	0.0017	31.7%	0.005	Within an Order of Magnitude of the Regulatory Limit
Silica as SiO2				149	113	mg/L	2.86	1989	2.86	0	NA		No Regulatory Limit
Silver	ND	0.002	0.002	0	9	ug/L	9.82E-05	0	0.0021	0.0024	4.9%	0.0041	Within an Order of Magnitude of the Regulatory Limit
Sodium				398	599	mg/L	10.88	5314	10.88	0	NA		No Regulatory Limit
Strontium				2.89	1.05	mg/L	0.0430	38.6	0.0430	0	NA		No Regulatory Limit
Sulfate				1361	4231	mg/L	61.0	18171	61.0	0	NA		No Regulatory Limit
TDS	360	914	1524	4156	8521	mg/L	138.3	55487	1052	1105668	15.1%	1200	EXCEEDS REGULATORY LIMIT FOR THE RIVER
Zinc	ND	0.0851	0.044	150	325	ug/L	0.0052	2.00	0.0903	0.1030	6.1%	0.457	Within an Order of Magnitude of the Regulatory Limit

(1) The river water quality is the average of the analytical data from the Jordan River at Cudahy AB South Davis WWTP sampling site (Storet Number 499182). The averages are calculated by assigning a value of 25% of the regulatory limit when a sample was analyzed and the analyte was not detected.

(2) For some of the metals, the regulatory standard varies with the hardness of the receiving water. The regulatory standard presented is based on a hardness of 400 mg/L. The regulatory limit was calculated using a spreadsheet obtained from the DEQ.

(3) For the Kennecott wells no mercury data with a low detection limit was obtained. It was assumed the background mercury concentration would be similar to the JVWCD's well

ND = Not Detected
NA = Not Applicable

Table 11 Predicted Jordan River Water Quality – Spring
With 1.6 MGD of Concentrate (JVWCD Shallow Groundwater & KUC Zone B)
Discharged Below the CVWRF
Jordan River 228.0 cfs

Parameter	Jordan River Data[1]			Concentrate			Jordan River With Concentrate				Regulatory Compliance		
	Min mg/L	Average mg/L	Max. mg/L	JVWCD Shallow GW Source Concentration	KUC Zone B Source Concentration	Units	Added Concentration mg/L	Added River Load lbs/Day	Total River Concentration, mg/L	Total River Load, lbs/Day	Percent of Increase Over Back-ground, %	Regulatory Standard[2], mg/L	Comments
Alkalinity				1285	1375	mg/L	28.6	17156	28.6	0	NA		No Regulatory Limit
Aluminum	ND	0.0214	0.115	0.3	0.35	mg/L	0.0070	4.01	0.0284	26.3	32.5%	0.75	Within an Order of Magnitude of the Regulatory Limit
Arsenic	ND	0.0357	0.015	0.06	0.096	mg/L	0.0017	0.801	0.0374	43.9	4.7%	0.19	Within an Order of Magnitude of the Regulatory Limit
Barium	0.050	0.0635	0.078	0.13	0.09	mg/L	0.0024	1.74	0.0659	78	3.7%		No Regulatory Limit
Bicarbonate				1133	814	mg/L	20.91	15127	20.91	0	NA		No Regulatory Limit
Boron	ND			0.95	0.76	mg/L	0.0184	12.68	0.0184	0	NA	0.75	Order of Magnitude Below Regulatory Limit
Cadmium		0.001	0.001	0	0.0129	mg/L	0.0001649	0.0334	0.0012	1.23	16.5%	0.00440	Within an Order of Magnitude of the Regulatory Limit
Calcium		93.2		545	1612	mg/L	23.2	7276	116	114656	24.8%		No Regulatory Limit
Chloride	ND	213		847	951	mg/L	19.31	11308	232	261995	9.1%		No Regulatory Limit
Chromium	ND	0.0028	0.011	0	0.067	mg/L	0.0007	0	0.0035	3.40	25.9%	0.011	Within an Order of Magnitude of the Regulatory Limit
Copper		0.0114	ND	0	0.061	mg/L	0.0007	0	0.0120	14.0	5.7%	0.0516	Within an Order of Magnitude of the Regulatory Limit
Fluoride				0.89	1.81	mg/L	0.0290	11.88	0.0290	0	NA		No Regulatory Limit
Gross Alpha						pCi/L					NA	0.015	Order of Magnitude Below Regulatory Limit
Gross Beta						pCi/L					NA	0.05	Order of Magnitude Below Regulatory Limit
Hydrogen Sulfide						ug/L	0	0	0	0	NA	0.000002	Order of Magnitude Below Regulatory Limit
Iron	ND	0.097	0.45	0.26	6.48	mg/L	0.0724	3.47	0.1698	119.8	74.3%	1	Within an Order of Magnitude of the Regulatory Limit
Lead	ND	0.0056	0.01	0	46.5	ug/L	0.0005	0	0.0061	0.0068	9.0%	0.0286	Within an Order of Magnitude of the Regulatory Limit
Lithium				0	0.31	mg/L	0.0034	0	0.0034	0	NA		No Regulatory Limit
Magnesium				214	473	mg/L	7.38	2857	7.38	0	NA		No Regulatory Limit
Manganese	0.012	0.0282	0.075	0.04	0.43	mg/L	0.0050	0.534	0.0332	34.6	17.9%		No Regulatory Limit
Mercury[3]	0.000002	0.000003	0.000004	0.0125	0.0125	ug/L	2.68E-07	0.0003	0.00	0.0003	8.9%	0.000012	Within an Order of Magnitude of the Regulatory Limit
Molybdenum				0	48.5	ug/L	0.0005	0	0.0005	0	NA		No Regulatory Limit
Nickel				0	0.12	mg/L	0.0013	0	0.0013	0	NA	0.679	Order of Magnitude Below Regulatory Limit
Nitrate as N		2.65		15.5	10.43	mg/L	0.278	207	2.92	3253	10.5%	4	Within an Order of Magnitude of the Regulatory Limit
pH				7.6	0						NA		No Regulatory Limit
Phophorus, Ortho		0.948		0.15	0	mg/L	0.0151	18.8	0.963	1166	1.6%	50	Order of Magnitude Below Regulatory Limit
Potassium		11.8		23.18	30.5	mg/L	0.576	309	12.4	14560	4.9%		No Regulatory Limit
Selenium	ND	0.0014	0.005	20	20.5	ug/L	0.0004	0.267	0.0018	0.0017	31.2%	0.005	Within an Order of Magnitude of the Regulatory Limit
Silica as SiO2				149	113	mg/L	2.81	1989	2.81	0	NA		No Regulatory Limit
Silver	ND	0.002	0.002	0	9	ug/L	9.66E-05	0	0.0021	0.0025	4.8%	0.0041	Within an Order of Magnitude of the Regulatory Limit
Sodium				398	599	mg/L	10.71	5314	10.71	0	NA		No Regulatory Limit
Strontium				2.89	1.05	mg/L	0.0423	38.6	0.0423	0	NA		No Regulatory Limit
Sulfate				1361	4231	mg/L	60.0	18171	60.0	0	NA		No Regulatory Limit
TDS	360	914	1524	4156	8521	mg/L	136.1	55487	1050	1123704	14.9%	1200	EXCEEDS REGULATORY LIMIT FOR THE RIVER
Zinc	ND	0.0851	0.044	150	325	ug/L	0.0051	2.00	0.0902	0.1047	6.0%	0.457	Within an Order of Magnitude of the Regulatory Limit

(1) The river water quality is the average of the analytical data from the Jordan River at Cudahy AB South Davis WWTP sampling site (Storet Number 499182). The averages are calculated by assigning a value of 25% of the regulatory limit when a sample was analyzed and the analyte was not detected.

(2) For some of the metals, the regulatory standard varies with the hardness of the receiving water. The regulatory standard presented is based on a hardness of 400 mg/L. The regulatory limit was calculated using a spreadsheet obtained from the DEQ.

(3) For the Kennecott wells no mercury data with a low detection limit was obtained. It was assumed the background mercury concentration would be similar to the JVWCD's well

ND = Not Detected
NA = Not Applicable

Table 12 Predicted Jordan River Water Quality – Summer
With 1.6 MGD of Concentrate (JVWCD Shallow Groundwater & KUC Zone B)
Discharged Below the CVWRF
Jordan River 234.1 cfs

	Jordan River Data[1]			Concentrate			Jordan River With Concentrate				Regulatory Compliance		
Parameter	Min mg/L	Average mg/L	Max. mg/L	JVWCD Shallow GW Source Concentration	KUC Zone B Source Concentration	Units	Added Concentration mg/L	Added River Load lbs/Day	Total River Concentration, mg/L	Total River Load, lbs/Day	Percent of Increase Over Back-ground, %	Regulatory Standard[2], mg/L	Comments
Alkalinity				1285	1375	mg/L	27.8	17156	27.8	0	NA		No Regulatory Limit
Aluminum	ND	0.0214	0.115	0.3	0.35	mg/L	0.0068	4.01	0.0282	27.0	31.7%	0.75	Within an Order of Magnitude of the Regulatory Limit
Arsenic	ND	0.0357	0.015	0.06	0.096	mg/L	0.0016	0.801	0.0373	45.1	4.6%	0.19	Within an Order of Magnitude of the Regulatory Limit
Barium	0.050	0.0635	0.078	0.13	0.09	mg/L	0.0023	1.74	0.0658	80	3.6%		No Regulatory Limit
Bicarbonate				1133	814	mg/L	20.37	15127	20.37	0	NA		No Regulatory Limit
Boron	ND			0.95	0.76	mg/L	0.0179	12.68	0.0179	0	NA	0.75	Order of Magnitude Below Regulatory Limit
Cadmium		0.001	0.001	0	0.0129	mg/L	0.000160683	0.0334	0.0012	1.26	16.1%	0.00440	Within an Order of Magnitude of the Regulatory Limit
Calcium		93.2		545	1612	mg/L	22.6	7276	116	117698	24.2%		No Regulatory Limit
Chloride	ND	213		847	951	mg/L	18.81	11308	232	268946	8.8%		No Regulatory Limit
Chromium	ND	0.0028	0.011	0	0.067	mg/L	0.0007	0	0.0035	3.49	25.3%	0.011	Within an Order of Magnitude of the Regulatory Limit
Copper		0.0114	ND	0	0.061	mg/L	0.0006	0	0.0120	14.4	5.6%	0.0516	Within an Order of Magnitude of the Regulatory Limit
Fluoride				0.89	1.81	mg/L	0.0283	11.88	0.0283	0	NA		No Regulatory Limit
Gross Alpha						pCi/L					NA	0.015	Order of Magnitude Below Regulatory Limit
Gross Beta						pCi/L					NA	0.05	Order of Magnitude Below Regulatory Limit
Hydrogen Sulfide						ug/L	0	0	0	0	NA	0.000002	Order of Magnitude Below Regulatory Limit
Iron	ND	0.097	0.45	0.26	6.48	mg/L	0.0705	3.47	0.1679	123.0	72.4%	1	Within an Order of Magnitude of the Regulatory Limit
Lead	ND	0.0056	0.01	0	46.5	ug/L	0.0005	0	0.0060	0.0070	8.8%	0.0286	Within an Order of Magnitude of the Regulatory Limit
Lithium				0	0.31	mg/L	0.0033	0	0.0033	0	NA		No Regulatory Limit
Magnesium				214	473	mg/L	7.19	2857	7.19	0	NA		No Regulatory Limit
Manganese	0.012	0.0282	0.075	0.04	0.43	mg/L	0.0049	0.534	0.0331	35.6	17.5%		No Regulatory Limit
Mercury[3]	0.000002	0.000003	0.000004	0.0125	0.0125	ug/L	2.62E-07	0.0003	0.00	0.0003	8.7%	0.000012	Within an Order of Magnitude of the Regulatory Limit
Molybdenum				0	48.5	ug/L	0.0005	0	0.0005	0	NA		No Regulatory Limit
Nickel				0	0.12	mg/L	0.0013	0	0.0013	0	NA	0.679	Order of Magnitude Below Regulatory Limit
Nitrate as N		2.65		15.5	10.43	mg/L	0.271	207	2.92	3340	10.3%	4	Within an Order of Magnitude of the Regulatory Limit
pH				7.6	0						NA		No Regulatory Limit
Phophorus, Ortho		0.948		0.15	0	mg/L	0.0148	18.8	0.963	1197	1.6%	50	Order of Magnitude Below Regulatory Limit
Potassium		11.8		23.18	30.5	mg/L	0.562	309	12.4	14947	4.7%		No Regulatory Limit
Selenium	ND	0.0014	0.005	20	20.5	ug/L	0.0004	0.267	0.0018	0.0018	30.4%	0.005	Within an Order of Magnitude of the Regulatory Limit
Silica as SiO2				149	113	mg/L	2.74	1989	2.74	0	NA		No Regulatory Limit
Silver	ND	0.002	0.002	0	9	ug/L	9.42E-05	0	0.0021	0.0025	4.7%	0.0041	Within an Order of Magnitude of the Regulatory Limit
Sodium				398	599	mg/L	10.43	5314	10.43	0	NA		No Regulatory Limit
Strontium				2.89	1.05	mg/L	0.0412	38.6	0.0412	0	NA		No Regulatory Limit
Sulfate				1361	4231	mg/L	58.5	18171	58.5	0	NA		No Regulatory Limit
TDS	360	914	1524	4156	8521	mg/L	132.6	55487	1046	1153516	14.5%	1200	Within an Order of Magnitude of the Regulatory Limit
Zinc	ND	0.0851	0.044	150	325	ug/L	0.0050	2.00	0.0901	0.1074	5.8%	0.457	Within an Order of Magnitude of the Regulatory Limit

(1) The river water quality is the average of the analytical data from the Jordan River at Cudahy AB South Davis WWTP sampling site (Storet Number 499182). The averages are calculated by assigning a value of 25% of the regulatory limit when a sample was analyzed and the analyte was not detected.

(2) For some of the metals, the regulatory standard varies with the hardness of the receiving water. The regulatory standard presented is based on a hardness of 400 mg/L. The regulatory limit was calculated using a spreadsheet obtained from the DEQ.

(3) For the Kennecott wells no mercury data with a low detection limit was obtained. It was assumed the background mercury concentration would be similar to the JVWCD's well

ND = Not Detected
NA = Not Applicable

Table 13 Predicted Jordan River Water Quality – Fall
With 1.6 MGD of Concentrate (JVWCD Shallow Groundwater & KUC Zone B)
Discharged Below the CVWRF
Jordan River 202.4 cfs

	Jordan River Data[1]			Concentrate			Jordan River With Concentrate				Regulatory Compliance		
Parameter	Min mg/L	Average mg/L	Max. mg/L	JVWCD Shallow GW Source Concentration	KUC Zone B Source Concentration	Units	Added Concentration mg/L	Added River Load lbs/Day	Total River Concentration, mg/L	Total River Load, lbs/Day	Percent of Increase Over Background, %	Regulatory Standard[2], mg/L	Comments
Alkalinity				1285	1375	mg/L	32.1	17156	32.1	0	NA		No Regulatory Limit
Aluminum	ND	0.0214	0.115	0.3	0.35	mg/L	0.0078	4.01	0.0292	23.4	36.6%	0.75	Within an Order of Magnitude of the Regulatory Limit
Arsenic	ND	0.0357	0.015	0.06	0.096	mg/L	0.0019	0.801	0.0376	39.0	5.3%	0.19	Within an Order of Magnitude of the Regulatory Limit
Barium	0.050	0.0635	0.078	0.13	0.09	mg/L	0.0027	1.74	0.0661	69	4.2%		No Regulatory Limit
Bicarbonate				1133	814	mg/L	23.52	15127	23.52	0	NA		No Regulatory Limit
Boron	ND			0.95	0.76	mg/L	0.0207	12.68	0.0207	0	NA	0.75	Order of Magnitude Below Regulatory Limit
Cadmium		0.001	0.001	0	0.0129	mg/L	0.000185546	0.0334	0.0012	1.09	18.6%	0.00440	Within an Order of Magnitude of the Regulatory Limit
Calcium		93.2		545	1612	mg/L	26.1	7276	119	101760	28.0%		No Regulatory Limit
Chloride	ND	213		847	951	mg/L	21.72	11308	235	232526	10.2%		No Regulatory Limit
Chromium	ND	0.0028	0.011	0	0.067	mg/L	0.0008	0	0.0036	3.01	29.2%	0.011	Within an Order of Magnitude of the Regulatory Limit
Copper		0.0114	ND	0	0.061	mg/L	0.0007	0	0.0121	12.4	6.5%	0.0516	Within an Order of Magnitude of the Regulatory Limit
Fluoride				0.89	1.81	mg/L	0.0326	11.88	0.0326	0	NA		No Regulatory Limit
Gross Alpha						pCi/L					NA	0.015	Order of Magnitude Below Regulatory Limit
Gross Beta						pCi/L					NA	0.05	Order of Magnitude Below Regulatory Limit
Hydrogen Sulfide						ug/L	0	0	0	0	NA	0.000002	Order of Magnitude Below Regulatory Limit
Iron	ND	0.097	0.45	0.26	6.48	mg/L	0.0814	3.47	0.1788	106.3	83.6%	1	Within an Order of Magnitude of the Regulatory Limit
Lead	ND	0.0056	0.01	0	46.5	ug/L	0.0006	0	0.0061	0.0061	10.1%	0.0286	Within an Order of Magnitude of the Regulatory Limit
Lithium				0	0.31	mg/L	0.0038	0	0.0038	0	NA		No Regulatory Limit
Magnesium				214	473	mg/L	8.30	2857	8.30	0	NA		No Regulatory Limit
Manganese	0.012	0.0282	0.075	0.04	0.43	mg/L	0.0057	0.534	0.0338	30.7	20.2%		No Regulatory Limit
Mercury[3]	0.000002	0.000003	0.000004	0.0125	0.0125	ug/L	3.02E-07	0.0003	0.00	0.0003	10.1%	0.000012	Within an Order of Magnitude of the Regulatory Limit
Molybdenum				0	48.5	ug/L	0.0006	0	0.0006	0	NA		No Regulatory Limit
Nickel				0	0.12	mg/L	0.0015	0	0.0015	0	NA	0.679	Order of Magnitude Below Regulatory Limit
Nitrate as N		2.65		15.5	10.43	mg/L	0.313	207	2.96	2887	11.8%	4	Within an Order of Magnitude of the Regulatory Limit
pH				7.6	0						NA		No Regulatory Limit
Phophorus, Ortho		0.948		0.15	0	mg/L	0.0170	18.8	0.965	1035	1.8%	50	Order of Magnitude Below Regulatory Limit
Potassium		11.8		23.18	30.5	mg/L	0.649	309	12.5	12922	5.5%		No Regulatory Limit
Selenium	ND	0.0014	0.005	20	20.5	ug/L	0.0005	0.267	0.0019	0.0015	35.1%	0.005	Within an Order of Magnitude of the Regulatory Limit
Silica as SiO2				149	113	mg/L	3.17	1989	3.17	0	NA		No Regulatory Limit
Silver	ND	0.002	0.002	0	9	ug/L	1.09E-04	0	0.0021	0.0022	5.4%	0.0041	Within an Order of Magnitude of the Regulatory Limit
Sodium				398	599	mg/L	12.05	5314	12.05	0	NA		No Regulatory Limit
Strontium				2.89	1.05	mg/L	0.0476	38.6	0.0476	0	NA		No Regulatory Limit
Sulfate				1361	4231	mg/L	67.6	18171	67.6	0	NA		No Regulatory Limit
TDS	360	914	1524	4156	8521	mg/L	153.2	55487	1067	997309	16.8%	1200	Within an Order of Magnitude of the Regulatory Limit
Zinc	ND	0.0851	0.044	150	325	ug/L	0.0057	2.00	0.0908	0.0929	6.7%	0.457	Within an Order of Magnitude of the Regulatory Limit

(1) The river water quality is the average of the analytical data from the Jordan River at Cudahy AB South Davis WWTP sampling site (Storet Number 499182). The averages are calculated by assigning a value of 25% of the regulatory limit when a sample was analyzed and the analyte was not detected.

(2) For some of the metals, the regulatory standard varies with the hardness of the receiving water. The regulatory standard presented is based on a hardness of 400 mg/L. The regulatory limit was calculated using a spreadsheet obtained from the DEQ.

(3) For the Kennecott wells no mercury data with a low detection limit was obtained. It was assumed the background mercury concentration would be similar to the JVWCD's well

ND = Not Detected
NA = Not Applicable

Table 14
Mercury Analytical Test Results
Jordan River [#] and JVWCD Main Office Well

Sampled Date	Mercury Concentration Well, ng/L	Mercury Concentration River, ng/L	MRL
06/22/2000	2	3	1
06/22/2000*	2	4	1
06/28/2000	3	4	1
07/06/2000	3	4	1
07/13/2000^	2	3	1
07/20/2000	2	2	1
07/26/2000	2	2	1
08/03/2000	1	3	1
08/10/2000^	2	3	1
08/16/2000	2	2	1

[#]The River was sampled near 7800 South crossing.
*Two samples collected on the same day.
^Samples were tested for MTBE and MIB/Geosmin but neither was detected.

Average Concentration in the Well = 2.1
Average Concentration in the River = 3

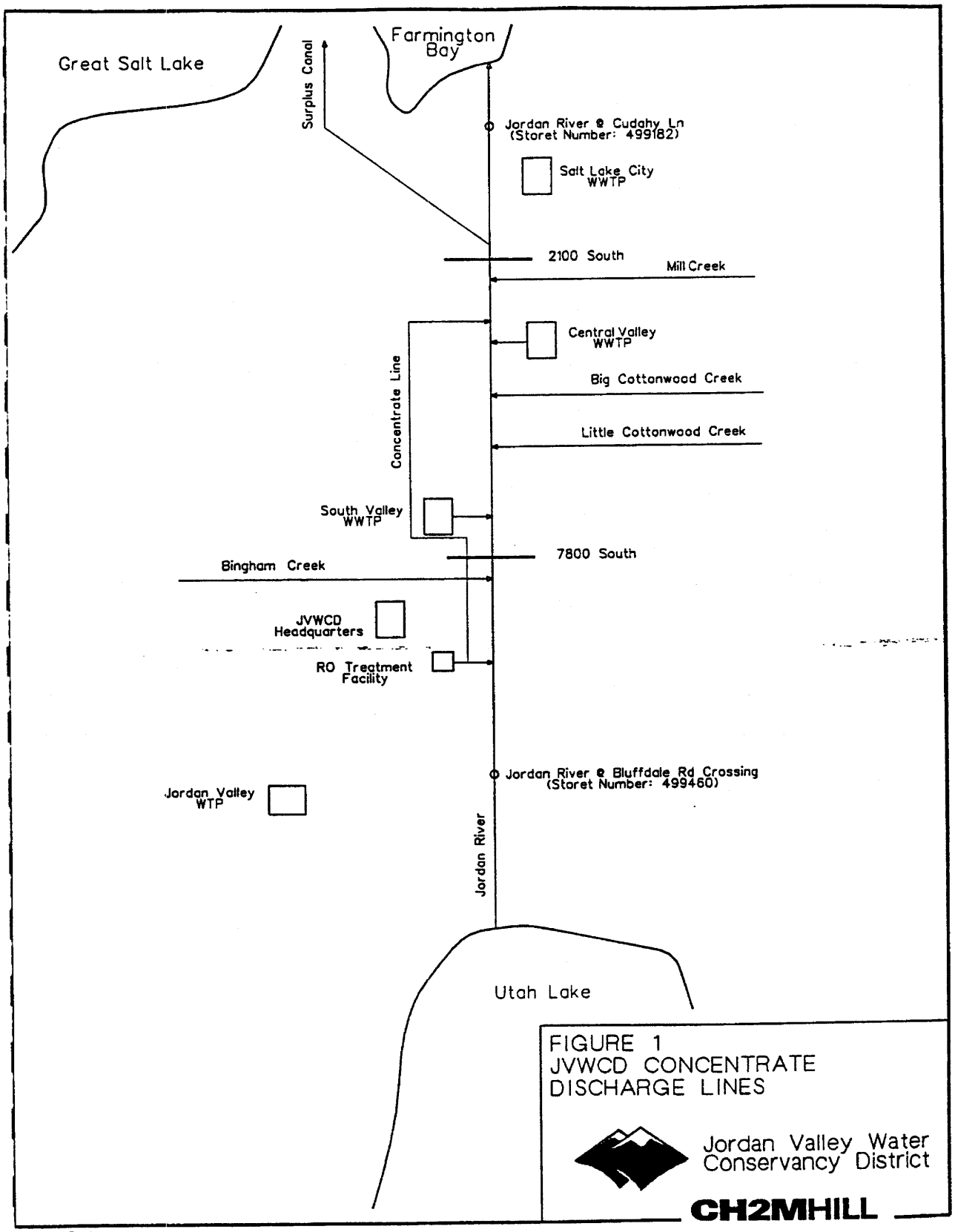

FIGURE 1
JVWCD CONCENTRATE DISCHARGE LINES

Jordan Valley Water Conservancy District

CH2MHILL

p:/158663/Fig 1.dgn

APPENDIX D

GROUNDWATER MODELING REPORT FOR KENNECOTT UTAH COPPER CORPORATION SOUTH FACILITIES GROUNDWATER PLUME SOUTHWESTERN JORDAN VALLEY, UTAH

REVISED FLOW AND TRANSPORT MODEL SOUTHWESTERN JORDAN VALLEY, UTAH

NOVEMBER 2000
(Revised: August 2003)

KENNECOTT UTAH COPPER CORPORATION

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EXECUTIVE SUMMARY

As part of additional studies related to a Remedial Investigation and Feasibility Study (RI/FS) of groundwater in the southwestern Jordan Valley (KUCC 1998), Kennecott Utah Copper Corporation (KUCC) has continued optimization of its groundwater flow and transport model while investigating possible remedial strategies for the Bingham Creek groundwater plume. This includes continual updating of model parameters and data in order to allow KUCC to more accurately analyze groundwater flow and contaminant migration.

KUCC has made improvements to the original flow and transport model used in the RI/FS investigations, including incorporation of a head-dependent (general head) boundary along the western edge of the model that replaced the constant flux boundary used in the original model. Also, the eastern model boundary was expanded from the Jordan River east to the base of the Wasatch Mountains. Updated field data were also incorporated into the current flow and transport model.

KUCC's current expanded sub-regional model of the southwestern Jordan Valley is bounded by the Oquirrh and Traverse mountains on the west and south and by the Wasatch Mountains and approximately 6000 South Street on the east and north. The model contains a grid of 94 rows and 136 columns, with variably sized cells and eight vertical layers.

The model incorporates recharge to the principal and shallow unconfined aquifers from the following sources:

- precipitation
- bedrock aquifer
- irrigation canals
- irrigated fields, lawns and gardens
- stream and channel fill
- reservoirs and evaporation ponds.

Discharge sources include extraction from wells, evapotranspiration and head-dependent boundaries (KUCC 1998).

KUCC recalibrated the expanded model for steady and transient states in the same manner as in the RI/FS study. The steady state simulated hydrologic conditions in 1965. The transient state simulated the period 1966-1998, and included annual stress periods. Calibration variables were adjusted within reasonable ranges, as determined from data collected from the RI/FS and other work. The calibration process is considered successful when a reasonable match is made between observed and modeled conditions for the years being simulated.

The calibrated model closely matched observed water-level declines, estimated flow exchange to the Jordan River, computed flows through the northern and eastern boundaries, sulfate concentrations and vertical hydraulic gradients throughout the modeled area. It is therefore considered to be a useful tool for predicting flow and contaminant transport for the SWJV.

Many potential remedial responses have been investigated with the updated flow and transport model since the publication of the RI/FS. The primary remedial strategy involves increased

extraction between the region of the acid extraction well ECG1146 and the sulfate extraction wells K109/B2G1193. All scenarios have used combined West Jordan municipal pumping rates of 2500 gallons per minute (gpm) for their four production wells W420, W361, W363 and W387 while Riverton municipal pumping was increased to 3500 gpm. West Jordan and Riverton municipal wells were changed in the model to more closely resemble seasonal pumping by incorporating extraction over a six-month period for each year and off for the other six-months. K109 and B2G1193 were pumped at constant rates of 1000 and 500 gpm respectively for all scenarios. Other KUCC extraction wells incorporated in the model include the Lark production well LTG1139 (average extraction of 250 gpm), sulfate extraction well LTG1147 (average extraction of 500 gpm). KUCC acid extraction well ECG1146 and four other proposed acid wells were modeled with varied pumping rates and durations, always totaling 2500 gpm combined (additional scenarios for acid pumping extraction between 2500 to 4000 gpm were investigated, but not included in this report). The north shoulder well was assumed to be off for these simulations.

1.0 INTRODUCTION

1.1 Background

The expanded predictive model was developed to provide a tool for better estimation of regional groundwater flow and contaminant transport as part of the continuing studies for the Kennecott Utah Copper Corporation (KUCC) Remedial Investigation and Feasibility Study (RI/FS) of groundwater in the southwestern Jordan Valley, Utah. The area of the expanded RI/FS model is shown in Figure 1.

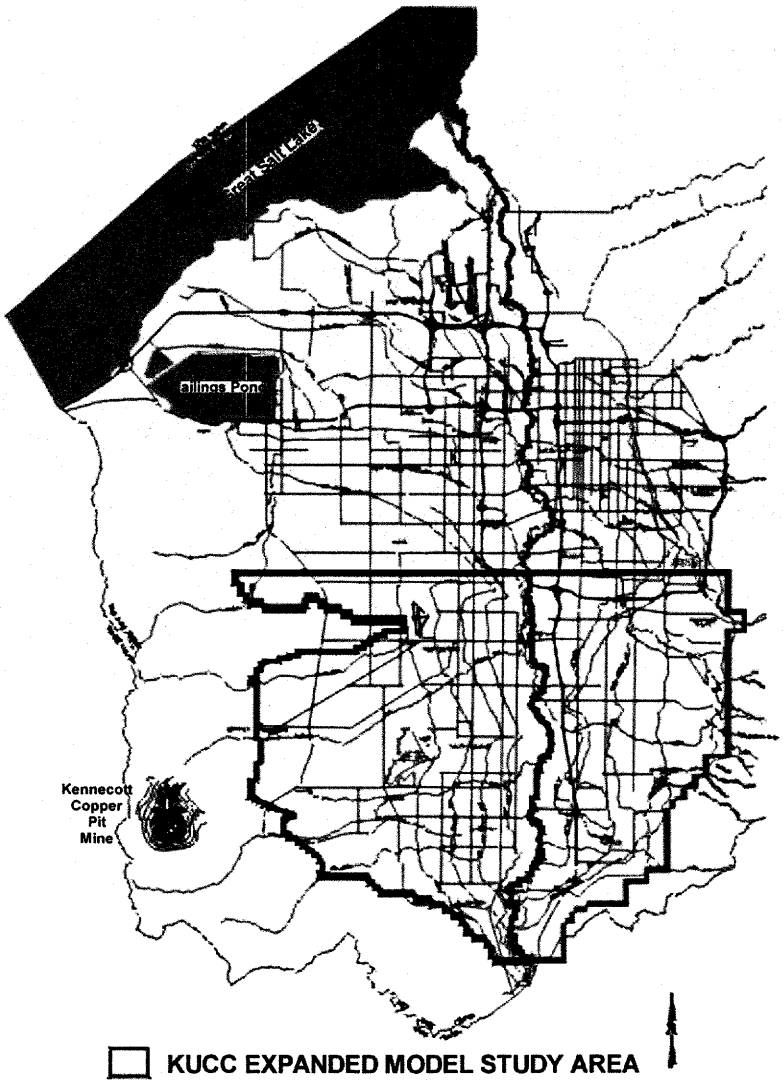

Figure 1: Expanded predictive flow model location map

1.2 Modeling Codes

The groundwater flow model was developed using the finite difference, modular, three-dimensional groundwater flow model MODFLOW (McDonald and Harbaugh 1988) coupled with MT3D (Zheng 1996), which is a three-dimensional transport code. MODFLOW was developed by the U.S. Geological Survey to approximate flow within a groundwater flow system. MT3D is a transport model that combines groundwater flow with the physical aspects of contaminant transport, including advection, dispersion and chemical reactions.

2.0 MODELING APPROACH

2.1 Purpose and Scope

The purpose of this report is to summarize the changes and updates incorporated into the KUCC South Facilities expanded flow and transport model since publication of the KUCC South Facilities RI/FS in 1998.

The primary reason for continuing to update the KUCC flow and transport groundwater model in this region is that comparison of current field conditions with 1996 data shows that the Bingham Canyon groundwater contamination has migrated. In order to provide a better estimation for possible containment scenarios within the model, updates to the model data need to be continually incorporated to provide higher confidence possible for modeling remedial actions.

This report focuses on the main issues of concern raised by the RI/FS Technical Review Committee (TRC) about the original RI/FS model including: the use of an upgradient constant-flux boundary, the Jordan River as a groundwater flow divide, the lack of a transport code capable of simulating density-driven flow and changes in the lengths of the stress periods to more accurately simulate seasonal well pumping. These previous modeling limitations were discussed in the RI/FS as well as in the modeling reports included in the RI/FS appendices.

2.2 Current Model Status

The current model has undergone the following major changes since March 1998:

1) Incorporation of an upgradient head-dependent boundary along the western margin
2) Expansion of the model's eastern boundary to extend from the Jordan River (previously modeled as a groundwater flow divide) to the base of the Wasatch Mountains
3) Change of simulation stress periods to six months to better emulate seasonal pumping
4) Integration of new data to provide the most recent and accurate information.

In addition, construction of a three-dimensional finite grid using the model code FEMWATER (developed by George T. Yeh) is underway. In addition, FEMWATER will provide a means to incorporate possible effects of density-driven flow for the acid portion of the Bingham Creek groundwater plume.

2.3 Head-Dependent Western Boundary

The specified-flux boundary was replaced by a head-dependent (or "general head") boundary along the model's western margin. This was done because a model with a fixed flux is likely to over-predict the effectiveness of containment scenarios in transport simulations.

Evaluation of the new head-dependent boundary involved assessing:

- horizontal exchange through the northern head-dependent boundary
- flow comparisons for the Jordan River reaches
- potentiometric surfaces
- drawdown maps
- calibration statistics.

Horizontal flow exchange (in versus out of the model) were compared to Hely and others (1971), as well as USGS and the previous KUCC model. Jordan River flow was investigated simultaneously with horizontal exchange to achieve a balanced representation between these two parameters. Evaluation of potentiometric maps, flow directions and drawdown for both the steady-state and transient calibrations yielded no notable problems.

The following table outlines the statistics of the current model's head-dependent western boundary. The zones mentioned in Table 1 are superimposed on model layer 3 and shown in Figure 2.

Table 1. Western Specified Flux Boundary vs. the Current Head-Dependent Boundary.

	Specified Flux Flow into the Model (cubic feet per day)	Head-Dependent (Percent Difference vs. Specified Flux)	
		Year 1	Year 50
Zone 1 (Layer 3)	729,972	-6.9	-2.2
Zone 2 (Layer 3)	269,500	1.8	11.7
Zone 3 (Layer 3)	292,994	4.1	5.0
Zone 1 (Layer 4)	187,960	4.5	56.8
Zone 2 (Layer 4)	70,190	5.7	13.5
Zone 3 (Layer 4)	195,510	7.5	17.2

The results of these comparisons show that as drawdown in the western portion of the model increases, flow into the model from this boundary also increased due to the increased gradient as expected compared to the characteristics of the original constant flux boundary.

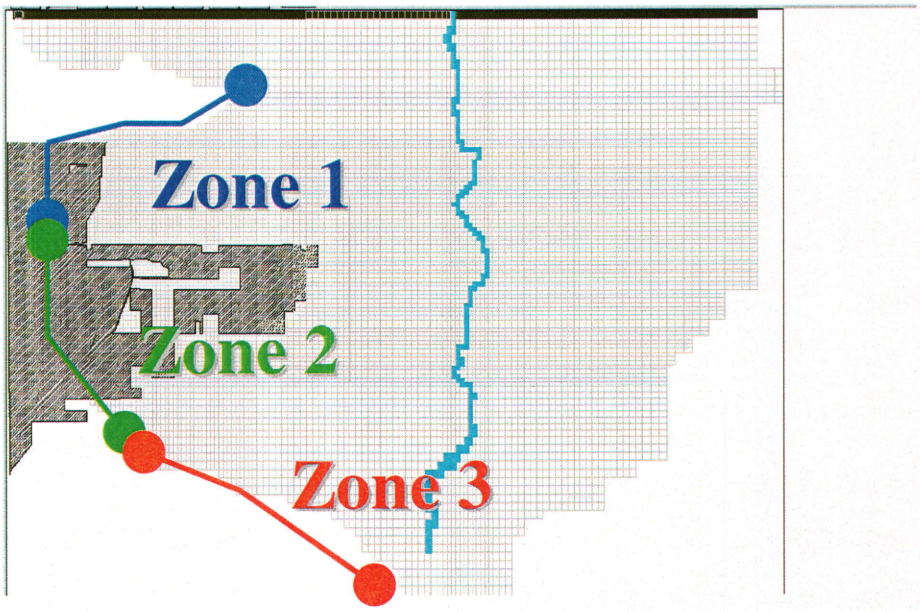

Figure 2: Evaluation zones for flow used in comparing head-dependent vs. specified flux boundaries

2.4 Eastern Boundary Model Expansion

Following incorporation of the head-dependent western boundary, the next step in updating the original RI/FS model involved expanding the model's eastern boundary from the Jordan River to the base of the Wasatch Mountains. This increased the number of columns in the model from 104 to 136. Figure 3 shows a comparison of the original eastern margin compared to the revised model.

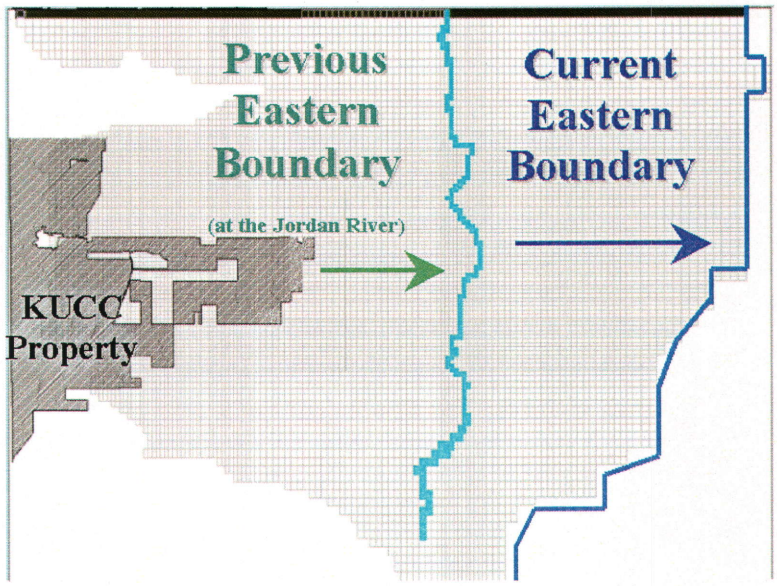

Figure 3: Revised model's expanded eastern boundary

Evaluation of the revised model following expansion of the eastern boundary involved assessing:

- horizontal exchange through the northern head-dependent boundary
- flow comparisons for the Jordan River reaches
- potentiometric surfaces
- drawdown maps
- calibration statistics.

Recalibration of the expanded model was done upon completion of model expansion as discussed in Section 2.5.

2.5 Revised Model Calibration

The KUCC model was calibrated for steady-state and transient-state conditions. Calibration of the model was completed in the same manner as in the original RI/FS. This involved an iterative process between steady and transient calibrations because of a shortage of data describing the steady-state condition of the aquifer. The calibration process focused on adjusting calibration variables to produce a reasonable match with observed water levels and estimated recharge and discharge sources within the principal and unconfined aquifers. The following sections describe steady- and transient-state calibrations for the revised KUCC model.

2.5.1 Steady-State Calibration

The steady-state calibration was directed towards achieving a reasonable match with the available measured water levels, estimated discharge to the Jordan River and the component of flow through the general-head boundaries. Vertical gradients were not considered during steady-state calibration due to the absence of data for comparison. The main parameters used as calibration variables were conductance and head values for incorporation of the western head-dependant boundary. Other calibration variables in the steady-state calibration also were investigated, including horizontal and vertical hydraulic conductivity, and areal and bedrock recharge. Irrigation and lawn watering seepage, irrigation canals seepage, river boundary parameters were not used as calibration variables. Much of the calibration process focused on the effects in the revised model due to differences in inflow from the head-dependent western margin.

Throughout the calibration process, results from each model run were compared with the available measured water levels found in the KUCC model domain. For the steady-state calibration, a total of 32 observation sites were available, all of which were located in the principal aquifer in layers 3 and 4. Data were not available within the study area for the water table within the shallow unconfined aquifer; data from the original RI/FS model were used as the default. The shallow unconfined aquifer could only be analyzed by evaluating the groundwater contribution to the Jordan River.

For each model run, a statistical analysis of the observed versus computed water levels was conducted to determine the accuracy of the simulation. Three methods were used for determining the level of accuracy. The first method involved calculating the mean of the residuals. This provides a measure of the bias of the distribution, indicating whether the simulation was over- or

under-estimating the water table as a whole. The second method involved the calculation of the root mean square or standard deviation of the residuals, which provides a measure of the squared differences in measured and computed water levels. The third method involved calculating the standard error between the observed and computed values. The standard error calculates the mean of the absolute values of the residuals. This provides a more realistic measure of the average difference between the observed and computed values.

Calibration targets for the observed versus computed heads were established by evaluating several parameters in each area of the model domain. The horizontal gradient was considered to be the most critical due to the steep water table along the western edge of the model domain. Flows from the shallow unconfined aquifer discharging to the Jordan River were also addressed in the steady-state calibration.

Another calibration target set for the steady-state calibration involved accurately representing flow through the northern model boundary. Flows through this boundary could not be independently calculated due to a lack of data concerning the geometry of the aquifer and the associated aquifer properties. The only basis for calibration was a comparison with the USGS model. This comparison was undertaken by comparing the total flow discharging from the model with the percentage leaving the northern boundary. A calibration target of ± 5 percent of the computed values of the USGS model was determined to be acceptable for calibration.

Results of the steady-state calibration for 32 modeling points comparing the original RI/FS modeling results to the current head-dependent expanded model are shown in Table 2. Calibration data was very comparable to results seen from the original RI/FS modeling calibration.

Table 2. Steady-State Flow Model Calibration Results (data in feet).

	Original RI/FS Model	Revised Model
Average Mean Error	NA	7.1
Average Mean Absolute Error	11.2	11.4
Root Mean Squared Error	14.5	14.7
Single Max. Difference Lower than Measured	37.0	26.9
Single Min. Difference Higher than Measured	32.0	45.3

2.5.2 Transient-State Calibration

The transient-state calibration relied predominately on matching the observed water level changes that have occurred within the SWJV from 1965 to 1998 with the original RI/FS modeling results. Extreme water-level declines have occurred within the modeled area due to excessive pumping of groundwater for municipal and industrial needs. The transient-state model also focused on estimating the leakage rates from the former Large Bingham Reservoir located at the mouth of Bingham Canyon. Groundwater discharge to the Jordan River, flow through the northern boundary and vertical gradients were also examined throughout the transient-state

calibration. Parameters treated as calibration variables included horizontal and vertical hydraulic conductivity, specific yield, storage coefficient and the recharge to the aquifer from the Large Bingham Reservoir.

Throughout the transient-state calibration, any changes made to the hydraulic conductivity fields required the steady-state simulation to be rerun. The transient-state calibration was used to identify problems with the steady-state calibration that could not be identified previously due to lack of data for describing the steady-state condition. Specific yield and storage coefficient estimates generated from the aquifer pump tests provided initial estimates for material types found within the study area. These values were modified in some situations to provide a better match with observed conditions. Model-computed results were compared to observed conditions through development of hydrographs for various locations throughout the study area. The calibration process provided the ability to examine the overall response of the model to a range of values for the parameters being considered as variables. The transient-state calibration concluded when a reasonable match was observed between computed and measured values. Figures 5-8 (see Attachments) are time series graphs for a sample of the 32 locations by which the transient simulations were judged. The simulations were compared versus observed data, the USGS model and the original RI/FS model.

2.5.3 Model Sensitivity

Classifications of previous sensitivity analyses for the original RI/FS model were followed and showed that parameters fit into three groups; sensitive, moderately sensitive and insensitive. Model parameters termed as sensitive included areal recharge, bedrock recharge and the horizontal hydraulic conductivity representing the principal aquifer. Increasing or decreasing the magnitude of the parameters termed as sensitive caused the model to produce erroneous results. The model responded by over- or under-predicting the water-level elevation or computing unacceptable discharge values to the Jordan River. Model parameters termed as moderately sensitive included specific yield, storage coefficient and the vertical hydraulic conductivity representing the principal aquifer. Modifying the magnitude of these parameters caused computed values to slightly deviate from observed conditions. Model parameters termed as insensitive included riverbed conductance, horizontal hydraulic conductivity of the shallow unconfined aquifer and vertical hydraulic conductivity of the shallow unconfined aquifer. When modifications were made to these parameters, computed results did not deviate from the observed conditions. This response indicates that a range of values are likely acceptable, along with exemplifying the potential for a non-uniqueness solution.

3.0 CURRENT MODELING RESULTS

3.1 Current Bingham Creek Groundwater Remediation Scenario

The current expanded head-dependent model has been used primarily to investigate possible remedial strategies for the Bingham Creek groundwater plume. Predictive modeling runs for 50 years have been investigated.

Table 3. Extraction Rates for the Proposed Remedial Strategy.

Well *(For ID/location, see attached figures)*	**Model Layer***	**Pumping Rate (gpm)**	**Years**
Acid Well (ECG1146)	4	1250	0-5
New Acid Well #1	4	750	6-15
New Acid Well #2	4	1250	0-30
New Acid Well #3	4	Varied †	6-50
New Acid Well #4	4 (50%), 5 (50%)	Varied ††	15-50
K109	4	167	0-50
K109	5	667	0-50
K109	6	166	0-50
B2G1193	4	65	0-50
B2G1193	5	435	0-50

* **Layer 3 is approximately 0 – 150 feet below the groundwater table**
Layer 4 is approximately 150 - 300 feet below the groundwater table
Layer 5 is approximately 300 – 450 feet below the groundwater table
Layer 6 is approximately 450 – 650 feet below the groundwater table
† **Varied Pumping: Years 6-30, 500 gpm; Years 31-50, 1250 gpm**
†† **Varied Pumping: Years 16-30, 750 gpm; Years 31-50, 1250 gpm**

Placement of these wells is shown below in Figure 4.

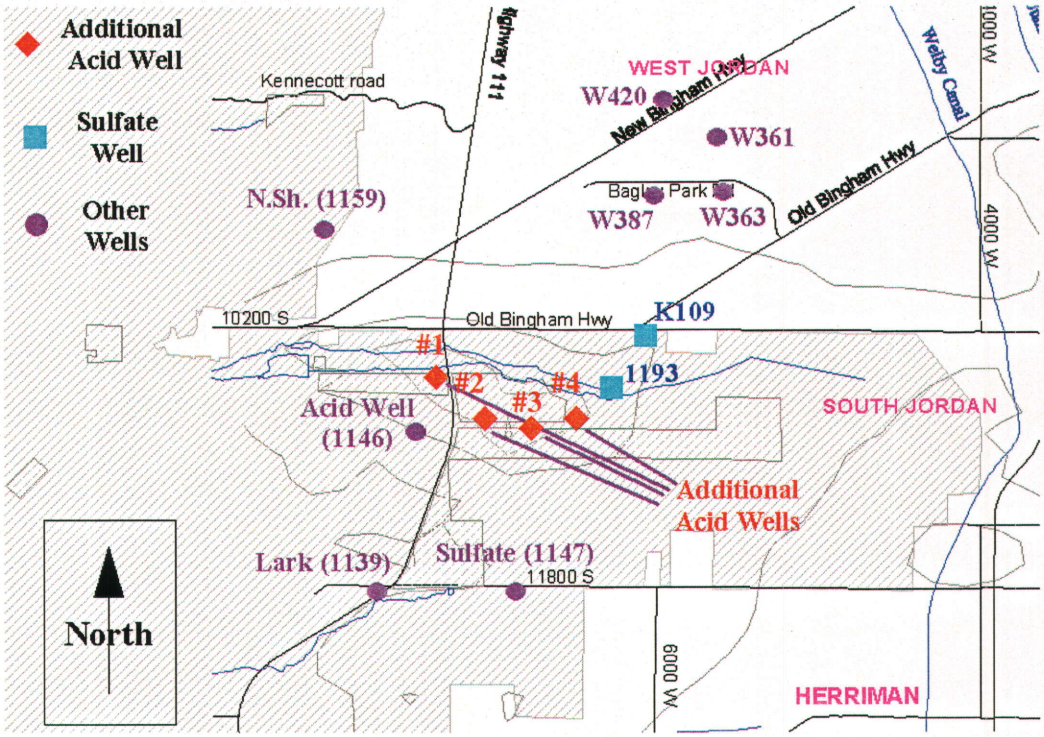

Figure 4: Current modeling scenario well placement locations

KUCC extraction at wells K109 and B2G1193 (K60 replacement well) and ECG1146 (Acid Well) are listed in Table 3 for the most current remediation strategy in coordination with the

proposed Natural Resource Damage plan. Additional KUCC pumping in this scenario included Lark production well LTG1139 pumping 250 gpm (from model layers 5, 6 and 7) and the sulfate extraction well LTG1147 pumping 500 gpm (from model layers 5 and 6). Extraction rates at the KUCC wells for this scenario were assumed to remain operative year-round for predictive model simulations.

All scenarios have used identical combined West Jordan municipal pumping of 2500 gallons per minute (gpm) from production wells W420, W361, W363 and W387. West Jordan municipal wells were changed in the current expanded model to more closely resemble seasonal pumping by incorporating extraction over a six-month period for each year and off for the remaining months. Riverton municipal pumping was increased to average 5600 acre-feet per year (afy) (3500 gpm) and like the West Jordan municipal wells, was also changed to mimic seasonal pumping. K109 and B2G1193 were pumped at constant rates of 1000 and 500 gpm respectively for all scenarios.

Additionally, model-simulated pumping in the Zone B plume was incorporated into the aforementioned modeling scenarios. The extraction in this zone was distributed between model layers 3 and 4 at seven individual well locations (see attached figures). Wells number 1 through 6 were assigned pumping rates of approximately 235 gpm each, and the seventh well was assigned pumping of 1200 gpm for a total of 2610 gpm (about 4200 afy). Pumping at these locations was designed to balance containment and contraction of the Zone B sulfate plume with regard to minimizing drawdown of the groundwater table.

4.0 LIMITATIONS OF THE MODELING

The hydrogeologic system in this area is complex and can only be approximated in the modeling. As a result, techniques directed toward smoothing and weighting collected data were required to incorporate the actual properties found within the groundwater system as described in the RI report (KUCC 1998).

The KUCC model is currently being updated to model variable density groundwater flow. Changes in plume movement due to density-driven flow could have a notable effect on any numerically modeled remediation system.

5.0 CONCLUSIONS

The KUCC model has been revised as part of the continuing effort to provide an improved means for analysis of flow and contaminant transport in the SWJV. This model incorporated previous hydrologic investigations and modeling studies related to the study area along with the data gathered by KUCC personal and consultants for the RI/FS. As with the previous RI/FS modeling, the revised model was developed and calibrated using the finite difference, modular, three dimensional groundwater flow model MODFLOW (McDonald and Harbaugh, 1988). Following calibration, the flow model was coupled with the contaminate transport code MT3D (Zheng 1996) to simulate the movement of sulfate, particularly focusing in the area of Bingham Creek.

The model was calibrated for steady-state and transient-state conditions in the same manner as the original RI/FS model. The steady-state simulations were developed to represent conditions in

1965. The transient-state simulation represents conditions from 1966-1998 with the results of the steady-state calibration being used for initial conditions.

The revised KUCC southwestern Jordan Valley model was represented with a variable space grid comprised of 104 rows by 136 columns. Cells sizes ranged from 500 ft by 500 ft in the vicinity of the Bingham Reservoir sulfate plume and Jordan River to 1000 ft by 1224 ft at the southern edge of the model domain.

The revised model has the same vertical layer distribution as the original RI/FS model. The aquifer was divided into 8 layers. Layer 1 represented the shallow unconfined aquifer located in the eastern part of the study area. Layer 2 represented the confining layer, separating the shallow unconfined and principal aquifer, and layers 3-8 represented the principal aquifer. The model incorporated specified flux cells to represent: seepage from irrigation canals, areal precipitation, infiltration of unconsumed irrigation water from fields, lawns and gardens, seepage from the Bingham Creek reservoir and KUCC evaporation ponds, and underflow at Bingham Canyon, Butterfield Canyon and the Jordan Narrows. Industrial, municipal, stock and domestic wells were also represented with specified flux cells. Head-dependent flux boundaries were incorporated at the northern model boundary and the Jordan River to simulate flow into and out of the model domain at these locations. The specified flux boundary was replaced in the revised model by a head-dependant boundary for a more accurate representation of bedrock recharge along that margin.

Steady-state calibration involved matching computed and observed conditions for the following: 1) water levels, 2) discharge to the Jordan River, and 3) discharge through the northern model boundary. The calibration process involved varying the head-dependent western margin parameters within probable ranges until a reasonable match with the above-mentioned conditions was achieved between Hely and others (1971), USGS and KUCC data. The results of the steady-state calibration showed a reasonable match was achieved for water levels throughout the model domain. Calibration of discharge to the Jordan River was shown to be in line with estimates made by Hely and others (1971), but slightly lower overall discharge than the USGS model. Discharge through the northern boundary was observed to be in line with computed values in the USGS model and other estimates.

The transient-state calibration relied on matching the following: water-level changes, discharge to the Jordan River, discharge through the northern boundary, and vertical hydraulic gradients throughout the model domain. Hydrographs of computed water levels were found to match observed water-levels changes through most of the modeled area. Discharge to the Jordan River provided a reasonable match with previous estimates, but was found to slightly over predict computed values from the USGS model. Model computed vertical hydraulic gradients matched the observed directions and provided a reasonable match with the observed magnitude of the gradient.

Classifications of previous sensitivity analyses for the original RI/FS model were followed and showed that parameters fit into three groups; sensitive, moderately sensitive and insensitive. Model parameters termed as sensitive included areal recharge, bedrock recharge and the horizontal hydraulic conductivity representing the principal aquifer. Model parameters termed as insensitive included riverbed conductance, horizontal hydraulic conductivity of the shallow unconfined aquifer and vertical hydraulic conductivity of the shallow unconfined aquifer.

Overall, the revised KUCC model shows improvements to the original RI/FS model including an expanded modeling area and improvements in the parameters for the western margin bedrock recharge. The model closely simulated observed water-level declines, estimated discharge to the Jordan River, computed flows through the northern boundary, and vertical hydraulic gradient throughout the modeled area. It is therefore considered to be an improved tool for predicting flow and contaminant transport for the Jordan Valley.

6.0 REFERENCES

Hely, A. G., Mower, R. W., and Harr, C. A., 1971, Water resources of Salt Lake County, Utah: State of Utah Department of Natural Resources Technical Publication No. 31.

Kennecott Utah Copper Corporation (KUCC), 1998, Final draft remedial investigation report for Kennecott Utah Copper south facilities groundwater plume, south Jordan Valley, Utah: Version B, March, variously paged.

McDonald, M.G., and Harbaugh, A.W., 1988, A modular three-dimensional finite-difference groundwater flow model: U.S. Geological Survey Techniques of Water Resources Investigation, book 6.

Zheng, C., 1996, MT3D a modular three dimensional transport model for simulation of advection, dispersion, and chemical reactions of contaminants in groundwater systems: S. S. Papadopolus and Assoc., Inc.

Attachments

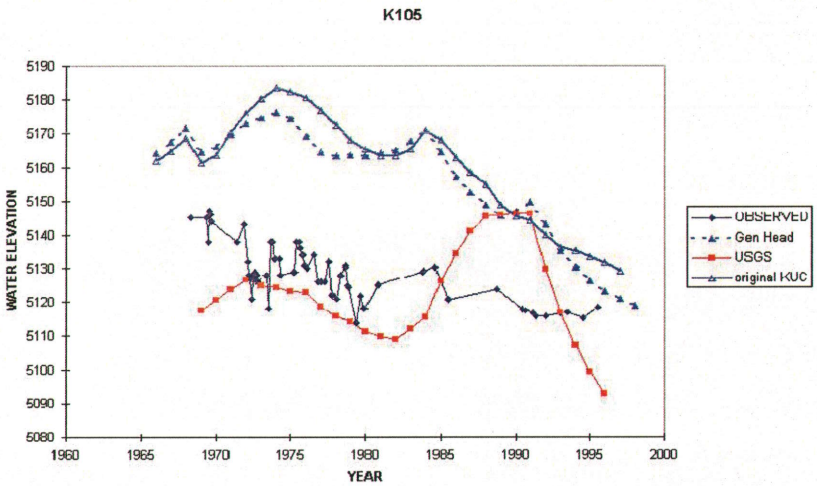

Figure 5. Transient calibration comparison at well K105.

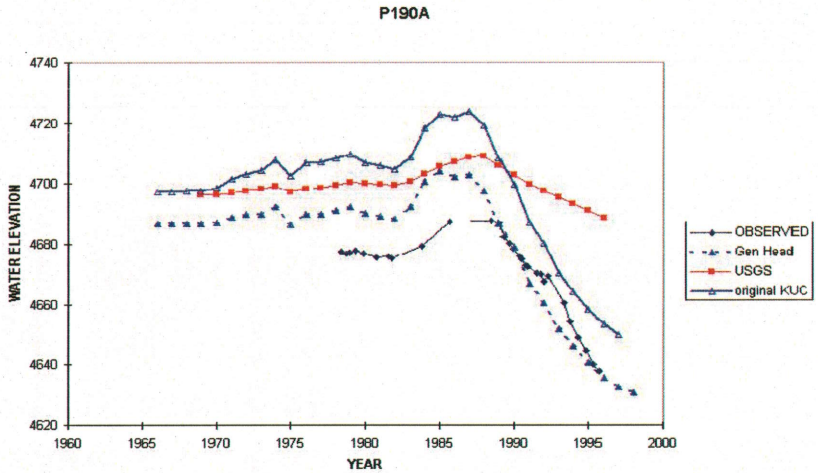

Figure 6. Transient calibration comparison at location P190A.

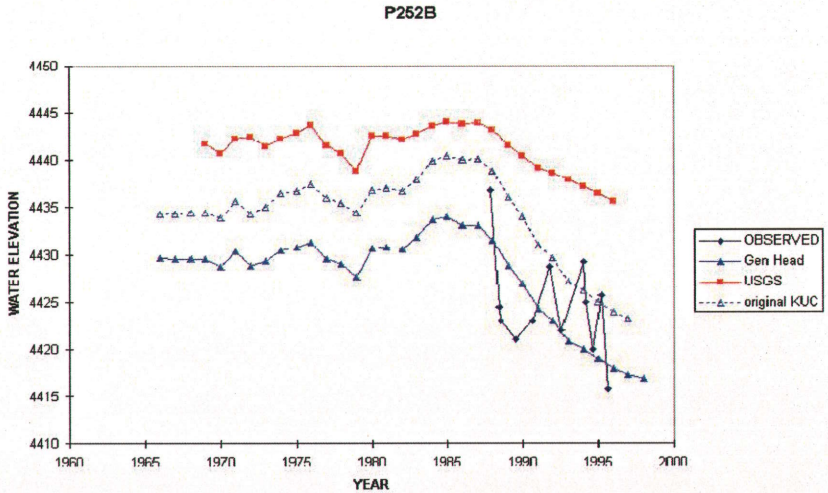

Figure 7. Transient calibration comparison at well P252B.

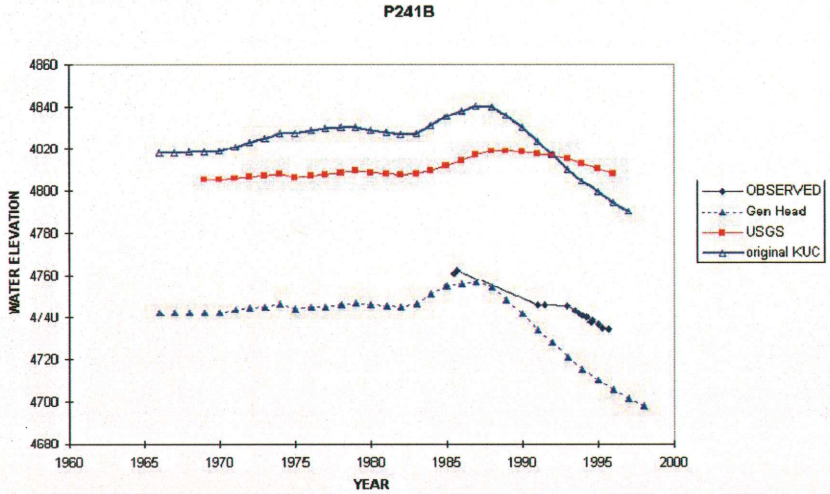

Figure 8. Transient calibration comparison at location P241B.

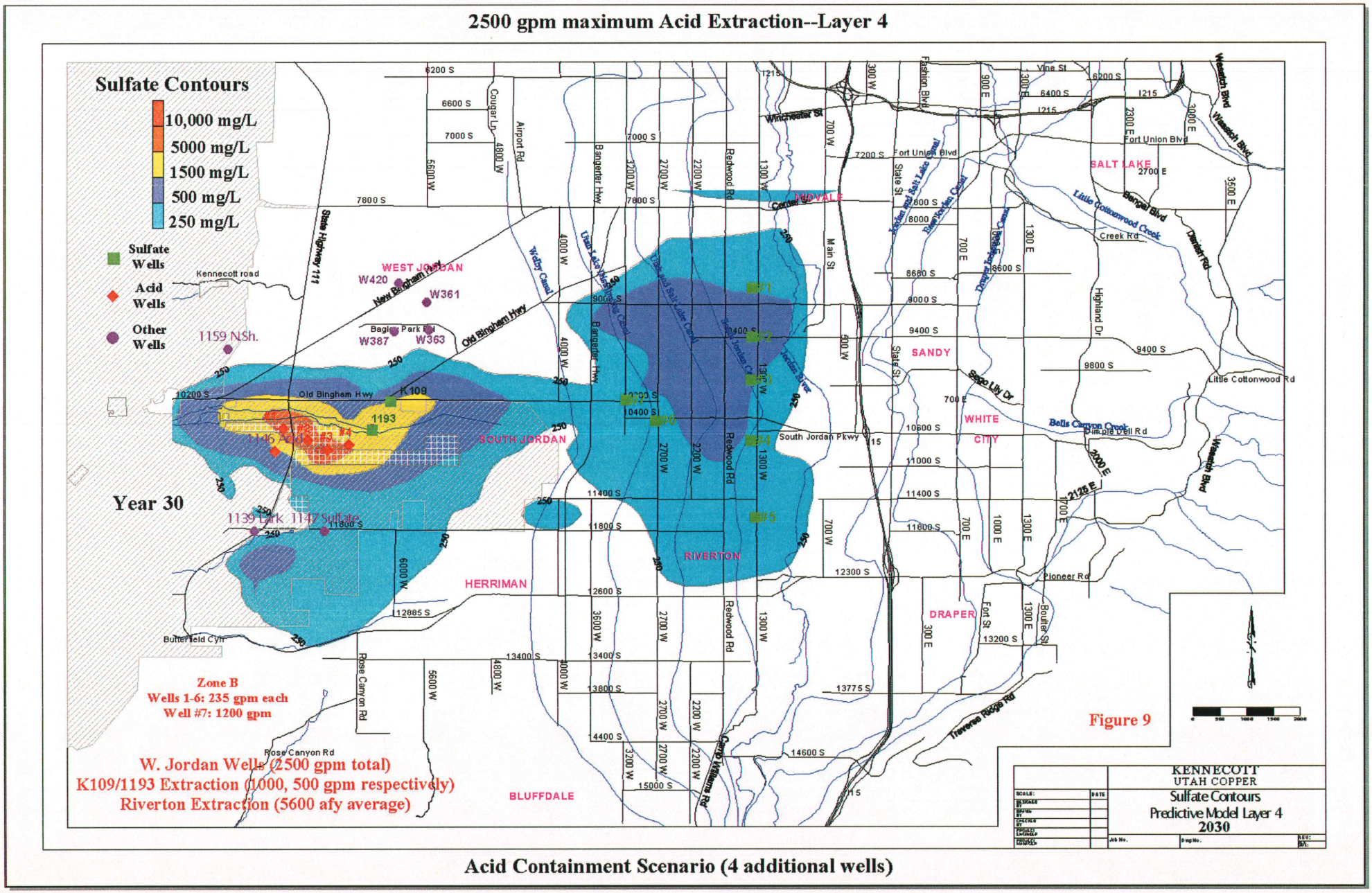

Figure 9. Predictive model sulfate values for the current acid containment scenario in year 2030.

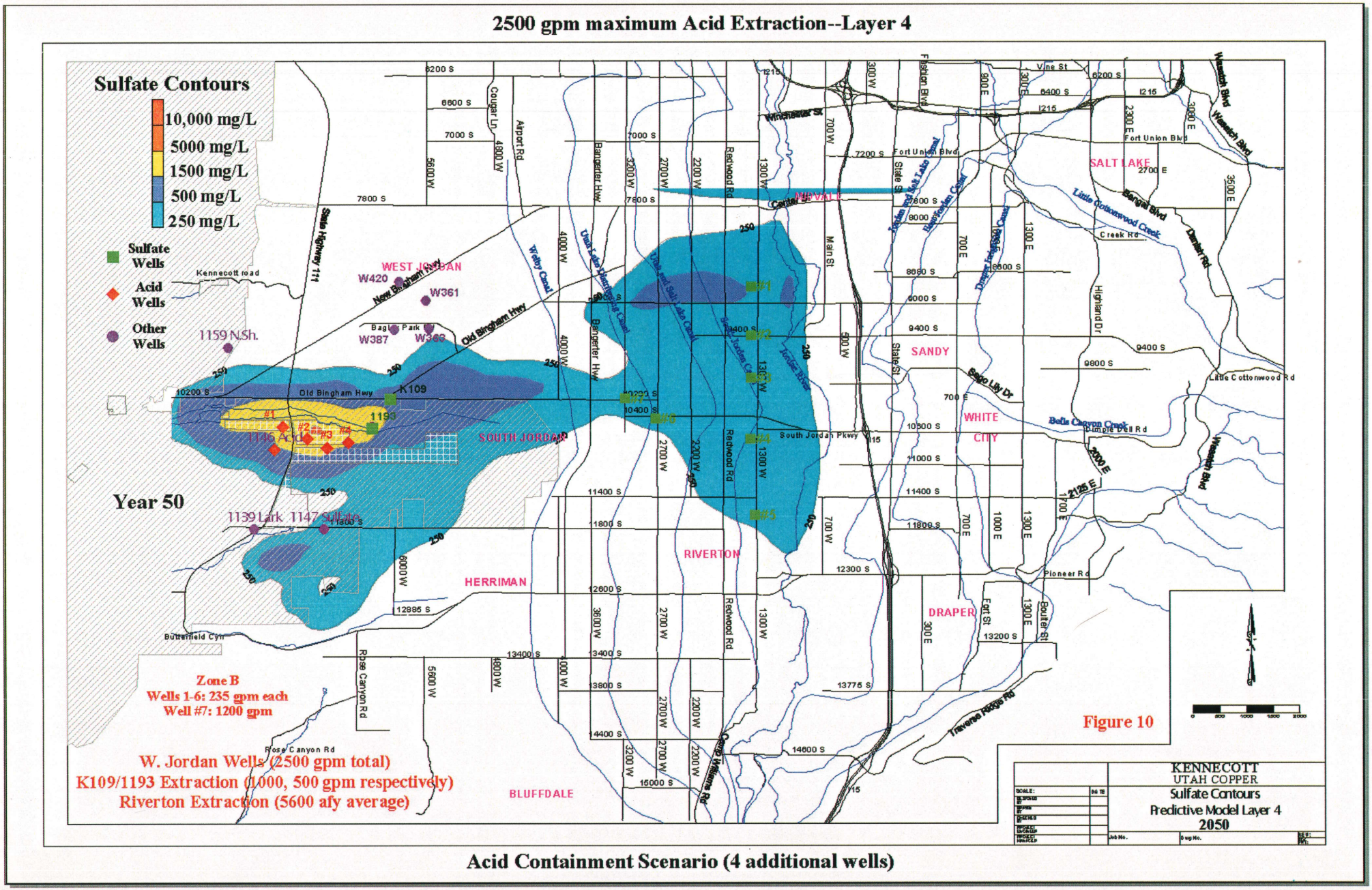

Figure 10. Predictive model sulfate values for the current acid containment scenario in year 2050.

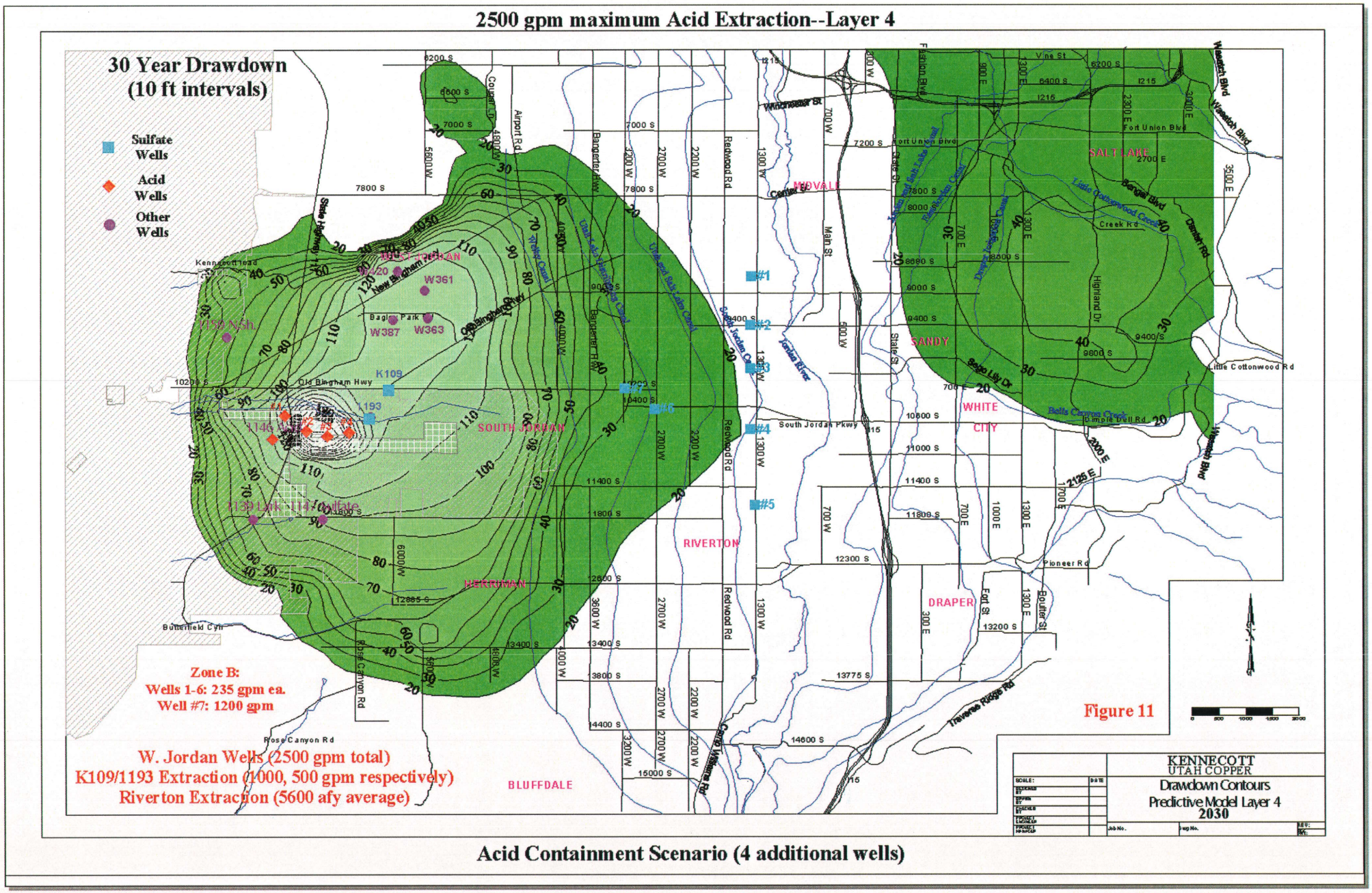

Figure 11. Predictive model draw down values for the current acid containment scenario in year 2030.

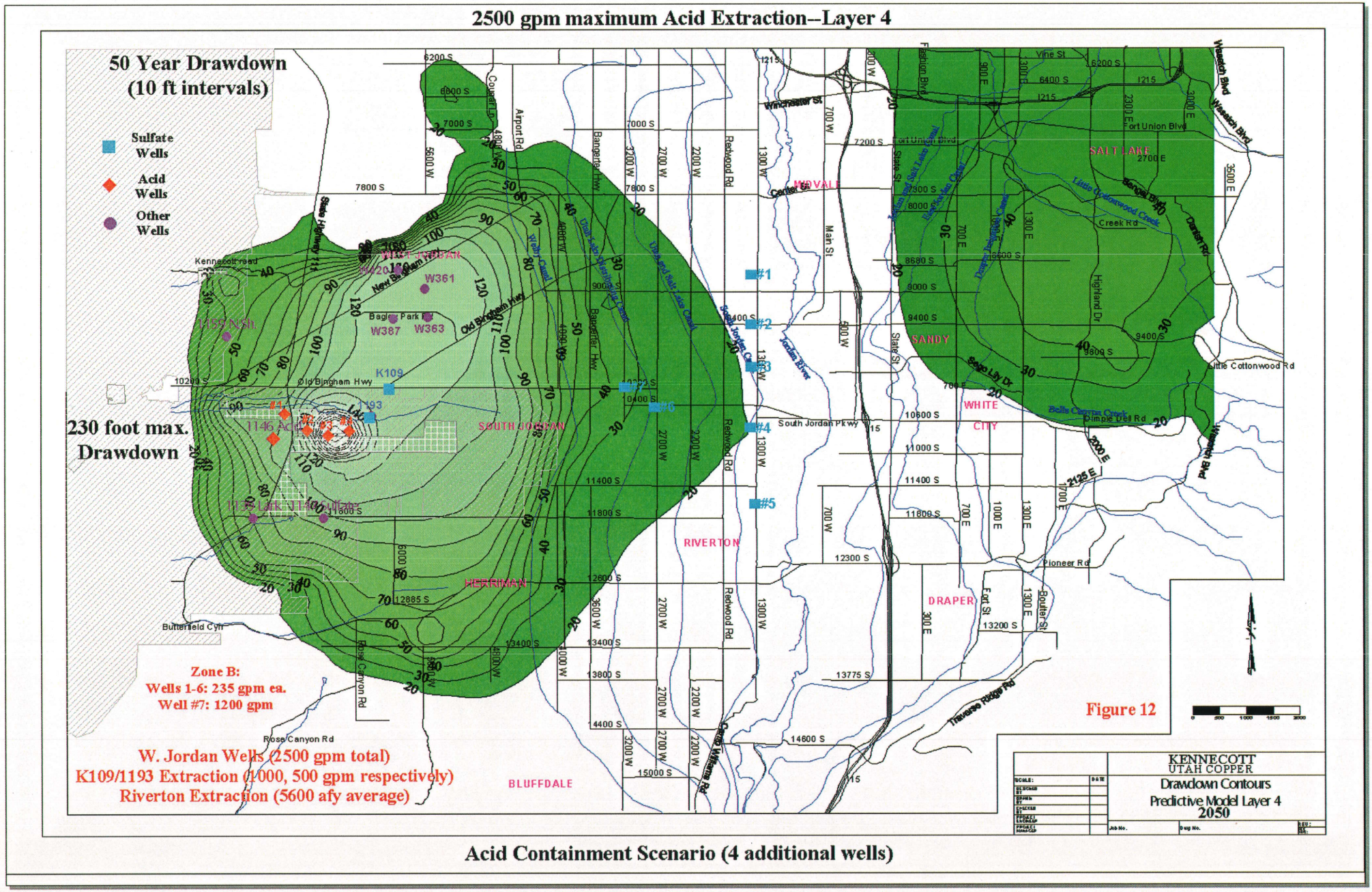

Figure 12. Predictive model draw down values for the current acid containment scenario in year 2050.

APPENDIX E

Jonathan F. Callender, Ph.D.
Kennecott Utah Copper Corporation
HSEQ/Technical Services
P.O. Box 112
Bingham Canyon, Utah 84006-0112

August 16, 1999

Robert L. Morgan, PE, State Engineer
Utah Division of Water Rights
1594 West North Temple, STE 220
PO Box 146300
Salt: Lake City, UT 84114-6300 HAND DELIVERED

Re: Proposal for restricted pumping in the southwestern Jordan Valley area

Dear Mr. Morgan:

Kennecott Utah Copper Corporation herein submits a request for the creation of a restricted pumping zone in certain parts of the former Management Area 8 of the interim Salt Lake Valley Ground Water Management Plan. The proposed restricted area overlies contaminated groundwater in the principal aquifer of the southwestern Jordan Valley, as documented in the enclosed Remedial Investigation and Feasibility Study done under CERCLA and State review (CD-ROM attached).

As part of its responsibilities under CERCLA and the Natural Resource Damage settlement with the State, Kennecott has completed source controls at its facilities to prevent further degradation of groundwater in the basin. Kennecott also has in place an extraction well for acidic water in the groundwater plume, two extraction wells at the leading edge of an elevated sulfate plume in the Bingham Creek area, and an extraction well at the leading edge of sulfate-contaminated water near Lark. Kennecott is currently conducting a joint study with the Jordan Valley Water Conservancy District of the feasibility of extracting and treating elevated sulfate groundwater and providing the treated water for municipal use.

Part of any effective remediation plan must include measures to protect groundwater users and prevent further migration of existing contamination. Although much of the affected aquifer is on Kennecott property (where Kennecott can control groundwater development), Kennecott is particularly concerned about future groundwater development along the outskirts of South Jordan and West Jordan cities, and in the Town of Herriman. Privately owned water rights exist in those areas, and the communities may require diversion of external water rights to the areas as part of development requirements. Unrestricted use of these water rights could draw elevated sulfate and TDS water into the currently clean aquifer, causing damage to the water users and exacerbating groundwater contamination.

Kennecott would like to propose a series of restrictions on future water well development in these areas. These restrictions would include:

1. Completion depth and pumping rate restrictions on wells drilled within 3000 feet south of the known 250-mg/L-sulfate isoconcentration line in the Herriman area, as shown on Figure 4-4 of the RI.

2. Completion depth and pumping rate restrictions on wells drilled within 3000 feet north of the known 250-mg/L-sulfate isoconcentration line in the West Jordan area, as shown on the same figure.

3. Prohibition of new well development within the 250-mg/L-sulfate isoconcentration line in the former Kennecott evaporation pond area (South Jordan) until Kennecott installs its NRD remediation and water supply and treatment systems, achieves hydraulic containment of the upgradient ground water plume, and the system reaches steady state and achieves a sulfate level in the area below 250 mg/L.

Appropriate completion depths and pumping rates would be determined on a case-by-base basis using the most up-to-date information on location and depth of contamination, aquifer properties, and user needs. Kennecott would supply this information to the State Engineer and any water user upon request. The restricted area will shrink as remediation and natural attenuation reduce the size of the contaminated zone.

Kennecott recognizes that these restrictions may adversely affect the water rights of private water users in these areas. Kennecott stands ready to assist affected property owners in obtaining an adequate water supply by identifying alternative water sources, providing technical assistance in siting and completing supply wells, and providing supplemental financing in cases where the presence of contamination causes an additional cost burden to the property owner.

Please contact me at 569-7015 if you have any questions. We would like to meet with you and your staff to discuss this matter at a suitable time.

Sincerely,

Jonathan F. Callender, Ph.D
Manager Strategic Resources

Cc: W.R. Williams, General Manager, KUCC
M. Shoop, Associate General Counsel, KUCC
Dallin Jensen, Parsons, Behle & Latimer

Enc. Figure 4-4, RI/FS

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RIGHTS

Michael O. Leavitt
Governor
Robert L. Morgan
Executive Director
Jerry D. Olds
State Engineer

1594 West North Temple, Suite 220
PO Box 146300
Salt Lake City, Utah 84114-6300
(801) 538-7240 telephone
(801) 538-7467 fax
www.nr.utah.gov

June 25, 2002

Salt Lake Valley Groundwater Users:

Enclosed is the final Salt Lake Valley Groundwater Management Plan which replaces the interim plan implemented in 1991. Although we are implementing this management plan on a "permanent" rather than on an interim basis, we are allowing for the prospect of modifying this plan in the future as conditions change. Modification to this management plan would occur in consultation with water users and other interested parties.

We have received numerous comments and a lot of input during the development of this plan. We would like to thank all of those who have contributed to this process. Many of the provisions in this plan reflect the concerns and issues raised by many of you.

In addition, we have relied heavily on data, information, and computer models which were developed by the United States Geological Survey. The publications containing much of this data and information and other related documents are available on the division's website - waterrights.utah.gov.

The water rights configuration in Salt Lake Valley is complex and offers many unique challenges for both water users and water managers. We believe that this management plan adequately addresses these challenges. We also believe that this will be a useful tool in helping water users plan for future development as well as help this division in the administration and management of this precious resource. We ask for your continued support.

Sincerely,

Jerry D. Olds

Jerry D. Olds, P.E.
Utah State Engineer

Utah!
Where ideas connect

Introduction

This document presents the state engineer's policy for the management of the ground-water resources of Salt Lake Valley. The objectives of this ground-water management plan are to promote wise use of the ground-water resource, to protect existing water rights, and to address water quality issues and over-appropriation of ground water in the valley. In implementing this ground-water management plan, the state engineer is using his statutory authority to administer the measurement, appropriation, and distribution of the ground water of Salt Lake Valley. The intent of this plan is to provide specific management guidelines under the broader statutory provisions within Title 73 of the Utah Code.

For the purposes of this plan, the Salt Lake Valley consists of the unconsolidated basin-fill material generally bounded by the Wasatch Range to the east, Oquirrh Range to the west, Great Salt Lake to the north, and Traverse Mountains to the south. This area is shown in Figure 1.

Salt Lake Valley Ground-Water Management Plan

The following policy guidelines are hereby implemented effective June 25, 2002:

1.0 Appropriations

The Salt Lake Valley is closed to new appropriations of ground water from the principal aquifer including fixed-time appropriations. This action is necessary because of the over-appropriation of water resources of the valley. All pending unapproved applications in the principal aquifer will be rejected. In addition, the state engineer will hold all applications to appropriate water from the shallow aquifer until further review and study of this source is conducted.

2.0 Ground-Water Withdrawal Limits

In order to fulfill the objectives of this management plan, guidelines are being implemented to help distribute ground-water withdrawals. If excessive withdrawals occur, the state engineer will distribute the water in accordance with the priority dates of the applicable water rights using the following guidelines:

2.1 Safe Yield from the Principal Aquifer

Salt Lake Valley has been divided into four regions: western, eastern, central, and northern as shown in Figure 1. The state engineer may limit the quantity of water withdrawn in these regions so that the average amount of water withdrawn over the long term does not exceed the safe yield. The safe yield of each region has been estimated and is shown in Table 1 below.

Salt Lake Valley Ground-Water Management Plan – June 25, 2002

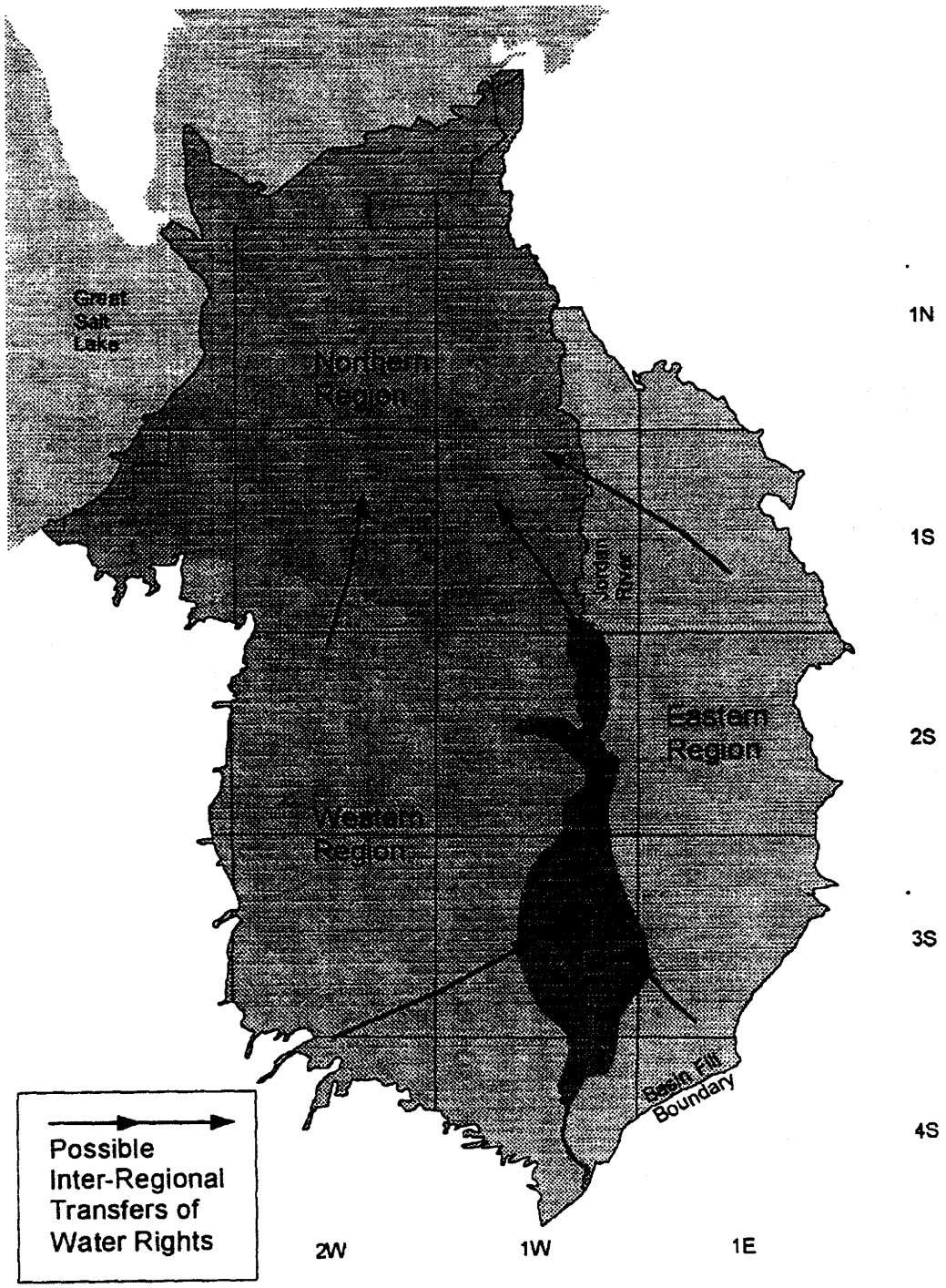

Figure 1. Salt Lake Valley Ground-Water Management Plan Regions

Table 1. Regional Safe Yields

Region	Safe Yield (acre-feet per year)
Western	25,000
Eastern	90,000
Central	20,000
Northern	30,000

2.2 Localized Ground-Water Withdrawals

The state engineer may limit withdrawals in any area of the valley where excessive withdrawals are causing definite and significant harm to the ground-water system. The state engineer recognizes that there are many different factors to consider in determining when and where this is occurring. Some of the relevant factors to consider are:

- ground-water level trends
- trends in the amount of ground-water withdrawals
- changes in water quality
- recent climatic conditions
- local hydro-geologic conditions

Upon identifying areas where excessive withdrawals are causing harm to the aquifer and after public review and commentary on applicable data, the state engineer may limit the withdrawals in that area according to the priority dates of each applicable water right and in harmony with all applicable state statutes. The total quantity of ground water restricted from withdrawal will correspond to at least the quantity necessary to preclude further harm to the aquifer system. Further pumping restrictions may be imposed if harm to the ground-water system worsens. Pumping restrictions may also be lifted in part or in whole after the ground-water system has recovered to an acceptable level, provided no future reoccurrences of the conditions which caused the harm are anticipated.

2.3 Ground-Water Withdrawals From the Southwestern Portion of the Valley

A portion of the aquifer in the Southwestern part of the valley is being remediated by the removal of contamination associated with past mining practices. As part of the remediation effort, Kennecott Utah Copper Corporation (KUCC) has committed to assist affected water users obtain adequate replacement water if adversely affected. Applications in this area which propose to change the point of diversion or drill a replacement well will be critically reviewed so as not to interfere with the remediation process. In conjunction with this, KUCC has committed to work with applicants to determine if there is a feasible well location, depth, and pumping rate for future wells in the contaminated area. The contaminated area is defined as extending 3000 feet from the known 250 mg/l sulfate isoconcentration contour. The approximate boundary for this area is shown in Figure 2.

3.0 Applications to Change the Point of Diversion, Place of Use, and/or Purpose of Use
Each change application will be evaluated based upon its own merits. Within the statutory requirements, the evaluation may consider - but will not necessarily be limited to - potential impacts on: existing water rights, the ground-water system, and overall water quality. In addition, the following guidelines will be used when evaluating change applications:

1) Change applications that propose to transfer water rights historically supplied from the shallow aquifer to the principal aquifer will not be approved.
2) Change applications that propose to transfer water rights into the eastern region, into the western region, or out of the northern region will not be approved. (See Figure 1.)
3) Change applications that propose to transfer water rights into a restricted area[1] will not be approved. (See Figure 2 and endnotes for details.)
4) Change applications that propose to transfer water rights into a section where the Transfer Index Number (TIN[2])under the current water rights exceed the limits set forth in Table 2 below will only be considered if the applicant can show that:
   a) There is sufficient reason to believe that existing water rights will not be impaired.
   b) Compensation and/or adequate replacement water will be provided to existing water right holders if impairment occurs.
   c) Additional ground-water withdrawals will not significantly reduce water levels, degrade the water quality, or otherwise negatively impact the ground-water system.

Region	TIN Limits (acre-feet per year)
Western	4,000
Eastern	12,000
Central	6,000
Northern	6,000

5) Change applications that propose to transfer water rights between sections that have Transfer Index Numbers exceeding the limits set forth in Table 2 may be approved provided that the TIN in the hereafter section is at most 75% of the TIN of the heretofore section and the criteria listed under items 1-4 above have been met.
6) Change applications that propose to drill a replacement well within a distance of 2,640 feet from the original point of diversion may be approved provided that the criteria listed under items I and 3, above, have been met.

Salt Lake Valley Ground-Water Management Plan – June 25, 2002

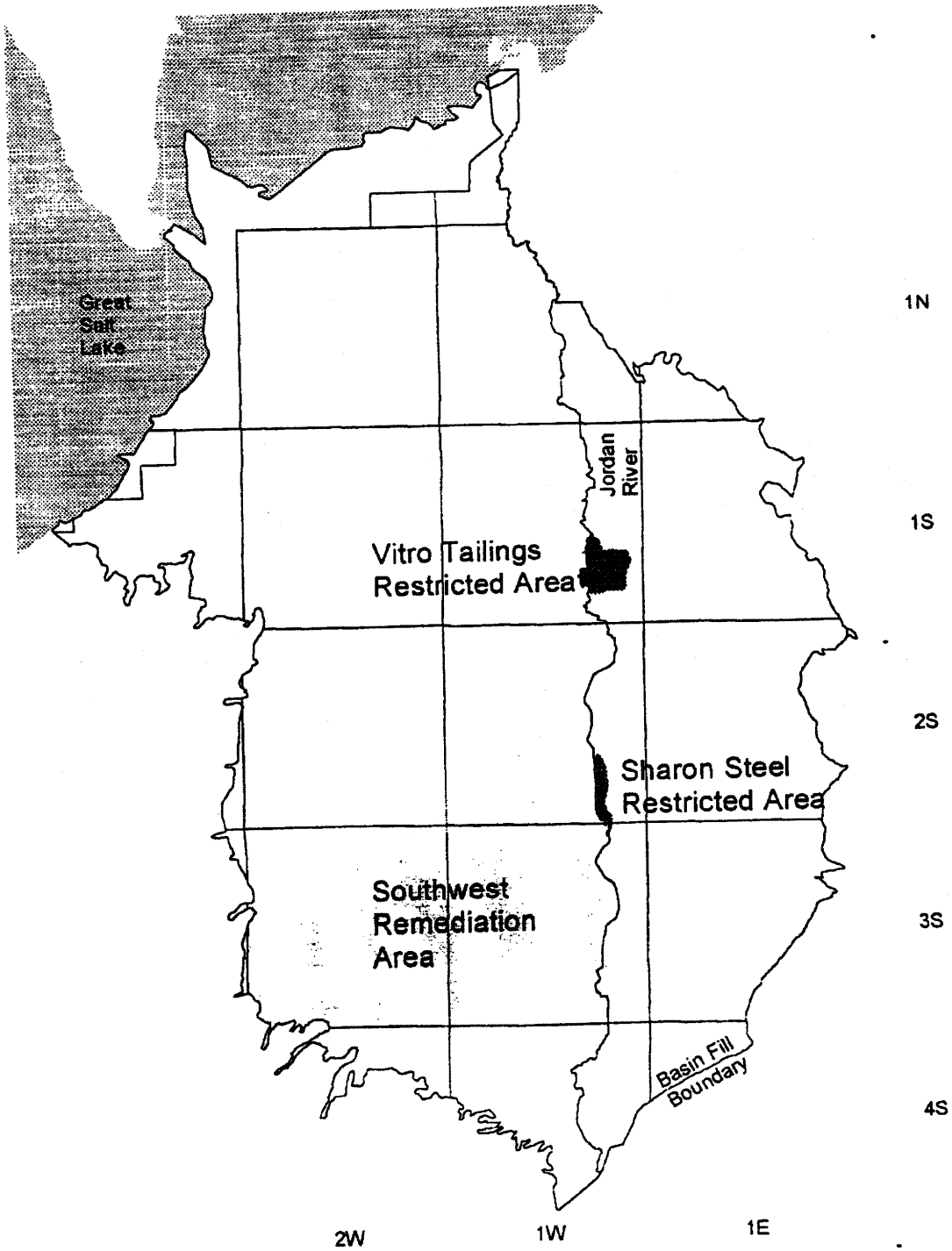

Figure 2. Salt Lake Valley Restricted Areas and Southwest Remediation Area

4.0 Well Spacing
Each new well should be designed, constructed, and operated so that, when pumped at its maximum flow rate, it will not cause more than 12 feet of draw down on an existing well unless the owner of the new well provides just compensation to the affected well owner(s).

5.0 Extensions of Time for Water Right Applications
The state engineer will critically review all future extension requests on approved applications to appropriate or change water pursuant to Section 73-3-12 of the Utah Code. When reviewing extension requests, if unjustified delays or a lack of due diligence is found, the state engineer may reduce the priority date, grant the request in part, or deny the extension of time request.

6.0 Ground-Water Remediation Projects
The state engineer will evaluate each proposed ground-water remediation project based upon its own merits. In order to allow for remediation of ground water the state engineer may support withdrawal amounts in excess of the regional safe yield values outlined in Section 2.1 above or allow changes that would exceed the limits set forth in Section 3.0 above if it is determined to be in the best interest of the public and has a specific project life.

7.0 Aquifer Storage Recovery (ASR)
The state engineer will evaluate each proposed ASR project based upon its own merits. In general, withdrawals credited from aquifer recharge will not count towards the safe yield values outlined in Section 2.1 above. Some of the factors that will be considered in the evaluation of potential ASR projects are:

- hydro-geologic properties of the aquifer
- ground-water velocities
- amount of time between recharge and recovery
- potential effect on other water rights

Applicants may be required to monitor the effects of ASR projects to ensure that no unreasonable impact to the ground-water system or other water rights occurs.

8.0 Monitoring Activities and Aquifer Status Update
The Division of Water Rights will monitor water quality reports submitted by water users to the Department of Environmental Quality and periodically produce an updated, valley-wide water quality summary. Additionally, the division will provide water use information. Also, the division will review new pertinent data that further, or more accurately, defines the ground-water. flow system and hydro-geology of Salt Lake Valley and will modify the plan if necessary. Any modifications to the plan will occur in consultation with water users and other interested parties.

June 25, 2002
Date

Jerry D. Olds
Jerry D. Olds, P.E.
Utah State Engineer

Endnotes

1. Restricted Areas
There are two restricted areas currently in the plan associated with the following contaminated sites as shown in Figure 2:

- Vitro Tailings Site
- Sharon Steel Site

In order to protect the quality of the water by preventing changes in the hydraulic gradient and mobilization of contaminants at these contaminated sites, the transfer of water rights into these areas will not be allowed. Restricted areas are based on available data and may change as new data is obtained. New restricted areas may be added to the plan upon request to the state engineer if an evaluation of the data supports such designation, and the public has had an opportunity to review the data and comment on the proposed designation.

2. Transfer Index Number (TIN)

Under the U.S. Public Land Survey system, the land is divided into township, range, and section. Each section is a square measuring approximately one mile on each side. In this management plan, each section in the valley fill of the Salt Lake Valley is assigned a Transfer Index Number which is based on the index values of every water use within that and each of the eight adjacent sections.

There are specific rules for calculating a section's TIN, which has units of acre-feet per year. A TIN may change over time as the water rights situation changes. The primary rules for calculating a section's TIN are outlined below.

1. Only approved and perfected, i.e. certificated, water rights are evaluated. Approved (but unperfected) changes on perfected water rights are not evaluated because of double accounting issues. Water rights under active litigation are not evaluated.
2. Only wells (both flowing and pumped) are evaluated. Tunnels, springs, drains, and other types of non-well, "underground" diversions are not evaluated.
3. Index values for indoor domestic uses are calculated at 0.45 acre-feet per family.
4. Index values for stock-watering uses are calculated at 0.028 acre-feet per equivalent livestock unit (ELU).
5. Index values for irrigation uses are calculated at 5 acre-feet per acre of irrigated land. If there is a sole supply acreage listed, the irrigation index value is equal to the number of sole supply acres multiplied by an irrigation duty of 5.
6. Index values for domestic, stock-watering, and irrigation uses are calculated by dividing the index value of a claims group by the number of supplemental rights in that group.
7. Index values for municipal uses are calculated by multiplying the flow rate (cfs) by 362.
8. Index values for industrial, mining, and other uses are calculated by multiplying the flow rate (cfs) by 181.

9. The total index value for a water right is the sum of the index values of all listed uses but will not exceed the maximum diversion volume (if listed on the right) nor the maximum flow rate (cfs) multiplied by 724.
10. The total index value for a particular water right is divided evenly between each point of diversion listed under that water right.
11. Index values are calculated for each point of diversion in a section and summed up for the section in question and every adjacent section. This has been done for section 11 in the example below. *(Note: The TIN for section 11 is not 500.)*

3 800	**2** 1600	**1** 2100
10 2600	**11** 500	**12** 1200
15 3300	**14** 1100	**13** 900

Figure A. Evaluating water rights in all adjacent sections

12. A section's TIN is the *maximum sum* of any four adjacent section index values. In the figure below, section 11 has a TIN of 7,500 acre-feet per year.

3 800	**2** 1600	**1** 2100
10 2600	**11** 500	**12** 1200
15 3300	**14** 1100	**13** 900

Sum = 5500

3 800	**2** 1600	**1** 2100
10 2600	**11** 500	**12** 1200
15 3300	**14** 1100	**13** 900

Sum = 5400

3 800	**2** 1600	**1** 2100
10 2600	**11** 500	**12** 1200
15 3300	**14** 1100	**13** 900

Sum = 7500

3 800	**2** 1600	**1** 2100
10 2600	**11** 500	**12** 1200
15 3300	**14** 1100	**13** 900

Sum = 3700

Figure B. Determining the TIN for a particular section by calculating the maximum sum

APPENDIX F

TABLE 11.0A

SOUTHWEST EXTRACTION AND TREATMENT PROJECT OPTIONS FOR ALLOCATION OF ZONE A BENEFITS (METHOD 1)

Entity	Population Projection (2003 Pop)	(%)	Area in "Affected Area" (Zones A and B) (Mi^2)	(%)	Approved Municipal Water Rights in "Affected Area" (Zones A and B) (cfs)	(%)	Combined Average
West Jordan	79,235 [a]	50%	8.7	17%	1.0	9%	25%
South Jordan	37,000 [b]	23%	18.8	38%	-	0%	20%
Herriman	5,000 [c]	3%	2.8[e]	6%	-	0%	3%
Riverton	37,888 [d]	24%	4.7	9%	1.25	12%	15%
SL County/JVWCD	(?)	-	15.1	30%	8.55	79%	37%
	159,123		50.1		10.8		

[a] From West Jordan City planning estimate
[b] From South Jordan City Planning estimate
[c] Herriman estimate
[d] From State Office of Planning and Budget
[e] See Table 11.0E, footnote (a)

TABLE 11.0B

SOUTHWEST EXTRACTION AND TREATMENT PROJECT OPTIONS FOR ALLOCATION OF ZONE A BENEFITS (METHOD 2)

Entity	Population Projection (2003 Pop)	(%)	Area in "Affected Area" (Zones A and B) (Mi^2)	(%)	Approved Municipal Water Rights in "Affected Area" (Zones A and B) (cfs)	(%)	Combined Average
West Jordan	79,235	50%	8.7	25%	1.0	44%	40%
South Jordan	37,000	23%	18.8	54%	-	0%	25%
Herriman	5,000	3%	2.8	8%	-	0%	4%
Riverton	37,888	24%	4.7	13%	1.25	56%	31%
	159,123		35.0		2.25		

TABLE 11.0C

SOUTHWEST EXTRACTION AND TREATMENT PROJECT OPTIONS FOR ALLOCATION OF ZONE A BENEFITS (METHOD 3)

Entity	Population Projection (2003 Pop)	(%)	Area in "Affected Area" (Zone A) (Mi^2)	(%)	Approved Municipal Water Rights in "Affected Area" (Zone A) (cfs)	(%)	Combined Average
West Jordan	79,235	50%	1.5	9%	-	0%	20%
South Jordan	37,000	23%	4.9	30%	-	0%	18%
Herriman	5,000	3%	2.8	17%	-	0%	7%
Riverton	37,888	24%	0.0	0%	-	0%	8%
SL County/JVWCD	(?)	-	7.3	41%	5.0	100%	47%
	159,123		16.5		5.0		

TABLE 11.0D

SOUTHWEST EXTRACTION AND TREATMENT PROJECT OPTIONS FOR ALLOCATION OF ZONE A BENEFITS (METHOD 4)

Entity	Population Projection (2003 Pop)	(%)	Area in "Affected Area" (Zone A) (Mi^2)	(%)	Approved Municipal Water Rights in "Affected Area" (Zones A) (cfs)	(%)	Combined Averages
West Jordan	79,235	50%	1.5	16%	-	0%	33%
South Jordan	37,000	23%	4.9	53%	-	0%	38%
Herriman	5,000	3%	2.8	31%	-	0%	17%
Riverton	37,888	24%	0.0	0%	-	0%	12%
	159,123		9.2				

APPENDIX G

Founded 1851

Herriman

97 N. Pioneer St. • Herriman, UT 84065
Office: (801) 446-5323
Fax: (801) 446-5324

24 November 1999

Richard P. Bay, PE
Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, UT 84088-0070

Dear Mr. Bay:

Thank you for the presentation to the Herriman Town Council on Thursday, 18 November. The presentation was most informative and interesting. We appreciate your time and your interest in available water resources for the town of Herriman.

This will also provide an expression of support for the proposed project to reclaim contaminated water for culinary use by the municipalities in the southwest sector of the Valley. Quality water resources are vital to the health and welfare of our communities. We are certainly interested in and support your efforts in behalf of Herriman.

Sincerely,

J. Lynn Crane
Mayor

March 24, 2000

Mr. Richard Bay, P.E.
Chief Engineer & Assistant General Manager Jordan Valley Water Conservancy District
8215 South 1300 West,
P.O. Box 70
West Jordan, Utah 84088-0070
Fax Number: 801-565-8917

RE: Kennecott Water Extraction and Treatment Project

Dear Richard:

A few months ago, you visited with us regarding the Kennecott Water Extraction and Treatment Project. This project will include the extraction and treatment of contaminated ground water from Kennecott's mining operations to be used for culinary purposes. As per our subsequent conversations, you were desirous to know if Riverton City wanted to participate in receiving an allocated portion of the water from the project. This letter is to confirm in writing our verbal conversations that Riverton City does request to keep the allocation percentage of water available from this project for our City. As shown in the studies that you shared with us, there are different methods of determining the percentage of allocation that Riverton should receive. Obviously, we would be in favor of the highest percentage of allocation for Riverton City.

As the time comes closer, we will stay in communication with you regarding the more precise amounts of water and percentages in relation to Riverton City and this project. Please keep in mind that the implementation of our new secondary water system will have a bearing on how much water we would want or need. We will have a better understanding of our needs when this system is on line and fully operational.

Please let me know if we can help in any way or if you have any questions.

Sincerely,

M. Leon Berrett, P.E.
City Engineer

cc: Mark Palesh, City Administrator
Scott Hill, Water Department Head

Tom Steele
Assistant City Manager
8000 South Redwood Road
West Jordan, Utah 84088
(801) 569-5102
Fax (801) 565-8978

April 22, 2003

Mr. Richard Bay
Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088-0070

Dear Mr. Bay,

On behalf of the City of West Jordan I am writing to confirm our community's interest and support for the Kennecott Water Extraction and Treatment Project. We understand that the project will provide for the treatment of extracted contaminated ground water from mining operations, to culinary quality.

The southwest cities have been offered the opportunity to benefit from the production of this culinary water source, and the city reaffirms its interest in securing an appropriate allocation of water from the reclamation process.

We appreciate all who have worked to develop the program, and stand ready to cooperate to move towards completion of the project.

Sincerely,

Tom Steele
Assistant City Manager

SOUTH JORDAN CITY
CITY COUNCIL REGULAR MEETING

NOVEMBER 16,1999

Present: Mayor Dix McMullin, Councilman Skip Criner, Councilman Eugene Findlay, Councilwoman Mary Lynn Liddiard, Councilman Richard Warne, City Administrator Gary Chandler, Executive Director MaryAnn Dean, Public Works Director Steve Bowen, Community Development Director Clark Labrum, Water Superintendent George Leatham

Others: Marnie Jensen, Jonathan Callender, Glenn Barnes, Blair Brown, Ron Bagley, Dwayne Woolley, Robert & Nancy Ledford

Councilman Criner made a motion to go into closed meeting for property acquisition and litigation. Councilman Findlay seconded the motion. The vote was unanimous in favor, with Councilwoman Liddiard and Councilman Christensen absent.

CLOSED MEETING

Councilman Criner made a motion to come out of closed meeting. Councilman Findlay seconded the motion. The vote was unanimous in favor, with Councilwoman Liddiard and Councilman Christensen absent.

I. GENERAL BUSINESS

A. Welcome, Roll Call, And Prayer

Mayor McMullin welcomed everyone present. He excused Councilman Christensen, who will not be in attendance tonight. All other members of the City Council were present. Councilwoman Liddiard offered the opening prayer.

B. Pledge Of Allegiance

Community Development Director Labrum led the audience in the Pledge Of Allegiance.

C. Committee Reports

There were no committee reports given.

D. Minute Approval

1. October 26, 1999

Councilman Warne made a motion to approve the October 26, 1999 City **Council meeting minutes, as printed. Councilman Criner seconded the motion. The vote was unanimous in favor, with Councilman Christensen absent.**

II. AWARDS, PRESENTATIONS, APPOINTMENTS, AND PROCLAMATIONS

A. U.S. Census 2000 Presentation By Joanie Burum

Joanie Burum, said she is a recruiter with the U.S. Census. She showed a video outlining the responsibility and impact that the census will have on the community. She provided some handouts (Attachment A). Ms. Burum said she will be training people for the southwest quadrant of the valley. She said there is a lot of information, and there is a lot of needs to meet. She said forms will be sent to the residents on March 15th, requesting census information. She said the second notice will be sent on April 1st, also known as Census Day. She said they will be doing a lot of advertising, and working with the cities to get a good count for the census. She said the people doing the counting will be starting the end of April, or the beginning of May. She said they will also have Quality Assurance Centers for people to bring in their census forms.

B. Jordan Valley Water Conservancy District (Richard Bay) And Kennecott Utah Copper Corporation (John Callender) Presentation

Richard Bay, Jordan Valley Water Conservancy District, and **Jon Callender,** Kennecott, introduced themselves. Dale Gardner, representative for South Jordan City, and Mr. Henderson with the Jordan Valley Water Conservancy District, were also introduced.

Mr. Bay passed out some information on their proposed Southwest Extraction and Treatment Project (Attachment B).

Jon Callender, Kennecott, showed a map of the Southwest Jordan Valley sulfate concentration at any depth 1994-1996, with 1998-99 data changes. He said in 1986, the State of Utah sued Kennecott Copper for damage to the state's natural resources which, in this case, is ground water resources. He said a settlement was agreed upon in 1995, in which Kennecott Copper paid the State of Utah $9 million, and put aside a trust fund of $28 million to restore and remediate this contamination, and provide drinking water as part of the restoration process. He said in 1995, the U.S. EPA began to evaluate the nature of the contamination. He said it was agreed that Kennecott would have the ability and right until the year 2000 to evaluate the situation, and to propose a remedy, which would make use of the trust fund money set aside to provide the restoration and treatment of water in this region. He said in July 2000, the trustee (Diane Nielson, Director of the Utah Department of Environmental Quality) will make the decision of whether or not to accept Kennecott's proposal or to go to a general use of the money and cash in the trust fund.

Mr. Bay showed a map of the proposed groundwater extraction and treatment system

(Attachment B). He said the treatment process is a reverse osmosis treatment that produces good drinking water. He reviewed the capital, operation, and maintenance, and replacement costs as outlined in Table 8.6 A (Attachment B). He summarized the proposed funding of the project as outlined in Table 9.0A (Attachment B). He summarized the annual groundwater extraction volumes in table 5.2A (Attachment B). He said they have selected zone A (3500 acre feet) as an allocation that would go directly to the benefit of the 4 communities effected, and would provide a reduced water price for a 50 year period. He reviewed the options for allocation of Zone A benefits, as shown in Tables 11.0A-G (Attachment B). He pointed out Tables 12.4A, which shows the operation, maintenance, replacement and ownership of facilities for the proposed project, and 12.1 A, which shows the proposed project schedule. (Attachment B).

Mr. Callender said this proposal will provide better quality water, with higher water pressure, at a lower cost and will utilize existing infrastructure.

Mr. Bay said this proposal will be presented to the State of Utah and the EPA in early December, and they are seeking the City's endorsement.

Mayor McMullin asked what percent of the water supply will come from this source if they support this plan, and what happens to the rights that the City has in the Deer Creek water? Mr. Bay said the water from Deer Creek reservoir constitutes most of what the Jordan Valley Water Conservancy District currently provides to the City. He said this would be a new supply in addition to the Deer Creek water, and would not effect the current contract with the City, or the current water supply that Jordan Valley Water Conservancy District provides to the City. He said it will reduce the amount of water from other sources, such as the Bear River, in the future.

Mayor McMullin asked if after 50 years, would the water blend with the Deer Creek water? Mr. Bay said the water would blend, and the quality would be equivalent. He said the reduced price, as proposed, would be available for 50 years, it would revert back to the normal price. City Administrator Chandler said this would be about 15 percent of the City's total current water usage.

Councilman Warne said Table 11.0B shows that South Jordan has 50 percent of the effected area, but the allocation is only 30 percent. Mr. Bay said they used three criteria to come up with the allocation. Councilman Warne said South Jordan City has been negatively impacted for a long time, and the neighboring communities have the capability to drill wells, which South Jordan does not have. He said as a result, the neighboring communities have also had their water at a cheaper rate because South Jordan has to buy all of their water from the Jordan Valley Water Conservancy District. He feels that should be considered in the allocation. Mr. Bay said they would consider his request, and pointed out that they have had the same request from each of the other three communities for other reasons. The other three communities are West Jordan, Riverton, and Herriman.

Mayor McMullin asked if they would start construction of this project in 2003? He was told that was correct. He asked what size of line would be installed in 1300 West, and where would the line be located? Mr. Bay said the proposal is to put the pipe in the road right-of-way, and the pipeline is from 6-16 inch in diameter. Mayor McMullin said the City is looking at reconstructing 1300 West, and they need to coordinate with the Jordan Valley Water Conservancy District so the road is not torn up again. Mr. Bay said they would like to work with the City, and see if they can move the schedule up.

Mayor McMullin asked how big the wells are that have been identified in the plan? Mr. Bay said there are 8 wells, and each well has identified 2-4 possible sites. He said they could be as small as 80 feet by 100 feet, and it would be put on a'/. lot, or larger. Mayor McMullin asked that they meet with Community Development Director Labrum to make sure the wells are not proposed under a project that is planned.

Mr. Callender said two of the sites are already in operation on the Kennecott property.

Mayor McMullin said the City is going to be designing 10400 South, from 2700 West to 3200 West, and they need to include those plans in conjunction with this project.

Mayor McMullin said he thinks this program is great, and he hopes the City will continue their good relationship with Kennecott, as the west side of the City is developed. He recognized the Chairman of the Board of the Jordan Valley Water Conservancy District, and Dale Gardner, South Jordan representative, and said Mr. Gardner has done more for the southwest portion of the valley than any other individual with regards to the water lawsuit over the last several years.

Councilman Warne concurred, and thanked Mr. Gardner for his work.

Councilman Warne asked if the net 1999 water rate ($203.02) was a fixed cost, and how long would it be effective? Mr. Bay said it is a fixed formula that will be in place for 50 years.

Mayor McMullin asked if they can look at putting the pipe, or a portion of the pipe, in 1300 West, and have Kennecott or the Jordan Valley Water Conservancy District advance the money? Mr. Bay said they will take that request to the Board of Directors. Mr. Callender said they will work with the City.

Councilman Criner made a motion to support this proposal, and to relook at the 30 percent allocation for South Jordan. Councilwoman Liddiard seconded the motion.

Councilman Criner commended Kennecott for their hard work in remedying this situation.

The vote was unanimous in favor, with Councilman Christensen absent.

III. CITIZEN REQUESTS

Kent Sorenson, Peterson Development, said on the south side of the Jones Farm subdivision, on 10200 South, he is required to install the landscaping in the parkstrip and the homeowners are to maintain the parkstrip. He said it does not make sense to install the landscaping now because the homes will not be completely finished for a year, and he would have to install separate water meters and electrical panels for each house, and then he would take them out when all of the houses are finished. He asked if the City Council would let him post another bond, or add this onto his existing bond, and allow him to delay installing the landscaping for a year?

Councilman Warne asked if he would still be installing the collector street fencing? Mr. Sorenson said the collector street fencing is already in.

Councilman Warne made a motion to allow Peterson Development to landscape the parkstrip on 10200 South in conjunction with the construction of houses in the Jones Farm subdivision, and to allow the developer to post a separate cash bond for improvements, and at the appropriate time, the rest of the bond be released, and that the improvements be done within 12 months. Councilman Criner seconded the motion. The vote was unanimous in favor, with Councilman Christensen absent.

IV. PUBLIC HEARINGS

A. Text Amendment To Section 12.54.160 Eliminating The Requirement For 8' Wide Landscape Planters Between Double Parking Rows In The Redwood Road MU Zones

Community Development Director Labrum said they found a duplication in the Ordinance regarding parking landscaping. He said the current Ordinance requires an 8 foot park strip between double parking rows, and landscaping on the perimeter of the parking lot. He said staff is recommending that they eliminate the 8 foot parkstip requirement, and only require planters on single parking rows every 10 stalls, and double rows every 6 stalls. He said it would still provide the desired shading. He said the Boyer Company is the main developer requesting this amendment. He said it will reduce the parking lot area dedicated to grass and shrubs.

Mayor McMullin opened the public hearing. There were no public comments. He closed the public hearing.

V. SUMMARY ACTION CALENDAR

None.

VI. SUMMARY ACTION ITEMS HELD OVER

None.

VII. DISCUSSION/POTENTIAL ACTION ITEMS

A. Text Amendment To Section 12.54.160 Eliminating The Requirement For 8' Wide Landscape Planter Between Double Parking Rows In The Redwood Road MU Zones

Councilman Warne asked if this Ordinance amendment could only apply to the MU City Center zone? Community Development Director Labrum feels it should be applied to all MU zones because there are landscaping requirements, and they will be getting the landscape strips in the parking lot. He said this will help simplify the designing of the parking lots for developments to come.

Mayor McMullin asked if the developers still have to meet the percentage of green space requirement for a parking lot? Community Development Director Labrum said they would have to meet the 25 percent landscaping requirement.

Councilman Findlay asked about the status of Harman's coming to South Jordan? City Administrator Chandler said it is not absolute that they are coming because of the Super Wal-Mart, but they seem to be moving forward. He said Harman's is relooking at the demographics for their store.

Councilman Criner said the Planning Commission passed this amendment unanimously, and no one spoke in opposition to it.

Councilwoman Liddiard made a motion to approve the Text Amendment To Section 12.54.160 Eliminating The Requirement For 8' Wide Landscape Planters Between Double Parking Rows In The Redwood Road MU Zones. Councilman Warne seconded the motion. The vote was unanimous in favor, with Councilman Christensen absent.

B. File #27-20-351-005, Deferral Agreement For Frontage Improvements For Property Located At 3892 West 11800 South Street, Anthony Rivera And Marnie Jensen (Applicants)

Councilman Criner made a motion to circle item VII. B. Councilman Findlay seconded the motion. The vote was unanimous in favor, with Councilman Christensen absent.

C. File #27-14-302-017, Conditional Use Permit-Site Plan, Caroline Dreams Reception Center, Ron Bagley/Furst Construction (Applicant)

Community Development Director Labrum said this project is on two acres, east of the Grandpa Maddox restaurant, and they have met all of the conditions for the C-C zone. He feels it will be a nice development.

Councilman Warne commended the developers on their nice building, and the exterior building materials.

Councilman Findlay made a motion to approve File #27-14-302-017, Conditional Use Permit-Site Plan, Caroline Dreams Reception Center. Councilman Criner seconded the motion. The vote was unanimous in favor, with Councilman Christensen absent.

D. South Jordan City Police Job Description

Councilman Warne made a motion to approve the South Jordan City Police Job Description. Councilman Criner seconded the motion.

Mayor McMullin said this will ensure proper training for the officers, and recognize them in the retirement plan.

The vote was unanimous in favor, with Councilman Christensen absent.

VIII. INFORMATIONAL ITEMS AND OTHER BUSINESS

A. CALENDARING ITEMS

Councilwoman Liddiard asked for the status of the City Administrator position. City Administrator Chandler said the screening committee has all of the packets of applications to make their top selections.

Mayor McMullin said they need to determine a deadline, and dates to set up the interviews. Mayor McMullin suggested they get a report back next week, have the staff call their references, and set up the interviews. Mayor McMullin said he would follow up with the screening committee.

Mayor McMullin said the 1300 West reconstruction project is on the agenda next week, and they need to meet with Kennecott and the Jordan Valley Water Conservancy District to coordinate with their project. He asked the City Engineers to look at the situation and work with them.

Councilman Criner said the Jordan Valley Water Conservancy District will want a right-of-way easement from the City. Mayor McMullin said they should ask the Jordan Valley

Water Conservancy District what is in their budget plans to purchase the easement.

B. COMMENTS FROM MAYOR AND MEMBERS OF THE CITY COUNCIL

Mayor McMullin said the Historical Committee met and they are getting the committee organized. He said they talked about the issues with the widening of 1300 West. He said their next meeting will be Thursday, November 18th, at 4:00 p.m. He said the Historical Committee needs to be invited to the public hearing with UDOT regarding 10400/10600 South. He said the Historical Committee is looking at preserving the flour mill off of 10400 south. He said they are also looking at having a marker used on the various historical places in the City. He said they have looked at using the Paul Nielson home for storage of the historical items that are collected. He said he has additional names to be added to the committee: Jan Criner, Robert Thomas, Glade McKee, Elmo Turner, and Jean Jackman. He asked that a letter be sent to them inviting them to participate. He said they will be organizing the committee with a chair, vice chair, secretary, etc. He asked that this item be put on the agenda next week to accept the new members, and then they will start looking for applications for funding for the committee.

Councilman Criner asked that they ensure Paul Nielson's home is safe according to the building and fire departments.

Councilman Wame suggested they look at getting a temporary shed for storage of the Historical Committee items and lock it with the Public Works equipment, to ensure the items are safe.

City Administrator Chandler said the City Christmas party date has been set for December 4, 1999 at Merit Medical, from 7-9 p.m.. Mayor McMullin asked that the citizen committees be invited to the party.

Councilman Criner made a motion to go into closed meeting for personnel. Councilman Findlay seconded the motion. The vote was unanimous in favor, with Councilman Christensen absent.

CLOSED MEETING

ADJOURNMENT

Councilman Findlay made a motion to adjourn. Councilman Criner seconded the motion. The vote was unanimous in favor, with Councilman Christensen absent.

The November 16, 1999 City Council regular meeting adjourned at 10:00 p.m.

This is a true and correct copy of the November 16, 1999 City Council meeting, which was approved on December 7, 1999.

C. L. Ponzurick

South Jordan City Recorder

APPENDIX H

LICENSED PROFESSIONAL ENGINEER
NO. 5055060
BRYANT LYNN
BENCH
STATE OF UTAH

Jordan Valley Water Conservancy District

Pilot Study Final Report

Reverse Osmosis Pilot Study

October 2002
FINAL

carollo engineers

12592 WEST EXPLORER DRIVE, SUITE 200 • BOISE, IDAHO 83713 • (208) 376-2288 • FAX (208) 376-2251
H:\Client\Jvwcd_BOI\6170a00\Report\Final\TOC.doc

TREATMENT FACILITY

6.1 INTRODUCTION

The material presented in this section details the design criteria developed during pilot testing and the resulting capital and operations cost estimates for the combined Zone B/Lost Use RO treatment plant. Conveyance and disposal system costs are also presented. The District also wishes to quantify the incremental cost of treating these supplies from a finished water TDS of 800 mg/L to 250 mg/L. KUCC is required to pay for the treatment of these supplies to a TDS concentration of 800 mg/L. The 250 mg/L finished water TDS goal is an enhanced treatment required by the District to match the high quality water that they currently distribute and their customers have come to expect. The District is required to pay KUCC $49 per AF (in 1995 dollars) and pay the incremental cost of treatment to 250 mg/L. The information in this section also presents a breakdown of these incremental treatment costs.

6.2 DESIGN CRITERIA

Prior to this study, little was known about the Zone B or Lost Use water supplies and their suitability to provide water for RO treatment. Limited data was available that detailed SDI and turbidity for these supplies. Pilot tests were conducted to determine if fouling would occur and to determine design criteria for required pretreatment, chemical cleaning, and membrane life. Additionally, the District required determination of an appropriate Lost Use by-pass treatment system. A by-pass treatment system concept was developed and presented previously in Section 3. Design criteria for this system were developed based on water quality data, regulatory requirements, and industry standard practice.

Table 6.1 presents design criteria for the Zone B and Lost Use treatment facility based on the work previously performed by the District and the pilot study data presented in Section 5. Zone B design criteria are broken down based on the treated water TDS of 800 mg/L and 250 mg/L. The design criteria for the Lost Use system only result in the production of 250 mg/L water. Additionally, an alternate treatment concept for the Lost Use supply is presented. This treatment concept requires operating the RO process at a 72% recovery to eliminate the possibility of irreversible silica fouling, which was observed during the pilot tests operated at 85% recovery.

As indicated in **Table 6.1**, treatment to the 250 mg/L finished water TDS goal requires more Zone B RO capacity than for the 800 mg/L TDS standard. However, blending flows are reduced, thus resulting in the same treated water capacity. Additionally, cleaning chemical RO process flows increase when the finished water TDS goal is lowered to 250 mg/L. These design criteria are all important due to their impact to both capital and operations costs.

Table 6.1 Reverse Osmosis Treatment Process Design Criteria
Zone B Reverse Osmosis Pilot Study
Jordan Valley Water Conservancy District

Parameter	Unit	Zone B 800 mg/L	Zone B 250 mg/L	Lost Use [a]	Lost Use [a] (Alternate)
Treatment Plant Operation					
Operating Days per Year	days/year	330		330	330
RO Recovery [b]	%	80		85	72
Treatment System Recovery [c]	%	84	81	87	76
Blend Ratio [d]	%	34	8	17	17
Process Flow Rates					
Raw Water	mgd	4.03	4.26	2.60	3.00
Process Feed	mgd	2.84	3.98	2.21	2.62
RO Capacity/Permeate	mgd	2.28	3.18	1.88	1.88
By-pass Water	mgd	1.18	0.28	0.39	0.39
Finished Water	mgd	3.46		2.27	2.27
Concentrate	mgd	0.57	0.80	0.33	0.73
Cartridge Filtration					
Cartridge Filter Loading Rate					
Process Feed	gpm/10-in.	2.8	3.9	2.2	2.6
Blend Water	gpm/ft^2	NA	NA	0.125	0.125
Cartridge Filter Replacement Frequency	days	183		183	183
RO Equipment					
Pressure Vessel Array		38:19	52:26	30:15	30:15
Membranes per Vessel	No.	7		7	7
Flux Rate	gfd	16		16	16
Cleaning Frequency	No./year	3		6	3
Membrane Life	years	5		1.5	5
Operating Pressure [e,f]	psi	230		225	225
Decarbonation					
Decarbonation Efficiency	%	90	90	90	90
Tower Diameter	ft	12	15	15	15
Decarbonator Loading Rate [g]	gpm/ft^2	18	20	20	20

Table 6.1 Cont'd **Reverse Osmosis Treatment Process Design Criteria**
Zone B Reverse Osmosis Pilot Study
Jordan Valley Water Conservancy District

Parameter	Unit	Zone B 800 mg/L	Zone B 250 mg/L	Lost Use [a]	Lost Use [a] (Alternate)
Air to Water Ratio		30:1		30:1	30:1
Chemical Feed System					
Scale Inhibitor Dose [h]	mg/L	4		4.3	1.1
Sodium Hypochlorite Dose [i]	mg/L	1	0.5	0.5	0.5
Sodium Hydroxide Dose [j]	mg/L	0	14.3	14.3	14.3
Membrane Cleaning Chemicals					
Low pH	lbs./year	2000	5250	6060	3030
High pH	lbs./year	2000	5250	6060	3030
Silica	lbs./year			6060	
UV Disinfection System					
UV Dose	mJ/cm^2	NA		40	40
UV Transmittance	%	NA		90	90
No. of UV Lamps	No./Reactor	NA		7	7
UV Lamp Replacement Freq.	hours	NA		10,000	10,000
UV Electrical Draw	kW	NA		1.33	1.33
UV Cleaning Frequency [k]	No./yr	NA		TBD	TBD
UV Cleaning Chemical Demand [l]	lbs./yr	NA		280	280

Notes:
NA Not applicable
TBD To be determined
a Based on Lost Use blended water TDS of 250 mg/L

b $R_{RO} = Q_{Permeate} / Q_{RO\ Feed}$

c $R_{RO} = Q_{Finished\ Water} / Q_{Well\ Water}$

d $r_{Blend} = Q_{Permeate} / Q_{Finished\ Water} = (C_{Feed} - C_{Goal}) / (C_{Feed} - C_{Permeate})$

Table 6.1 Cont'd	Reverse Osmosis Treatment Process Design Criteria Zone B Reverse Osmosis Pilot Study Jordan Valley Water Conservancy District				
		Zone B			
Parameter	Unit	800 mg/L	250 mg/L	Lost Use [a]	Lost Use [a] (Alternate)

e Modeled Using RODESIGN V.7.0 (assumes CPA2 membrane or equivalent)
f Feed pressure at ½ of membrane life (i.e., year 2.5 of 5 year membrane life) at fouling rate estimated by pilot testing
g Blended Zone B and Lost Use permeate water.
h Modeled using Water Wizard KLT V.1.1
i Based on $SDS_{48\ hr}$-Chlorine Demand presented in **Table 5.6**
j Modeled Using The Rothberg Tamburini and Winsor Model for Water Process and Corrosion Chemistry V. 4.0
k To be determined during start-up testing
l Solution can be re-used in off-line low-pressure UV cleaning. Demand based on other applications of similar quality.

Raw water, RO process feed, and concentrate flows increase when the Lost Use RO recovery is decreased from 85% to 72%. However, as indicated in **Table 6.1,** a decrease in the cleaning frequency and an increased membrane life is assumed. Since the 72% RO recovery was not pilot tested, and based on past experience with lower saturation of silica and calcium carbonate, these values are chosen as a conservative estimate. Since silica and calcium carbonate will not be as saturated at the lower, alternate Lost Use recovery, a lower scale inhibitor dose is also indicated.

The decarbonation process design criteria presented in **Table 6.1** indicates that a 15-foot diameter tower is required to treat the combined Zone B and Lost Use permeate water when the treatment goal is 250 mg/L TDS. This tower diameter is too large to be shipped in one piece and will require field assembly, which will impact capital costs.

Unit costs for consumable items that will be used during the operation of the combined Zone B and Lost Use treatment plant are presented in **Table 6.2**. It should be noted that cartridge filters for the RO membranes are estimated to be significantly less expensive than those used for the Lost Use by-pass treatment system. Cartridge filters used for RO pretreatment are of the glass fiber wound variety that will provide basic protection for the RO membranes if there were an up-set in the well field or a failure of a well screen. The by-pass cartridge filters are specially engineered and highly efficient at removing particles within the 2 to 5-μm size range. The filters that are used for the purpose of this estimate are approved in the States of Alaska and Idaho for *Giardia* and *Cryptosporidium* removal. Material specification sheets are provided in **Appendix C**.

Included in the unit costs of consumable items in **Table 6.2** is a patent royalty fee for the UV disinfection process. The certified UV systems that are currently included in Carollo's standard specifications are subject to this royalty fee. However, this patent is currently being challenged in several states and may only apply to medium and high pressure UV technologies. Carollo's specifications include one low pressure UV system that may be exempt from this patent royalty fee. Regardless, this fee has been included in the cost estimate to provide a realistic interpretation of what the operations costs of UV treatment may be.

Table 6.2 Operations and Maintenance Unit Costs
Zone B Reverse Osmosis Pilot Study
Jordan Valley Water Conservancy District

Description	Unit Cost
Membrane Element Replacement	$500 per element
Cartridge Filter Replacement	$3 per 10-inches of filter length
By-pass Cartridge Filter Replacement	$355 per filter
Electrical Power	$0.055 per kW-hr
Scale Inhibitor	$0.86 per lb.
Caustic Soda	$0.21 per lb. as NaOH
Sodium Hypochlorite [a]	3.5 kW per lb. Cl_2
Membrane Cleaning Chemicals	
Low pH	$2.80 per lb.
High pH	$3.18 per lb.
Silica	$4.14 per lb.
UV Lamps	$200 each
UV Cleaning Chemical	$5.00 per lb.
UV Patent Royalty [b]	$0.015 per 1,000 gallons

Notes:
a On-site generation of hypochlorite
b Patent currently under contest review. Vendors that have validated performance do not hold patent.

6.3 FACILITY LAYOUT

Before capital costs can be estimated, a site plan and facility layout are required to more closely estimate the costs for site work and building materials. **Figures 6.1 and 6.2** present the location and site plan of the combined Zone B/Lost Use treatment facility. This site is located near the District's main office on 8215 South 1300 West, West Jordan, Utah.

Figure 6.1. Facility Site Location (8215 South 1300 West)

Figure 6.2. Zone B/Lost Use Treatment Facility Site Plan

As indicated in **Figure 6.1**, the planned Zone B/Lost Use treatment plant will be located in the southwest portion of the District's property, in an area that is currently used as a cattle pasture. This area is assumed to have a similar soils composition as the adjacent area where the maintenance, vehicle storage, and operations buildings are located. Based on a soils study conducted by the District and previous construction in the adjacent area, this site requires over excavation to 20-feet and structural fill under the building foundations due to the potential for liquefaction. Roadways are assumed to be excavated to 1.25-feet and filled to 12-inches with road base and 3-inches of asphalt. These costs were previously unaccounted for in studies commissioned by the District and should be included in the capital cost estimate for the Zone B/Lost Use treatment facility.

Figure 6.2 presents a site plan for the planned Zone B/Lost Use treatment facility. This site covers approximately 5.6-acres. Access to the Zone B/Lost Use treatment plant building is provided on the south side for chemical deliveries and equipment maintenance. As indicated in **Figure 6.3**, the equipment has been placed in the building in such a fashion that the Lost Use RO treatment and the decarbonation processes may be easily expanded to the north and southwest side of property. A wet well to capture water after decarbonation, blending and post treatment, that would also provide water for the finished water pump station is located sub-grade to the planned facility, under the finished water pumps and decarbonation tower.

It should be noted that alternate locations for the placement of this facility have been identified. These sites include the hill located between the Administration building and the North Jordan Canal, and the hill between 1300 West and the Administration building. It may be possible to build a two-story treatment plant into the side of these hills and maximize the use of any hydraulic gradients that occur naturally. Additionally, soils conditions may be better in these locations, which will minimize the site work costs associated with over excavation and structural fill that will be incurred at the site presented in **Figures 6.1 and 6.2**. These alternatives should be visited during the pre-design phase of this project.

6.4 CAPITAL COST ESTIMATE

Capital costs for the Zone B/Lost Use treatment facility and the conveyance and by-product water disposal systems are provided in **Tables 6.3 through 6.6**. **Tables 6.3 and 6.4** detail the capital costs associated with the District treatment goal of 250 mg/L TDS. Capital costs for treatment to 800 mg/L TDS are detailed in **Tables 6.5 and 6.6**. As indicated, the incremental capital cost in treatment from the 800 mg/L TDS to 250 mg/L TDS goal is estimated to be approximately $594,000. This includes the incremental costs for the treatment and required infrastructure for conveyance of raw, finished and by-product water. Some of the capital costs presented in Tables 28 and 30 are adapted from the District's previous study in 1999. These costs were adjusted using the *Engineering News Record*

Table 6.3 Zone B/Lost Use Treatment Facility Capital Cost Estimate (250 mg/L)
Zone B Reverse Osmosis Pilot Study
Jordan Valley Water Conservancy District

Classification	Quantity	Units	Unit Cost	Extended Cost
Building				
Foundation	900	CY	$400	$360,000
Structural & Architectural	15250	SF	$100	$1,525,000
Electrical	1	LS	$960,000	$960,000
HVAC/Plumbing	1	LS	$400,000	$400,000
Instrumentation	1	LS	$625,000	$625,000
RO Equipment = 3.18 + 1.88	5.06	MGD	$740,000	$3,745,000
Cartridge Filters	2	EA	$50,000	$100,000
Decarbonator	1	LS	$400,000	$400,000
Chemical Storage/Feed System				
Scale Inhibitor	2	LS	$50,000	$100,000
On-site Hypochlorite	1	LS	$120,000	$120,000
Caustic Soda	1	LS	$180,000	$180,000
By-pass Treatment System				
Cartridge Filter	1	LS	$80,000	$80,000
UV Disinfection	1	LS	$125,000	$125,000
Product Water Pumps (770 hp)	1	LS	$160,000	$160,000
Contact Tank (30 minutes)	640	CY	$624	$400,000
Site Work				
Over Excavation	17117	CY	$12	$206,000
Structural Fill	17117	CY	$20	$343,000
Paving & Sidewalks	125740	SF	$2.10	$265,000
Other	1	LS	$35,000	$35,000
Subtotal				$10,129,000
Contractors Overhead & Profit			27%	$2,735,000
Construction Cost Subtotal				$12,864,000
Design Contingency			10%	$1,287,000
Change Order Allowance			5%	$644,000
Total Construction Cost				**$14,795,000**

Table 6.3 Cont'd	Zone B/Lost Use Treatment Facility Capital Cost Estimate (250 mg/L) Zone B Reverse Osmosis Pilot Study Jordan Valley Water Conservancy District			
Classification	**Quantity**	**Units**	**Unit Cost**	**Extended Cost**
Pre-design & Final Design Engineering			10%	$1,287,000
Engineering Services During Construction			5%	$644,000
On-site Construction Services & Administration			5%	$644,000
Total Engineering Services				**$2,575,000**
TOTAL PROJECT COST ESTIMATE				**$17,370,000**

Notes:
ENR 20 City Average CCI 1999 = 6060
ENR 20 City Average CCI 2002 = 6526 (as of 10/1/02)
Means Salt Lake City Average CCI 1999 = 88.4
Means Salt Lake City Average CCI 2002 = 93.4

Table 6.4	Conveyance and Disposal System Capital Cost Estimate (250 mg/L) Zone B Reverse Osmosis Pilot Study Jordan Valley Water Conservancy District				
Classification	**Quantity**	**Units**	**Unit Cost**	**Extended Cost**	**Source**
Zone B Wells and Pump Houses	7	EA	$320,000	$2,240,000	District
Lost Use Wells and Pump Houses	4	EA	$81,000	$324,000	CDM
Raw Water Conveyance					
Zone B (8 to 16-inch)	52,800	per foot	$64	$3,380,000	Carollo
Lost Use (8 to 12-inch)	10,000	per foot	$43	$410,000	CDM
Treated Water Pipe (24-inch)	14,000	per foot	$130	$1,820,000	Carollo
Concentrate Pipe (10-inch)	43,600	per foot	$83	$3,700,000	Carollo
Subtotal				$11,874,000	
Contingency			10%	$1,188,000	
Construction plus Engineering			43%	$5,106,000	
TOTAL PROJECT COST ESTIMATE				**$18,168,000**	

Notes:
ENR 20 City Average CCI 1999 = 6060
ENR 20 City Average CCI 2002 = 6526 (as of 10/1/02)
Means Salt Lake City Average CCI 1999 = 88.4
Means Salt Lake City Average CCI 2002 = 93.4

Table 6.5 Zone B/Lost Use Treatment Facility Capital Cost Estimate (800 mg/L)
Zone B Reverse Osmosis Pilot Study
Jordan Valley Water Conservancy District

Classification	Quantity	Units	Unit Cost	Extended Cost
Building				
Foundation	900	CY	$400	$360,000
Structural & Architectural	15250	SF	$100	$1,525,000
Electrical	1	LS	$960,000	$960,000
HVAC/Plumbing	1	LS	$400,000	$400,000
Instrumentation	1	LS	$625,000	$625,000
RO Equipment = 2.84 + 1.88	4.72	MGD	$740,000	$3,493,000
Cartridge Filters	2	EA	$40,000	$80,000
Decarbonator	1	LS	$300,000	$300,000
Chemical Storage/Feed System				
Scale Inhibitor	2	LS	$50,000	$100,000
On-site Hypochlorite	1	LS	$120,000	$120,000
Caustic Soda	1	LS	$180,000	$180,000
By-pass Treatment System				
Cartridge Filter	1	LS	$80,000	$80,000
UV Disinfection	1	LS	$150,000	$150,000
Product Water Pumps (770 hp)	1	LS	$160,000	$160,000
Contact Tank (30 minutes)	640	CY	$624	$400,000
Site Work				
Over Excavation	17117	CY	$12	$206,000
Structural Fill	17117	CY	$20	$343,000
Paving & Sidewalks	125740	SF	$2.10	$265,000
Other	1	LS	$35,000	$35,000
Subtotal				$9,782,000
Contractors Overhead & Profit			27%	$2,642,000
Construction Cost Subtotal				$12,424,000
Design Contingency			10%	$1,243,000
Change Order Allowance			5%	$622,000
Total Construction Cost				**$14,289,000**

Table 6.5 Cont'd	Zone B/Lost Use Treatment Facility Capital Cost Estimate (800 mg/L) Zone B Reverse Osmosis Pilot Study Jordan Valley Water Conservancy District			
Classification	**Quantity**	**Units**	**Unit Cost**	**Extended Cost**
Pre-design & Final Design Engineering			10%	$1,243,000
Engineering Services During Construction			5%	$622,000
On-site Construction Services & Administration			5%	$622,000
Total Engineering Services				**$2,487,000**
TOTAL PROJECT COST ESTIMATE				**$16,776,000**

Notes:
ENR 20 City Average CCI 1999 = 6060
ENR 20 City Average CCI 2002 = 6526 (as of 10/1/02)
Means Salt Lake City Average CCI 1999 = 88.4
Means Salt Lake City Average CCI 2002 = 93.4

Table 6.6	Conveyance and Disposal System Capital Cost Estimate (800 mg/L) Zone B Reverse Osmosis Pilot Study Jordan Valley Water Conservancy District				
Classification	**Quantity**	**Units**	**Unit Cost**	**Extended Cost**	**Source**
Zone B Wells and Pump Houses	7	EA	$320,000	$2,240,000	District
Lost Use Wells and Pump Houses	4	EA	$81,000	$324,000	CDM
Raw Water Conveyance					
Zone B (8 to 16-inch)	52,800	per foot	$64	$3,380,000	Carollo
Lost Use (8 to 12-inch)	10,000	per foot	$43	$410,000	CDM
Treated Water Pipe (24-inch)	14,000	per foot	$130	$1,820,000	Carollo
Concentrate Pipe (8-inch)	43,600	per foot	$83	$3,600,000	Carollo
Subtotal				$11,774,000	
Contingency			10%	$1,178,000	
Construction plus Engineering			43%	$5,063,000	
TOTAL PROJECT COST ESTIMATE				**$18,168,000**	

Notes:
ENR 20 City Average CCI 1999 = 6060
ENR 20 City Average CCI 2002 = 6526 (as of 10/1/02)
Means Salt Lake City Average CCI 1999 = 88.4
Means Salt Lake City Average CCI 2002 = 93.4

Figure 6.3. Zone B/Lost Use Treatment Facility Layout

(ENR) 20 City Average Construction Cost Index (CCI). The 1999 costs increased by approximately 8% when this correction is applied. The District should be interested in these indices to determine the present day cost of previous capital cost estimates to determine if this project still meets their criteria for participation.

6.5 OPERATIONS AND MAINTENANCE COST ESTIMATE

Operations and maintenance (O&M) costs for the Zone B/Lost Use treatment plant are presented in **Table 6.7**. O&M costs for the Zone B and Lost Use treatment systems are based on design criteria and unit costs presented previously in **Tables 6.1 and 6.2**. The alternate Lost Use treatment costs are based on the lower, 72% RO recovery rate design criteria and assumptions discussed previously.

As indicated in **Table 6.7**, pumping costs represent approximately fifty percent of the total O&M cost. Labor, membrane replacement and chemical costs represent between thirty to forty percent of the remaining O&M cost. This distribution of cost is not uncommon for other RO treatment facilities.

Operations and maintenance is the largest component of cost over the life of an RO treatment plant. Therefore, by finding ways to reduce these costs, the process can become more economical. As indicated in **Table 6.7**, O&M cost for treatment to a finished water TDS of 250 mg/L is estimated to be reduced by lowering the Lost Use RO recovery from 85% to 72%. This cost savings is not realized for treatment to 800 mg/L. The reduction in O&M cost is primarily associated with a reduced membrane replacement and chemical cleaning cost. Pumping costs increase when recovery is lowered, however, when the RO treatment capacity increases to meet the 250 mg/L TDS goal, the cost savings associated with membrane replacement and chemical cleaning begin to outweigh the increased cost of pumping. Therefore, O&M costs can be reduced when the RO recovery is lowered from 85% to 72%.

The District may also consider other cost saving methods to reduce to cost of O&M and improve the economics of RO treatment. Low pressure RO membranes are available that can potentially reduce RO pumping costs by an estimated $230 per day (i.e., $75,000 per year). However these membranes should be tested to assess their suitability for use on the Zone B and Lost Use supplies. Improving the Lost Use system recovery may further reduce costs. While pilot tests indicated that the Inhibitor 2 was not successful at controlling scale formation at a recovery rate of 85%, the industry is frequently developing new scale inhibitors that may be able to control scale (i.e., silica) formation at this recovery rate. The District should consider including pilot equipment in their RO treatment equipment procurement contract documents to test the latest developments in the RO industry. An increased Lost Use RO recovery would reduce pumping costs and lower the overall costs if scale formation can be successfully controlled.

Table 6.7 Zone B/Lost Use Treatment Facility O&M Cost Estimate
Zone B Reverse Osmosis Pilot Study
Jordan Valley Water Conservancy District

Description	Daily Costs (2002 $)							
	Zone B		Lost Use	Lost Use (alt.)	Combined Zone B & Lost Use Treatment Plant			
	800 mg/L	250 mg/L	250 mg/L	250 mg/L	800 mg/L	250 mg/L	800 mg/L (alt.)	250 mg/L (alt.)
Well Water Pumping [a, b]	360	380	180	375	540	560	735	755
RO Feed Pumping [a]	355	495	295	315	475	790	485	810
Product Water Pumping [a, c]					615	615	615	615
Concentrate Pumping [a, d]					78	40	245	115
Electrical Pumping Costs					*1708*	*2005*	*2080*	*2295*
Cost per MG					*297*	*348*	*362*	*399*
General Building Electric Load					79	79	79	79
Decarbonation Blower					25	25	25	25
Electrical Operating Costs (not including pumping)					*104*	*104*	*104*	*104*
Cost per MG					*18*	*18*	*18*	*18*
Cartridge Filters	17	17	20	20	37	37	37	37
Scale Inhibitor	91	127	76	81	120	203	99	150
Sodium Hydroxide					-	159	-	160
Sodium Hypochlorite [e]					10	5	10	5
Membrane Chemical Cleaning	36	95	186	55	222	281	91	150
Chemical Operating Costs					*389*	*685*	*237*	*502*
Cost per MG					*68*	*120*	*41*	*88*
By-pass Cartridge Filters			30	30	30	30	30	30
By-pass UV Power			2	2	2	2	2	2
By-pass UV Lamp Replacement			3	3	3	3	3	3
By-pass UV Chemical Cleaning			5	5	5	5	5	5
Patent Royalty [f]	NA	NA	6	6	6	6	6	6

Table 6.7 Cont'd — **Zone B/Lost Use Treatment Facility O&M Cost Estimate**
Zone B Reverse Osmosis Pilot Study
Jordan Valley Water Conservancy District

Description	Daily Costs (2002 $)							
	Zone B		Lost Use	Lost Use (alt.)	Combined Zone B & Lost Use Treatment Plant			
	800 mg/L	250 mg/L	250 mg/L	250 mg/L	800 mg/L	250 mg/L	800 mg/L (alt.)	250 mg/L (alt.)
By-pass Operating Costs					*46*	*46*	*46*	*46*
Cost per MG					*8*	*8*	*8*	*8*
Membrane Replacement [g]	130	179	345	103	475	524	233	282
Labor [h]					732	732	732	732
Laboratory Testing					65	65	65	65
General Building Utilities					21	21	21	21
Equipment Replacement Parts and Consumables					244	244	244	244
Indirect Operating Costs					*1,537*	*1,586*	*1,295*	*1,344*
Cost per MG					*268*	*277*	*226*	*235*
JVWCD Overhead Allocation					*100*	*100*	*100*	*100*
Cost per MG					*17*	*17*	*17*	*17*
TOTAL COST (w/o pumping)					**2,176**	**2,521**	**1,782**	**2,096**
COST PER MG (w/o pumping)					**380**	**440**	**310**	**366**
TOTAL COST (with pumping)					**3,884**	**4,526**	**3,862**	**4,391**
COST PER MG (with pumping)					**675**	**787**	**661**	**764**

Table 6.7 Cont'd	Zone B/Lost Use Treatment Facility O&M Cost Estimate Zone B Reverse Osmosis Pilot Study Jordan Valley Water Conservancy District							
	Daily Costs (2002 $)							
	Zone B		Lost Use	Lost Use (alt.)	Combined Zone B & Lost Use Treatment Plant			
Description	800 mg/L	250 mg/L	250 mg/L	250 mg/L	800 mg/L	250 mg/L	800 mg/L (alt.)	250 mg/L (alt.)

Notes

a Power cost = $0.055/kW-hr; η_{pump} = 0.75; η_{motor} = 0.9; Hazen & William's C = 130 (PVC = 150 psi max.)
b 30 psi residual pressure at RO WTP
c Finished water to Jordan Aqueduct, hydraulic gradient = 4700 ft H_2O
d 8-inch by-product pipe for 800 mg/L; 10-inch by-product pipe for 250 mg/L
e On-site generation of hypochlorite
f Vendors that have certified (i.e., by DVGW) reactor performance do not hold patent. Patent is currently being challenged.
g Interest/Inflation = 2.5%
h Includes 2 operators per well supply. One supervisor provided under enhanced treatment costs.

The incremental cost of treatment from a finished water TDS goal of 800 mg/L to 250 mg/L is estimated to be approximately $530 per day assuming that the 72% Lost Use recovery rate is implemented initially. The incremental costs are primarily associated with additional RO feed water pumping, membrane replacement, and chemical use. Labor costs also increased to provide consistency with the District's previous study.

6.6 SUMMARY

Design criteria, facility layouts and cost estimates were presented in this section based on pilot testing data presenting previously in this report. An alternative for the Lost Use facility that was not pilot tested, operating at an RO recovery of 72%, was also presented. The incremental costs associated with RO treatment from a finished water TDS of 800 mg/L to 250 mg/L are also summarized as being approximately $594,000 in capital costs and between $194,000 per year in operations costs assuming that a 72% Lost Use recovery rate is implemented.

Alternatives exist that hold potential for the District to further reduce their costs. During the pre-design phase of this project the District should consider:

- Alternate sites for the treatment facility. Locating the treatment plant in a two story structure on the hill to the east or west side of the District's main office may provide

cost savings due to better soils conditions and less site work and also by utilizing the hydraulic gradient of the hill to move water from the RO through the post treatment processes.

- Operating the Lost Use treatment facility at a recovery of 72%. Operating the Lost Use system at a lower recovery may lower O&M costs by an estimated $135 per day (i.e., $50,000 per year). These savings are the result of an estimated reduction in chemical cleaning frequency and an extended membrane life.

The incremental cost of treatment from a TDS goal of 800 mg/L to 250 mg/L is estimated to be approximately $594,000 in capital costs and between $530 per day in operations costs assuming that the Lost Use system is operated at a 72% recovery. Incremental capital and operations costs are primarily associated with additional RO treatment required to meet the 250 mg/L TDS goal.