M/035/002

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 Salt Lake Valley

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Submitted December 16, 1999
Revised April 28, 2000

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Kennecott

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M/035/002

Kennecott

28 April 2000

Dianne R. Nielson, Ph.D.
Executive Director
Utah Department of Environmental Quality
168 North 1950 West
Salt Lake City, UT 84114-4810

HAND DELIVERED

RE: Final Kennecott Proposal for a Groundwater Extraction and Treatment Remedial Project

Dear Dr. Nielson:

Enclosed are six copies of the "Proposal to the Utah State NRD Trustee and USEPA CERCLA Remedial Project Manager for a Groundwater Extraction and Treatment Remedial Project in the southwestern Salt Lake Valley" by Kennecott Utah Copper Corporation and the Jordan Valley Water Conservancy District.

This revision of our December draft proposal responds to the questions and concerns raised by your staff and other stakeholders. It also includes additional data to support the proposed plan.

Please feel free to have your staff call me if you have any questions.

Sincerely,

Jonathan F. Callender, Ph.D.
Manager Strategic Resources

Cc: Eva Hoffman, USEPA
Robert L. Morgan, UDWR
Richard Bay, JVWCD
W. R. Williams, KUCC
M.S. Shoop, KUCC

DOGM Received two copies of proposal

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M/035700

Southwestern Jordan Valley Ground Water Plumes Proposed Plan

Addressing Operable Unit 2 of the Kennecott South Zone and State Trustee's Plan for use of Damage Settlement Trust Funds

EPA/UDEQ **August, 2000**

EPA AND UDEQ ANNOUNCE PREFERRED CLEANUP ALTERNATIVE

The public is invited to comment on a proposal to clean up ground water in Southwest Salt Lake County. The plan was drafted by the U.S. Environmental Protection Agency (EPA), in coordination with the Utah Department of Environmental Quality (UDEQ). The agencies also worked closely with Kennecott, the Jordan Valley Water Conservancy District, and local and state water interests to develop this plan.

The ground water was contaminated by historic mining activities in the Oquirrh Mountains. Several plumes were formed as a result. A pump and treat method has been selected as the preferred cleanup alternative. The agencies have determined that it is necessary to remove the contaminated water from the aquifer to prevent it from spreading. The water will be treated then made available as a public drinking water source.

The public is invited to review and comment on the preferred alternative, as well as the other alternatives considered. The original documents used in the study and selection process - including the Remedial Investigation/ Feasibility Study[1], the Consent Decree between the State Trustee for Natural Resources and Kennecott Utah Copper Corporation, and plans submitted to the Trustee - are available on request at the information repositories. (See page two).

PUBLIC COMMENT PERIOD
August 1 to August 30, 2000
OPEN HOUSE
Tuesday, August 1 from 4 to 8 p.m.
(Brief presentation on each hour)
UDEQ, 168 N. 1950 W. Rm. 101
Salt Lake City
PUBLIC HEARING
Wednesday, August 9 - 7 p.m.
West Jordan City Council Chambers
8000 S. Redwood Road
QUESTIONS?
Project Managers
Eva Hoffman EPA
1-800-227-8917 x6764
Doug Bacon UDEQ
(801) 536-4282
Community Relations
Nancy Mueller, EPA
1-800-227-8917 x6602
Renette Anderson, UDEQ
(801) 536-4478

PUBLIC INVOLVEMENT PROCESS

The process is administered under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986[2]. This proposed plan is prepared to fulfill CERCLA public participation requirements. In addition, the State was awarded a Natural Resource Damage Claim settlement to "restore, replace, or acquire the equivalent" of the water lost to contamination. The Trustee (the UDEQ Executive Director) is seeking comment on the proposed cleanup action submitted by Kennecott and the Jordan Valley Water Conservancy District.

EPA and the UDEQ Trustee will select a final remedy only after considering comments from citizens, communities and other governmental agencies. Following public comment, EPA will publish a Record of Decision (ROD)[3] and UDEQ will respond to all comments received and document the rationale for the final decision.

Note: Footnoted words are defined at the end of the document.

PUBLIC INVOLVEMENT OPPORTUNITIES

*** PUBLIC COMMENT PERIOD**
Written comments on this plan and related documents will be taken through August 30. Bring them to the public meeting or send comments to:

Eva Hoffman, 8EPR-SR
EPA Region VIII
999 18th Street, Suite 500
Denver, CO 80202-2466
E-mail comments to: hoffman.eva@epa.gov

Oral comments will be taken at the August 9 Public Hearing (see front). If you need special assistance to participate, contact Renette Anderson at (801) 536-4478 or TDD# (801) 536-4414 at least three working days before the meeting.

RECORD OF DECISION:
Scheduled for Fall, 2000

*** INFORMATION REPOSITORIES**
The documents referenced in this proposed plan, along with other related documents, are available for public review or copying at the following locations:

West Jordan City Hall
City Recorder's Office
8000 South Redwood Road
Hours: M-F 8 a.m. to 5 p.m.

UDEQ Superfund Branch
168 North 1950 West, 1st Floor
Salt Lake City UT 84116
Hours: M-F 8 a.m. to 5 p.m.

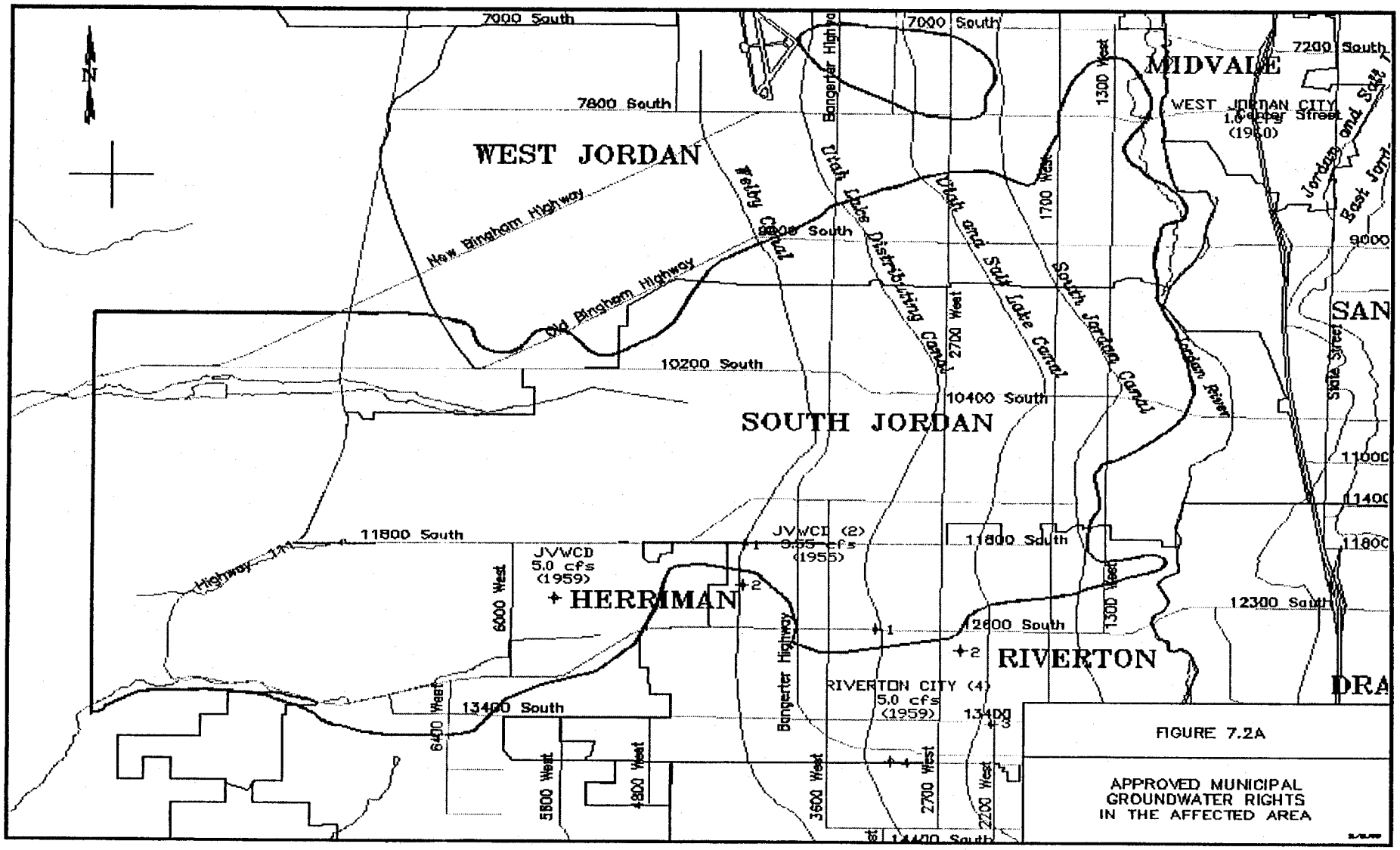
EPA Superfund Records Center
999 18th Street, Suite 500
Denver, CO 80202-2466
Hours: M-F 8:30 a.m. to 4:30 p.m.

***Note:** Upon timely request, the comment period may be extended. Such a request should be submitted in writing to EPA, postmarked no later than August 25, 2000. Failure to raise an issue or provide information during the public comment period may prevent you from raising that issue or submitting such information in an appeal of the agencies' final decision.*

SITE BACKGROUND

Mining has taken place in the Oquirrh Mountains since the 1870s. Historical mining processes, including past and current Kennecott operations, have resulted in contamination of soil and ground water. Rain, snow, and water from mining activity, filtered through waste rock dumps and leached out acids, sulfates and metals. Reservoirs built to hold these waters leaked for many years. Contaminated water also washed down streams and creeks or seeped into the aquifer which, in turn, became contaminated. Non mining sources, such as irrigation canals, may have contributed to the problem.

Groundwater in the area flows underground from the Oquirrh Mountains toward the Jordan River. The existing contamination has spread out as plumes within the aquifer underlying the communities of West Jordan, South Jordan, Riverton, Herriman and adjacent unincorporated areas of southwest Salt Lake County. A recent study indicates that the volume of water with concentrations of chemicals above health standards is about 171,000 acre-feet of ground water.



The map shows the location of the ground water plumes in relation to the impacted communities. For study purposes, the plumes were divided into two zones. Zone A is adjacent to the Large and Small Bingham Reservoirs, cemetery pond, waste rock dumps, and the historic Lark operations. The Zone A plume contains a core which is made up of acidic water, heavy metals, and high concentrations of sulfates as well as an area of lower sulfate concentrations. Zone B includes the lower sulfate concentrations which leaked out of the South Jordan Evaporation Ponds.

There are three major sources of contamination:

1. Early miners noticed that water percolating through their dumps came out the bottom and contained substantial concentrations of acid, sulfate, and metals. Utah Copper (a predecessor of Kennecott) began capturing the water coming from its dumps as early as the 1920s in order to recover the metals. In 1942, Kennecott began placing recycled water on the waste rock dumps to actively leach metals from the waste rock. This water was collected and sent through an extraction process to remove copper. Some of the recycled water was lost from the circuit because of leaks.

Between 1965 and 1991, Kennecott stored some of this water in three collection reservoirs located east of Copperton. Investigation showed that these reservoirs were a major source of contamination that impacted the aquifer. The reservoirs were not lined and they leaked about 1 to 2.8 million gallons a day. The soils neutralized some of the acid. The contaminated ground water has moved about five miles from the original source. Kennecott reconstructed the leaking reservoirs in 1991 and lined them with clay and two layers of High Density Polyethylene (HDPE) plastic.

2. Another source was mining operations in the area near the former town of Lark. Two tunnels, the Mascotte Tunnel (1902 - present) and the Bingham Tunnel (1952 - present), discharged contaminated mine waters into Midas Creek, where some of it soaked into the ground. Sometimes the mine waters were used for irrigation by local farmers. The tunnels still discharge contaminated mine waters, but these waters have now been directed toward Kennecott's industrial process water circuit. Exposed waste and mill tailings may also have contributed to the problem.

3. The third major source was the former South Jordan Evaporation Ponds, located west of 4000 West between 10200 and 11800 South. This area was used to dispose of extra water from Bingham Creek that was not needed in mining. The water was diverted to ponds where it either evaporated or soaked into the ground. In the 1930s, this water was not treated. In the 1980s, the water was treated with lime before entering the ponds. In 1994, Kennecott removed all the sludges to a central repository located within the footprint of the original ponds.. The contaminated water which leaked into the ground has now spread nearly to the Jordan River.

SUMMARY OF SITE RISKS

Action is being proposed because EPA and UDEQ have determined there is a risk to public health and the environment from the ground water plume. EPA considers the principal threat in the area to be the original sources of the ground water contamination which are now controlled. The secondary threat is the ground water plume.

The contaminants of concern depend on location:

In Zone A, near the former Bingham Reservoirs, the contaminants are acidic water, heavy metals, and sulfate. Their concentrations exceed drinking water standards, sometimes by a factor of one hundred or more.

In Zone B, the contamination is solely due to sulfates.

Acidic waters can corrode pipes. Some heavy metals are carcinogens and others do damage to livers,

kidneys and the nervous system. EPA has determined that drinking water with sulfate concentrations in excess of 1,500 mg/l present a health threat, especially to visitors and infants. Local residents will build up a tolerance to sulfates. Visitors to the area who may drink the water may experience diarrhea. Infants are particularly at risk because the diarrhea can cause dehydration.

Sulfates in both zones exceed State Drinking Water Secondary Standards. Public water suppliers keep the sulfates lower than 250 mg/l because of taste and odor problems unrelated to health and because of marketability issues.

Experiments at the site indicate that water with less than 2000 mg/l sulfate can be used for irrigation without harming grass, shrubbery, trees, or alfalfa. Two experiments were performed, one by Kennecott and the other by Utah State University, in which different grasses, landscaping shrubs, and garden vegetables were investigated to see the effects of irrigating with water having different sulfate concentrations.

A major concern to the agencies is the proximity of the contaminated ground water plumes to the municipal well fields of West Jordan and Riverton. If nothing is done to control the spread of the plume, pumping by these two municipalities could draw the contaminated waters in the direction of the municipal wells and might cause the cities to have to abandon them. Kennecott has filed a petition with the State Engineer to place a moratorium on increased pumping rates and new well installations. In return, Kennecott is willing to provide alternative water sources to assist impacted well owners

REMEDIAL ACTION OBJECTIVES

The proposed action outlined in this plan is the result of environmental investigations and actions taken in the Kennecott South Zone. The surface waste problems were addressed in separate CERCLA actions. The surface wastes that were cleaned up were Bingham Creek sediments, the Lark waste rock and tailings, Butterfield mine waste rock, South Jordan Evaporation Ponds sludges, and the Large and Small Bingham Reservoir reconstruction. State ground water authorities are being used to control any potential leakages from the waste rock dumps, leachate collection system, and operating reservoirs.

This plan addresses both CERCLA and Natural Resources Damage Claim concerns over the ground water contamination. While the administration of the Zones A and B may appear to be separate, both agencies understand that the cleanup of the two are linked. EPA's focus has been on the Zone A plume because the State of Utah's settlement and involvement has been able to adequately address the issues involved with the Zone B plume. The State Trustee is concerned with cleanup of Zone A and B plumes. In order to obtain a full rebate under the settlement, Kennecott is required to make available 7,000 acre feet of water a year. This, in turn requires the company to treat water in both zones to generate that volume.

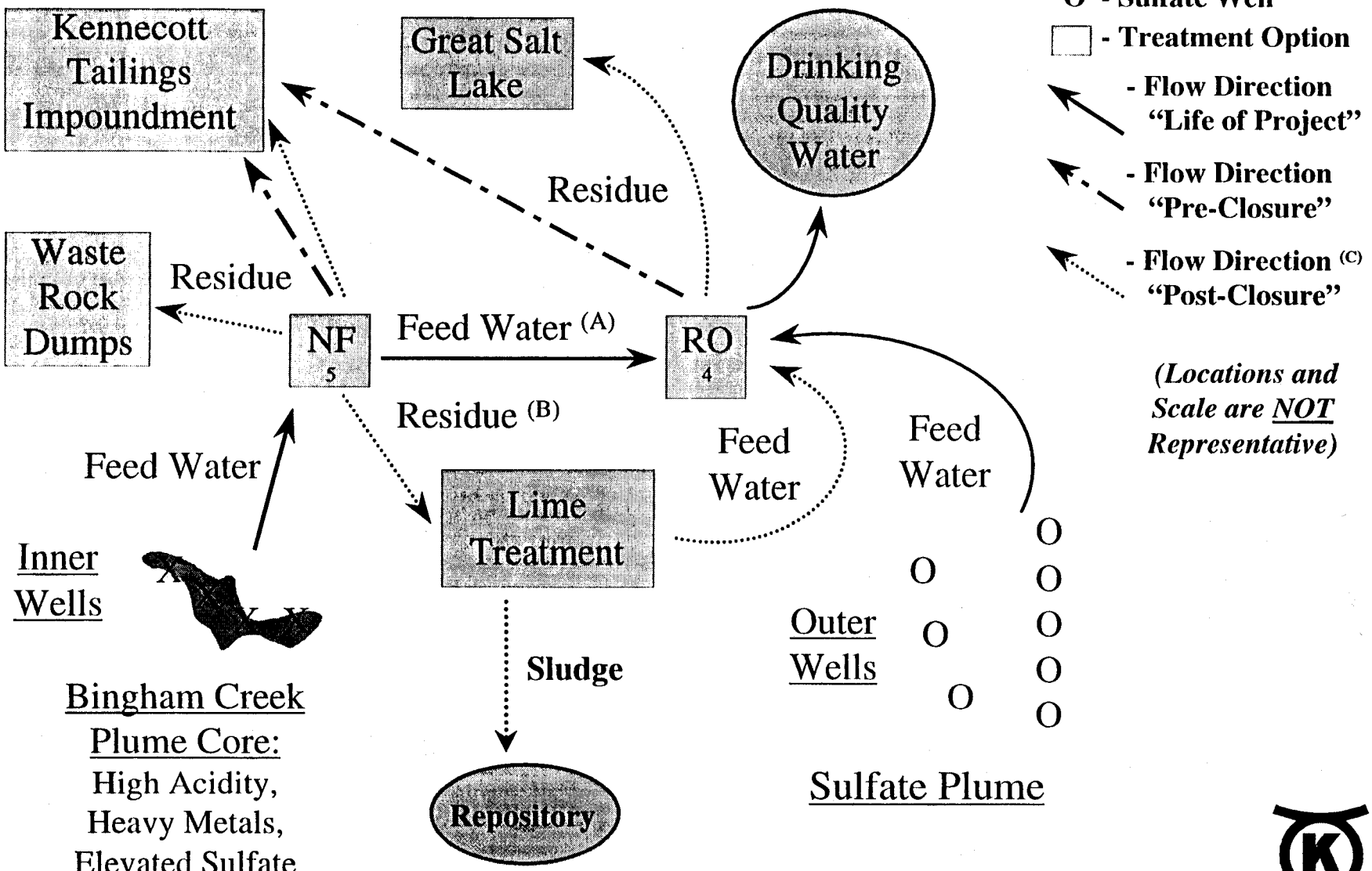
The major CERCLA objectives are:

(1) Prevent public exposure to contaminated ground water which exceeds drinking water standards;

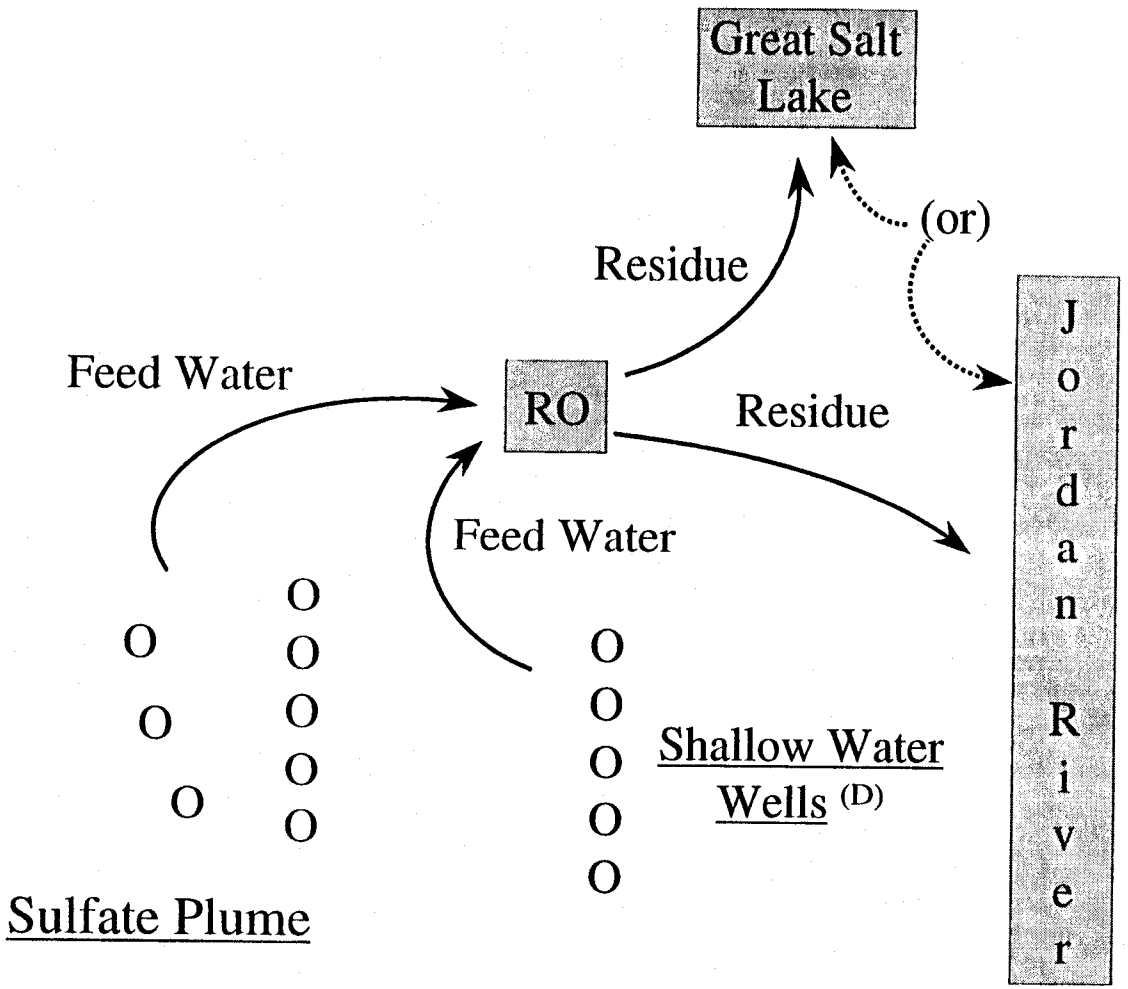
(2) Prevent exposure of aquatic organisms to contaminated ground water which may enter the Jordan River or the Great Salt Lake;

(3) Prevent further movement of the contaminated ground water into previously uncontaminated areas and to nearby municipal wells;

Zone A Plume-Treatment Flow Chart (E)



Zone B Plume-Treatment Flow Chart (E)



Footnotes:

(A) Feed water is pumped from the plumes and sent to the treatment plants for treatment.

(B) A residue is the waste material left over from the treatment process.

(C) There are three "Post-Closure" disposal options for the residue left over from treatment by nanofiltration.

i) Disposal into an evaporation pond on the waste rock dumps
ii) Disposal into an evaporation pond on the Magna Tailings Pond; or
iii) Lime treatment of the residue followed by disposal of the potentially hazardous sludge in a lined repository.

4 Reverse Osmosis, refer to glossary for definition.

5 Nanofiltration, refer to glossary for definition.

(D) Shallow water wells will be pumped to replace the lost portion of water due to the treatment process.

(E) Please refer to the revised clean up proposal submitted by Kennecott and the Jordan Valley Water Conservancy District to the State Trustee and EPA Remedial Project Manager on April 28, 2000. These are available at the information repository, IES.

(4) Provide treated drinking water to the municipalities impacted by the contamination.

The major objective of the Natural Resource Damage Claim is to "restore, replace, or acquire the equivalent" of the lost resource (in this case ground water). As part of the settlement between the State of Utah and Kennecott, the company was required to perform the following:

a. Complete the Remedial Investigation/Feasibility Study as part of the CERCLA action;

b. Extract from the acid/metal plume a rolling average of 400 acre feet on an annual basis to begin removing some of the contamination and contain the plume;

c. Complete additional source control measures. This entailed the completion of the eastside collection system and the Bingham Creek cutoff systems, in compliance with Kennecott's ground water discharge permit.

d. Create a trust fund, to include a cash sum of $9 million and an irrevocable letter of credit in the sum of $28 million, to be invested and eventually used to "restore, replace, or acquire the equivalent" of the lost resource to the benefit of the public within the affected area. Under the agreement, Kennecott can apply for a rebate of the trust fund sum based upon the quantity and quality of municipal (drinking) water they provide through treatment of the plume waters.

SUMMARY OF REMEDIAL ALTERNATIVES

Some cleanup strategies were eliminated in an initial screening because they were impractical or ineffective for the chemicals at the site. The Remedial Investigation/Feasibility Study (RI/FS) proposed six alternatives for further evaluation.

Alternative 1 is called the **"No Action"** alternative, although this is not strictly the case. It includes maintenance of pipelines, canals, and ponds used by Kennecott to provide source control. These controls are supervised under the UDEQ Ground Water Protection Program. Clean up of the ground water would rely solely on natural flushing of the aquifer. Because the aquifer is so severely contaminated, this could take 800 years or longer. The plumes may affect the Jordan River or the municipal well fields east of the river if they are not controlled.

Alternative 2, "Institutional Controls" proposes that Kennecott maintain the source control described in Alternative 1 and seek methods to prevent further well drilling in the area so that people would not be exposed to contaminated ground water. Institutional controls might include a State Engineer's moratorium on drilling, purchase of lands overlying the plumes, or purchase of impacted water rights. Like Alternative 1, there is no active restoration of the aquifer so clean up could take 800 years or longer. The plumes may affect the Jordan River or the municipal well fields east of the river if they are not controlled.

Alternative 3, "Point of Use Management" proposes that Kennecott maintain the source and institutional controls described in Alternatives 1 and 2. Kennecott and the State Engineer are investigating to see if a moratorium on new well installations in the affected area is feasible. Any citizens with private wells would be hooked up to municipal water or, if hookups were not possible, be provided with in-home treatment devices (point of use) such as reverse osmosis units. These units would fit underneath the kitchen sink and would need regular maintenance. Cost would be covered by Kennecott. Cleanup of the aquifer would rely

solely on natural flushing, and could take 800 years or longer. The plumes may affect the Jordan River or the municipal well fields east of the river if they are not controlled.

Alternative 4, "Containment," includes the measures described in Alternatives 1, 2, and 3, plus the installation of a series of barrier wells at the leading edge of the Zone A plume. As the contaminated ground water reaches these wells, it would be pumped and treated. At first, the plume could be treated by reverse osmosis. Eventually, (in five years or so), the part of the plume with the worst contamination would reach these wells and reverse osmosis[4] would no longer work. Additional treatment, probably using a new technique called nanofiltration[5], would be needed.

The primary concern with this alternative is that the barrier wells may not completely contain the plume. The secondary concern is that without treatment, the acidic ground water will take hundreds of years to clean itself up. This is because the metals trapped by the soils in the aquifer would gradually be released back into the water when fresh water begins to flush the aquifer.

Alternative 5, "Active Restoration," is the preferred alternative of EPA and UDEQ. It includes the measures described in Alternatives 1, 2, and 3, a barrier well system (outer) at the leading edge of the plume, and additional wells (inner) in the core of the plume.

The inner wells would be pumped as much as feasible in order to remove as much of the core in the shortest time possible. This pumping would drop the water levels in the area of the plume. Although this may affect nearby public and private wells, it may also serve to prevent further migration of the most seriously contaminated part of the plume. Instead of being the primary line of defense as envisioned in Alternative 4, the barrier wells would be a safety net in case any portion of the plume managed to escape withdrawal by the inner wells. Continued monitoring may provide additional information about the plume and the cleanup time frame involved.

Treatment of the outer well water would use reverse osmosis. Treatment of the inner well water would require nanofiltration before further treatment by reverse osmosis to provide drinking quality water. Kennecott proposes to build the nanofiltration and reverse osmosis treatment facility near the Copperton Cemetery along the Old Bingham Highway. While the reverse osmosis residue could be discharged to the Great Salt Lake, the nanaofiltration residue will be more heavily contaminated and will need to be handled differently. Options for this residue include (1) disposal into an evaporation pond on the waste rock dumps; (2) disposal into an evaporation pond on the Magna Tailings Pond; and (3) lime treatment of the residue followed by disposal of the potentially hazardous sludge in a lined repository.

The time required to restore the aquifer using this approach is uncertain. Kennecott's ground water mathematical model suggests that the acid plume can be withdrawn in 25 to 30 years. There are two problems in estimating the cleanup time. First, it is difficult to make decisions on information that is limited by the assumptions made by the modeler. Accuracy depends solely upon the assumptions built into the model. Second, some contaminants trapped in the soils of the aquifer will begin to redissolve back into the ground water when cleaner water begins to enter the aquifer. This could continue to pollute the ground water even if the acid plume has been withdrawn. Continued monitoring throughout the cleanup will be required so any unexpected results can be identified and addressed, if necessary. The agencies suggest that treatment in perpetuity may be needed for the ground water to be useable without restrictions.

Alternative 6 is essentially the same as Alternative 5, but the treatment methodology would be lime

treatment for the residues from the nanofiltration process. Acids would be neutralized using lime, creating a potentially hazardous sludge which would have to disposed of in a lined repository.

The Natural Resources Damage Abatement Alternative was proposed to the State Trustee to treat and contain the plumes, while providing drinking water to the affected communities. Pumping of the sulfate waters in Zone A will coincide with pretreatment and containment of the core waters in the same zone, as described in Alternative 5. The drinking water produced as a result will be combined with the drinking water produced from the treatment of Zone B ground water. This combined drinking water will be distributed to the affected communities so Kennecott can apply for a rebate of the damage claim fund.

The Zone B treatment proposal suggests the installation of wells along 1300 West and another set of wells between 2700 West and the Bangerter Highway. The ground water would be treated using reverse osmosis technology at a plant at the Jordan Valley Water Conservancy District Headquarters. Additional wells would be drilled in the shallow aquifer near the Jordan River. The water district and the Utah Division of Water Quality are investigating the feasibility of discharging the reverse osmosis concentrate into the Jordan River. Sulfate and other components of the concentrate may prevent use of this discharge location.

EVALUATION OF ALTERNATIVES

CERCLA requires that remedial alternatives be evaluated using the nine criteria of the Superfund National Contingency Plan (NCP). These criteria fall into three categories:

> The threshold criteria include: (1) protection of human health and the environment and (2) compliance with laws and regulations.
>
> The balancing criteria include: (3) long term effectiveness and permanence, (4) reduction of toxicity, mobility, or volume through treatment, (5) short term effectiveness, (6) implementability, and (7) cost.
>
> The modifying criteria include: (8) state acceptance and (9) community acceptance. In addition, the NCP lists certain specific expectations for ground water remedies. These include the return of useable ground water to beneficial uses (wherever practicable) or prevention of further migration, prevention of exposures, and other risk reduction measures.

The purpose of the Natural Resource Damage Claim settlement is to restore, replace, or acquire the equivalent of the natural resource (ground water) for the benefit of the public in the affected area. The settlement Consent Decree gives specific conditions whereby any plan submitted by Kennecott can receive financial credit from the settlement account. The amount of credit is related to both the quality and quantity of treated water that Kennecott provides the cities. The State Trustee can choose to reject the plan entirely and use the account to fund a different plan.

PREFERRED ALTERNATIVE

EPA and UDEQ prefer Alternative 5, coupled with the Natural Resource Damage Claim Settlement Alternative presented to the Trustee by Kennecott and the Jordan Valley Water Conservancy District. Of the alternatives evaluated, this preferred approach best satisfies the NCP criteria in protecting human health and the environment, and effectiveness in cleaning up the contaminated aquifer. The preferred alternative also

features return of the damaged waters to beneficial use by the public

The agencies prefer the disposal of concentrates from the acid plume into the tailings slurry pipeline while mining operations continue. A diagram of this alternative is given in Figure 2. Mine closure may occur either suddenly due to market turndown or not for 30 years or longer when ore reserves dwindle. The agencies believe that storage and evaporation in a lined facility or lime treatment of the concentrates can be implemented quickly should the mine close without much warning. This would depend on the chemical nature of the residues at the time. At this time, it is not known what effect other waste streams might have on the residues. The agencies also recognize that mine closure might not occur any time soon and, by that time, new technologies might be available for handling the wastes and more might be known about the impact the wastes might have. EPA suggests that investigations be undertaken during operations to determine how feasible it would to combine cleanup residues with other waste streams.

It is also uncertain at this time whether or not the treatment concentrates would exhibit hazardous waste characteristics. Depending on the alternative finally implemented, a waiver of certain state or federal regulations concerning the disposal of hazardous waste may be requested, based on the remedy meeting equivalent standards. The State is reviewing the Bevill exemption ruling, which contains specific rules applicable to mining waste, to determine if these waivers would apply.

GLOSSARY

1. **REMEDIAL INVESTIGATION/FEASIBILITY STUDY**: Collection and analysis of information about a site to determine the nature and extent of contamination that may be present, and identification and evaluation of the most appropriate technical approaches to address contamination at the site.

2.**CERCLA (Comprehensive Environmental Response, Compensation and Liability Act)**: A federal law passed in 1980 and amended in 1986 by **SARA (Superfund Amendments and Reauthorization Act)**. The Acts created a special tax that goes into a Trust Fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites. It also contains provisions whereby industries can clean up their own problems with federal and state oversight.

3. **ROD (Record of Decision)**: A public document that explains which cleanup alternative will be used at the site. The ROD also contains a Responsiveness Summary in which EPA responds to issues raised during the public comment period.

4. **REVERSE OSMOSIS**: A process for the removal of dissolved ions from water. Pressure is used to force the water through a semi-permeable membrane which will transmit water but reject most other suspended and dissolved materials. The process is called reverse osmosis because mechanical pressure is used to force water to flow in the direction that is reverse of natural osmosis, namely from the dilute to the concentrated solution.

5. **NANOFILTRATION**: A process which uses a semi-permeable membrane for the selective removal of chemicals from water. The membrane has small pores, allowing the removal of metals and sulfates from the contaminant plume.

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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 Salt Lake Valley

Submitted December 16, 1999
Revised April 28, 2000

1.0 INTRODUCTION

Kennecott Utah Copper Corporation (KUCC) and the Jordan Valley Water Conservancy District (JVWCD) make this joint proposal to Dr. Dianne R. Nielson, the Utah Trustee for natural resource damage (NRD), who also acts as Director of the Utah Department of Environmental Quality (UDEQ). In addition, the proposal is 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.

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. KUCC and JVWCD seek to utilize the trust fund set up under the 1995 NRD Consent Decree, in a manner consistent with the terms of the Consent Decree and to restore the equivalent injured resource.

The concepts of this Proposal have been presented to the governing organizations of West Jordan City, South Jordan City, Riverton City and the Town of Herriman.

1.1 Executive Summary

In summary, the Proposal:

- is designed to furnish up to 9,300 AF/year of municipal quality water to be provided to the public in the Affected Area
- includes the construction and operation of two reverse-osmosis water treatment plants

- includes construction and operation of pipelines and extraction wells

- seeks to utilize all portions of the Trust Fund, except that relating to administration and costs. As such, KUCC's portion of the Proposal seeks to use all the funds available under the Irrevocable Letter of Credit (ILC), thereby reducing the ILC to zero after the proposed project is constructed and operating. JVWCD seeks the balance of the Trust Fund to supply (restore or replace) the remaining amount of municipal quality water contemplated by the Consent Decree, including replacement of lost concentrate water

- provides additional costs and in-kind contributions to the Proposal of $164.4 million by KUCC, and. $16.4 million by JVWCD

- anticipates providing municipal quality water to the public in the Affected Area by December 2003 if the Joint Proposal is approved by September 2000

- presents a proposed 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 will submit change applications in spring 2000 to accomplish the proposed allocations

- integrates the CERCLA remedial response for the Bingham Creek acid and elevated sulfate plume with the actions required to satisfy the NRD Consent Decree.

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 hazardous substances from milling and mining activities by KUCC and its predecessors in the southwestern part of the Salt Lake Valley.

In 1990 the Utah Department of Environmental Quality (UDEQ), the successor Trustee, arrived at a natural resource damage (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 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 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 UDEQ State Trustee, who is also 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 acre-feet per year) 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% 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 Trustee then calculated the costs of producing 7,000 acre-feet of water annually for 50 years, in 1995 dollars, 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 the project was estimated at $28 million in 1995 dollars.

The trust fund includes $9 million that was provided to the State Trustee in cash by KUCC, and "which 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 trust fund also included an irrevocable letter of credit from KUCC in the amount of $28 million, escalating annually at 7 percent. The irrevocable letter of credit was the net present value of the funding to undertake the treatment program to produce (treat) municipal quality water from groundwater in the affected area.

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

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

[a] Increases at 7% annually
[b] Assumed annual increase of 5%, as invested by UDEQ

"Municipal Quality Water" is defined 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 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 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.

2.2 Federal CERCLA Requirements (USEPA)

Substantial commencement of remedial studies under the federal requirements of CERCLA (also known as Superfund) followed the approval of the NRD consent. 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, 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 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 has tentatively accepted this proposed remedial action plan and has submitted the integrated remedial response program to the federal Remedy Review Board (RRB) for their consideration and approval in May 2000; the RRB proposal is attached (Appendix B). The next steps in the federal CERCLA process involve public hearings and ultimately issuance of a Record of Decision (ROD) by USEPA.

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 more than 7,000 acre-feet (AF)/year 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 AF/year 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 up to 2,300 AF/year of treated water.[1]

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

Based on initial review of this proposal, JVWCD requested a memo from CDM that amends the November 1999 CDM Conceptual Design Report. This memo provides updated cost estimates for a single concentrate discharge pipeline from the combined Zone B treatment plant. This results from concentrate discharge issues that are further described in Section 5.6.

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 federal Third District Court of the State of Utah. A board of eight directors, who represent seven geographical divisions, governs JVWCD. They are nominated by either the county commission or a city council, depending upon the division they represent. The Governor appoints each director for a four-year term.

JVWCD provides municipal and industrial (M&I) water to most areas of Salt Lake County that lie outside of the Salt Lake City service area. Portions 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.

[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.

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 a proposed project that is comprehensive in meeting 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:

- Contain the contaminated groundwater plumes from enlargement
- Place the water to beneficial (municipal) use
- Remediate the aquifer over the long term
- Restore and replace the equivalent of the affected natural resource for the benefit of the public in the affected area.

3.2 Meet the Intent and Remedial Requirements of CERCLA

The project includes the following purposes anticipated in the RI/FS process:

- Protect human health and the environment
- Remediate the aquifer over the long term
- Contain the acid and highly elevated sulfate plume from enlargement.

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 beyond the 500-800 mg/L 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 Figure 4.1A) that is lost as a concentrate stream resulting from membrane treatment processes. JVWCD proposes a Jordan River/shallow groundwater membrane treatment project under its own water rights to accomplish this purpose, which is contemplated in the Consent Decree

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

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

4.0 AFFECTED AREA AND PUBLIC

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 defines the "Affected Area" as "the area in the southwestern portion of the Salt Lake Valley where surface and groundwater have been injured by Kennecott's mining and leaching operations." The Consent Decree further defines "injury to...groundwater" as contamination caused by Kennecott'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 redissolved in the future."

KUCC and JVWCD believe that the best representation of the Affected Area is the map of groundwater sulfate concentrations above 250 mg/L at any level. This is because sulfate concentrations above 250 mg/L are clearly above natural background concentrations. This map was developed in the RI/FS process, and has been updated by KUCC to represent recent data. That map is shown as Figure 4.1A.

KUCC and JVWCD have defined the envelope showing the Affected Area, as shown in Figure 4.1B. For purposes of the Proposal, the total envelope is divided into two zones, A and 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, some lower concentration plume areas emanating from the Lark area, and areas of sulfate concentrations from 250 to 1,000 mg/L in the Herriman area. Zone A includes the area commonly referred to by the TRC as the "acid plume."

Zone B encompasses approximately the eastern half of the Affected Area, and includes areas impacted originally by the evaporation ponds in South Jordan. It includes sulfate concentrations generally from 250 to 1,000 mg/L. It includes the majority of the area referred to by the TRC as the "sulfate plume."

4.2 Public in the Affected Area

Figure 4.2A shows the corporate boundaries of public agencies in the Affected Area. These include the cities of West Jordan, South Jordan and Riverton, the Town of Herriman, and unincorporated Salt Lake County lands.

5.0 PROPOSED PROJECT

5.1 General

The physical facilities of the proposed project are described in the conceptual design report by CDM, which is attached to this proposal. 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 and Zone B facilities. The CDM conceptual design report explains the cost-effective reasons for this segregation.

5.2 Groundwater Extraction

Groundwater extraction for treatment will involve existing KUCC extraction wells 1193 and 109 in Zone A and new extraction wells B1 through B8 in Zone B, as shown in Figure 5.2A (Figure 5-9 in the CDM report). Table 2-1 in the CDM report gives more information on each well. KUCC will continue to operate its acid plume extraction well 1146 and other acid extraction wells to be completed over the next 15 years to remove the majority of the mass of the acid plume before mine closure (see Appendix B). KUCC will also operate well LTG1147, its "sulfate extraction well" north of Herriman. This will contain and contract the Lark plume area. These wells are also shown on Figure 5.2A. Some portion of this extraction may be used as feed water for the Zone A treatment plant.

These extractions will provide sufficient feed water to membrane process water treatment plants to provide for 7,000 AF annually of treated water from the deep, principal aquifer. Table 5.2A shows the average annual volumes of groundwater extraction from these wells.

New wells SW1 through SW4 are additional shallow wells that will extract 3,000 AF annually from the shallow aquifer zone, which lies above the deeper principal aquifer in areas just west of the Jordan River. This will provide an additional component of the project to "restore or replace" the lost part of groundwater in the Affected Area, that is, loss of concentrate stream from 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.

TABLE 5.2A
Annual Groundwater Extraction Volumes

Wells	Annual Extraction (AF)
Zone A Acid Well	2400-4000
Zone A (wells 1193 and 109)	4000
Zone A sulfate well (1147)	800
Zone B (wells B1-B8)	4200
Shallow Wells SW1-SW4	3000
Total	14,500-16,000 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 6-16 inches will collect extracted water from project extraction wells and convey the feed water to Zone A and Zone B treatment plants. Collection pipelines for Zones A and B are shown in Figure 5-5 of the CDM report. Collection pipelines for the four shallow wells located in Zone B are shown in Figure 5-8 of the CDM report (slight modifications from the original plan for collection pipelines are shown in Figure 5.2A).

5.4 Water Treatment Plants

CDM has evaluated the treatment process required to produce municipal quality water from groundwater in the Affected Area. The membrane process known as reverse osmosis (RO) has been selected by CDM. CDM has outlined in section 3 of their report the treatment process performance to produce municipal quality water with a total dissolved solids (TDS) concentration of 250 mg/L.

Two water treatment plants are proposed. Figure 5-5 in the CDM report shows the Zone A plant, located near 7000 West 10200 South, and the Zone B plant located at 8300 South 1000 West. JVWCD and KUCC have slightly modified the Zone A plant location to 8200 West 10200 South as shown in Figure 5.2A. The Zone A plant will be constructed on land owned by KUCC. The Zone B plant will be constructed on land owned by JVWCD. The location of the Zone A plant may be modified by KUCC to optimize treatment and conveyance and reduce costs. The Jordan River shallow wells component will involve a common treatment plant with the Zone B plant, as shown on Figure 5-8 of the CDM report.

CDM has prepared site layouts and preliminary treatment plant designs for the Zones A and B plants. These are shown in Figures 5-10, 5-11 and 5-12 of the CDM report. Section 3 of the CDM report fully explains the treatment process parameters and characteristics of the Zones A and B treatment plants, including the shallow wells component. These plant conditions are summarized in Table 5.4A. Abbreviations in this table include acre-feet per year (AF/yr) and million gallons per day (MGD).

Table 5.4A

Treatment Process	Feed Water		Product (Treated) Water	
	(AF/yr)	(MGD)	(AF/yr)	(MGD)
Zone A	4500*	4.46	3500	3.46
Zone B	4200	4.06	3500	3.46
Shallow Wells	3000	3.0	2300	2.3

*Approximate. Zone A will deliver sufficient feed water to produce 3500 AF/yr of permeate.

5.5 Treated Water Deliveries

The two treatment plants are located within the service area of the JVWCD treated water conveyance infrastructure. The discharge 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 treatment 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 JVWCD's Zone C reservoir, at an elevation of 5,150 feet above sea level, at 7000 West 10200 South. 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.

The Zone B treated water will be conveyed southward to the JVWCD 16-inch transmission pipeline along 9000 South. In addition, it will be conveyed westward to the JVWCD 78-inch Jordan Aqueduct at 3600 West. Either location will provide water to the public in the Affected Area, as well as to other JVWCD member agencies.

5.6 Concentrate Disposal

KUCC proposes to use its existing tailings slurry conveyance pipeline from Bingham Canyon to the Magna tailings pond for conveyance of concentrate from the Zone A treatment plant. The much greater flow of KUCC tailings slurry in this pipeline will likely serve to stabilize the corrosive and precipitating nature of the project concentrate streams (Table 5.6A).

Disposal in the KUCC tailings pond will simplify discharge permitting issues. The tailings pond is subject to a UPDES and State of Utah groundwater permit, and KUCC will continue to be responsible for meeting discharge requirements from the impoundment. After mine closure, when 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.

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 6/1999	Zone A RO Concentrate	Composite Flow*	Net Change (%)
SO_4	3350	4736	3373	0.69
TDS	6200	10,259	6269	1.11
pH	6.7	7.7	6.7	0.24
Ca	722	1853	741	2.63
Cl	1070	1547	1078	0.75
K	81	27	80	-1.25
Mg	416	1080	427	2.64
Na	743	508	739	-0.54
Al	0.25	<1.0	0.26	<5
As	0.016	<0.014	0.016	<1
Cd	0.0005	<0.05	<0.001	NA
Cu	0.01	<0.05	0.011	<10
Hg	<0.0001	<0.0001	<0.0001	NA
Mn	6.00	<0.05	5.9	-1.83
Pb	0.0025	0.034	0.003	20
Se	0.016	<0.05**	0.017	<6
Zn	0.08	<0.10	0.08	<10

Notes: All values in mg/L except pH
*Composite flow uses MDL as concentration of metals in concentrate
** Se in concentrate, based on 0.002-0.003 mg/L in wells, would be 0.010 to 0.015 mg/L
All metals below detection limits in concentrate except Pb
Tailings water flow, 34,500 gpm RO concentrate flow, 600 gpm.
Range of tailings concentrations typically ± 20%.

Section 3 of the CDM report fully explains the recovery rate of the RO treatment processes and the concentrate streams. 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	0.9	Before mine closure to KUCC tailings pipeline and Magna tailings impoundment After mine closure to GSL via concentrate discharge pipeline
Zone B	0.6	To Jordan River*
Shallow Wells	0.6	To Jordan River*

*See text below for explanation

The concentrate stream resulting from the shallow wells component and from the deep wells for Zone B will be discharged northward to the Jordan River. The concentrate is proposed to discharge mainly to the Jordan River downstream from the Central Valley Water Reclamation Facility (CVWRF) discharge location at 3400 South. On certain occasions, however, the Zone B concentrate may discharge to the Jordan River at the 8300 South (Zone B plant site), as further described in the following paragraphs.

The Jordan River is governed by Utah stream classifications 3 and 4 in the vicinity of the Zone B treatment plant. Class 3 deals with fishery protection requirements, whereas Class 4 deals with agricultural water uses. The controlling parameter in Classes 3 and 4 stream classifications is a total dissolved solids (TDS) limitation of 1,200 mg/L.

JVWCD and UDEQ staffs have had several discussions regarding meeting stream classifications. The Division of Water Quality (DWQ) has performed initial contaminant loading model simulations for concentrate discharge downstream from CVWRF in the Jordan River. These simulations involved Jordan River records at 2100 South. In particular, they included the 80th percentile (highest) in TDS concentrations, and the tenth percentile (lowest) Jordan River flow rates downstream from CVWRF at 2100 South. The results show that the 1,200-mg/L TDS limitation under stream classification 4 can be met under these conditions, with a combined Jordan River TDS at 2100 South of 1120-1160 mg/L.

JVWCD is performing additional simulations using the DWQ model. However, it is apparent that the combined Zone B concentrate stream can be permitted under Utah discharge regulations. JVWCD and KUCC will hold further discussions with

the DWQ staff regarding toxicity testing or bioassays required to permit a new point source discharge to the Jordan River. However, the concentrations of metals in the RO concentrate from Zone B, which are lower than those of the Zone A concentrate. suggest that biotoxicity issues may be insignificant.

Table 5.6C summarizes the estimated inorganic quality of the concentrate streams originating from the Zone B treatment plant. The concentrate stream from the deep groundwater sulfate plume extraction wells is shown to be the worst case under initial pumping. The sulfate and calcium concentrations will substantially decrease over time, as shown in the CDM report. The shallow groundwater concentrate quality is also estimated. Table 5.6 C includes the estimated quality of the combined concentrate streams from deep groundwater and shallow groundwater extraction wells.

Table 5.6C
Zone B Treatment Plant Projected Concentrate Quality

Parameter	Units	Deep Groundwater [a]	Shallow Groundwater [b]	Combined Average Quality [c]
Calcium	mg/L	1,826	430	1128
Magnesium	mg/L	531	200	366
Sodium	mg/L	804	620	712
Potassium	mg/L	44	50	47
Strontium	mg/L	N/A	3.3	N/A
Barium	mg/L	0.10 [d]	0.14 [e]	0.12
Iron	mg/L	3.4 [d]	0.66	2.03
Manganese	mg/L	N/A	0.89	N/A
Carbonate	mg/L	N/A	1.7	N/A
Bicarbonate	mg/L	1,212	860	1036
Sulfate	mg/L	4,734	1070	2902
Chloride	mg/L	1,845	950	1398
Fluoride	mg/L	0.9	2.1	1.5
Nitrate	mg/L	18	11	15
Silica	mg/L	143	98	121
TDS	mg/L	11,160	3,800	7480
pH	s.u.	7.9	8.0	7.9

Notes:

(a) From CDM report, Appendix B

(b) From CH2M Hill report: "Shallow Groundwater Withdrawal and Treatment Studies", March 2000, Table 5-1

(c) Assumes deep and shallow groundwater concentrate streams each at 0.6 MGD

(d) Estimated as five times the feed water concentrations shown in CDM report, Table 3-2

(e) Estimated as five times the shallow groundwater concentration measured at JVWCD demonstration well in May 1999.

Certain assumptions concerning disposal of concentrate were made in reaching the NRD settlement and in developing this Proposal. KUCC and JVWCD will require sufficient flexibility to address concentrate disposal if these assumptions cease to be viable. Those assumptions are:

- Prior to mine closure, the concentrate stream from the Zone A treatment plant can be managed and conveyed in the tailings disposal 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.
- Effluent limits for the discharge of this Zone A concentrate would not be any more stringent than KUCC's soon-to-be-issued UPDES permit.
- After mine closure direct discharge of the Zone A concentrate stream to the Great Salt Lake will be permitted at such time as KUCC's tailings operation closes or prior to that time if for any reason the concentrate stream cannot be managed within the tailings disposal system.
- The combined concentrate streams from deep groundwater and shallow groundwater extraction wells at the Zone B treatment plant will be permitted as a point discharge to the Jordan River downstream from the CVWRF site.
- During selected months when the TDS concentration in the Jordan River at 8300 South is well below 1,200 mg/L, the combined Zone B plant concentrate stream may be discharged to the river at 8300 South. These occasional, periodic discharges would be made to allow filling of the Zone B concentrate pipeline with permeate from the Zone B plant for 2-6 months each time, to remove scaling that may occur in the Zone B concentrate pipeline.

6.0 GROUNDWATER IMPACTS AND REMEDIATION

6.1 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 northern base of the Traverse Mountains on the south. A more complete description of this model is included in Appendix A. Model calibration closely simulated observed aquifer conditions in the SWJV.

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.

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 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. A summary of recent extractions is included in Appendix A.

Groundwater Elevation Changes. The average depth below ground surface to the potentiometric surface of the principal aquifer in the SWJV 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 SWJV from 1986 to 1996. The Affected Area is included within SWJV. 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 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 109 and 1193 and the West Jordan municipal well field was investigated using the following pumping parameters: West Jordan pumping 4000 AF/yr, K109 at 2400 AF/yr, 1193 at 1600 AF/yr, Lark sulfate well 1147 at 800 AF/yr, and acid extraction wells (1146 and future wells) at 2400 to 4000 AF/yr. Based on these extractions, predictions can be made regarding the disposition of sulfate.

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 3,000 AF/yr. 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. See Appendix C 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 M&I water purveyors. It anticipates that municipal water rights will be used for project groundwater extractions.

7.2 Water Rights in the Affected Area

Appendix D tabulates all groundwater rights in the Utah Division of Water Rights database that lie within the Affected Area, as shown in Figure 4.1A. Various agricultural, stock watering, domestic and industrial water rights exist. The only water rights currently approved for municipal use in the Affected Area are shown in Table 7.2A and in Figure 7.2A:

TABLE 7.2A

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 within the Affected Area

Some noteworthy industrial water rights belong to KUCC, for pumping of their process production wells 1193 and 109, as follows:

TABLE 7.2B				
Water Right Number	Owner	Priority Date	Flow Rate (cfs)	Potential Annual Withdrawal (AF)
59-1653	KUCC	1961	4.0	2895
59-1042	KUCC	1962	4.44	3214
59-5314	KUCC	1962	0.52	376

JVWCD also has pending change applications for shallow groundwater rights near the Jordan River in the Affected Area. These are based upon the following change application numbers:

TABLE 7.2C				
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 Company	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

These water rights have underlying Utah Lake and/or Jordan River rights of early priority dates. JVWCD anticipates that the State Engineer will approve these rights for operation of shallow aquifer wells.

7.3 Proposed Change Applications for the Project

The following water rights are proposed for extraction wells in Zones A and B of the proposed project:

TABLE 7.3A				
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[a]	KUCC	1600	A	1193
59-1042[a]	KUCC	2400	A	109
59-5314[a]	KUCC	374	A	1147
57-5513	JVWCD	3000	B	SW1-4
[a] To be converted to municipal rights and transferred to JVWCD within five years.				

The Kennecott groundwater rights will be converted to municipal use initially. After KUCC operates the Zone A treatment plant for approximately five years, to reach stability in the treatment process, the groundwater rights will be transferred to JVWCD.

7.4 Proposal to the State Engineer Concerning Water Rights

In August 1999, KUCC proposed to the State Engineer (Appendix E) 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.

KUCC is committed to assist affected property owners in obtaining an adequate water supply by identifying alternative water sources, providing technical assistance in siting and completing 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

This is the base project that was specifically contemplated by the State NRD Consent Decree. The CDM conceptual design report includes extensive documentation and tables showing capital cost estimates for this portion of the project in Zones A and B. In summary, Table 7-2 in the CDM report shows these capital cost estimates. The total capital cost estimate is $29.7 million, based upon a 10% contingency estimate.

JVWCD and KUCC requested an updated cost estimate from CDM for the combined concentrate discharge pipeline from the Zone B plant, and for the modified treated water discharge pipelines from the Zone B plant (as shown in Figure 5.2A). That updated cost estimate is included in an updated memorandum from CDM in Appendix F. The new total capital cost is estimated at $68.45 million, based on a 10% contingency.

8.2 Capital Cost Estimates for Shallow Groundwater Extraction

This is a project enhancement proposed by JVWCD and endorsed by KUCC. The capital costs are explained fully in the CDM conceptual design report. Their Table 7-2 summarizes those capital costs. The total cost estimate is $7.3 million, based upon a 10% contingency estimate.

The April 2000 updated CDM cost estimates in Appendix F modified the cost for the Zone B project to an estimated $45.02 million, based upon a 10% contingency.

8.3 Post-Mine Closure Costs (Zone A Concentrate Pipe)

JVWCD and KUCC will share capital costs to create new conveyance of Zone A concentrate to the Great Salt Lake after mine closure. This is estimated to occur in 2015-2030. One of Kennecott's two tailings pipelines may be available for this use. No cost estimates have been made for this conveyance cost at this time.

8.4 Operation, Maintenance and Replacement Costs

The CDM conceptual design report fully explains the estimates for operation, maintenance and replacement (OM&R) costs. The CDM report also estimates the net present value of these costs. Table 7-2 summarizes the annual OM&R costs, and shows their net present value, based upon 50 years of operation. CDM's updated cost estimates in Appendix F include new OM & R costs. The major change is the decreased pumping cost for the Zone B concentrate pipeline.

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 municipal water purveyors. The Consent Decree contemplates that the water purveyor(s) receiving the Trust Fund benefits would pay its avoided cost of developing groundwater, absent contamination. This is referred to as "cost of development without contamination" in Attachment 16 of the Consent Decree.

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 is $2.9 million.

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/AF/yr 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 50-year period, assuming a 7 percent discount rate. The net present value is $4.7 million (in 1999 dollars), and $4.9 million (in 2000 dollars), as shown in Table 9.0A.

8.7 Total Cost Estimate

The total cost of the proposed project, including capital costs and net present value for 50 years of O, M&R costs is shown in CDM's Table 7-2, and in Table 8.7A. Table 8.7A has been updated since the December 16, 1999 draft KUCC/JVWCD proposal to include the CDM updated cost estimates shown in Appendix F. The total net present cost, in 1999 dollars, is $68.5 million, based on

a 10% contingency estimate. These total project costs do not include additional capital and OM&R costs that KUCC will provide in industrial pretreatment of Zone A water to allow for the conventional RO treatment of Zone A water described in this project. Also not included are the costs of pilot testing and Zone A operating costs related to additional CERCLA response actions that KUCC will provide.

Table 8.7A
Present Worth Costs of Proposed Project (thousands of 1999 dollars)[a]
(Based on 10% Contingency)

Facility	Capital Costs	O&M Annual Costs	O&M Present Costs	Replacement Costs	Total Present Costs
Zone A RO facility	10,580	810	11,100	920	22,600
JVWCD Zone A Enhancement	310	40	490	60	860
Zone B RO facility	18,220	630	8,660	990	27,870
JVWCD Zone B Enhancement	1,550	120	1,660	180	3,390
Shallow wells (capital)	9,020	NA	NA	NA	9,020
Shallow wells (JVWCD OM&R)	NA	290	4,060	680	4,740
Total Costs	**39,680**	**1,890**	**25,970**	**2,830**	**68,480**

Note: (a) Costs do not include pilot testing, which will be paid by KUCC and JVWCD
NA = Not Applicable.

TABLE 8.4A

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

September 1, 1999

1. **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

2. **Facilities:**
   (See Figure 8.4A)

3. **Cost Estimates:**
   - Pipelines:
     16,500 LF 10" PVC pipe at $4.0/LF = $66,000

   - Well Drilling:
     (Compare with 1997 1159 East 4500 South drilling costs, plus 8%)

Typical Well:		
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

Table 8.5A (continued)

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

- Pump building and site improvements:
  (Compare with 1998-1999 1159 East 4500 South well construction costs, plus 4%):

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

4. **Summary of costs:**

Pipelines	$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**

9.0 PROJECT FUNDING

KUCC and JVWCD propose to share in funding the proposed project, together with funds from the NRD Trust Fund. Table 9.0A lists the overall funding allocations proposed by KUCC and JVWCD. This table does not reflect timing of capital and OM & R funding sources, but instead shows overall project cost allocations for 50 years. Table 9.0 B shows the proposed sources and timing of capital funding for the project. Table 9.0C shows the proposed funding sources of OM & R costs for the project. Transfers from the NRD Trust Fund are proposed in three stages as follows:

Stage 1: Portions of the cash trust fund amount would be released by the Trustee directly to JVWCD for capital costs of the "Lost Use" shallow groundwater portions of the project. These funds will be released on a quarterly or monthly basis during pilot testing, design and construction.

Stage 2: KUCC would provide capital funds for pilot testing, right-of-way acquisition, design and construction costs of the Zones A and B deep groundwater portions of the project. After these facilities are deemed by the Trustee to be complete and operational, the Trustee would reduce the Trust Fund Irrevocable Letter of Credit (ILC) by the proportional capital component of the ILC.

Stage 3: When all project facilities are deemed by the Trustee to be operational, based on established obligations (by agreement) to provide 7,000 AF of treated water per year for at least 40 years, the Trustee would release the remainder of the ILC for OM & R to KUCC and would release the remainder of the cash amount in the Trust Fund to JVWCD for OM & R costs for the "Lost Use" shallow groundwater portion of the project.

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, and to be acquired by JVWCD, will be made to the project:

- Zone A treatment plant site contributed by KUCC
- Zone A pre-treatment facilities owned by KUCC
- Wells 1193 and 109 wells and sites owned by KUCC
- Water rights for wells 1193,109, and 1147 contributed by KUCC
- Zone B treatment plant site owned by JVWCD
- Wells SW1 and SW2 - land, plus well SW1 owned by JVWCD
- Water rights for wells B1-8 and SW1-4 owned by JVWCD.
- Additional in-kind contributions by KUCC include:
- Use of its slurry pipeline for concentrate disposal
- Acid plume well facilities and OM&R

- Sulfate extraction well facilities and OM&R
- Zone A pretreatment and water quality management prior to RO.

Table 9.0A
Allocation of Project Costs (thousands of July 2000 dollars)[1]
Based on Present Costs, 10% contingency, 50 years operation

Facility	Capital	O&M	Replacement	Total	Cost Allocation		
					Trust Fund	KUCC	JVWCD
Zone A							
Source control	127,000	26,343	2,291	155,634		155,634	
Acid wells	5,600	10,287	504	16,391		16,391	
Sulfate well	650	2,576	58	3,284		3,284	
RO plant	10,897	11,433	948	23,278	19,650[2]	3,628	
JVWCD process enhancement	319	505	62	886			886
Subtotal A	**144,466**	**51,144**	**3,863**	**199,473**	**19,650**	**178,937**	**886**
Zone B							
RO plant[3]	19,067	8,920	1,020	29,007	19,650[2]		2,885[4] 4,876[5] 1,596[6]
JVWCD process enhancement	1,597	1,710	185	3,492			3,492
Subtotal B	**20,664**	**10,630**	**1,205**	**32,499**	**19,650**		**12,849**
Subtotal A+B	**165,130**	**61,774**	**5,068**	**231,972**	**39,300[7]**	**178,937**	**13,735**
Lost Use (JVWCD shallow wells)	9,290	4,182	700	14,172	11,043[8]	Note 9	3,129[6]
Trustee share	657			657	657		
TOTALS	**175,077**	**65,956**	**5,768**	**246,801**	**51,000**	**178,937**	**16,864**

Notes:
1. July 2000 dollars estimated by multiplying CDM/JVWCD estimates from CDM Table 7-2 and JVWCD/KUCC Table 15.0 by 1.03
2. 50% of Letter of Credit value ($39.3 million) as of September 2000
3. Includes $300,000 for pilot testing
4. JVWCD avoided capital cost for groundwater development of 7,000 AF/yr without contamination
5. JVWCD avoided O&M cost for groundwater development of 7,000 AF/yr without contamination
6. JVWCD to pay OM&R costs of shallow wells (total estimated at $4.725 million in 2000 dollars)
7. Value of Letter of Credit by September 2000
8. Trust Fund to pay from "cost of lost use" funds (estimated at $11.7 million in July 2000)
9. Underlying water right was previously transferred to JVWCD by KUCC.

Table 9.0B Capital Cost Disbursement Schedule[1]							
Facility	Total Capital	Capital During Design and Construction[2]			Fund Disbursement after "Complete and Operational" Status Reached		
		Trust Fund[3]	KUCC	JVWCD	Trust Fund[4]	KUCC	JVWCD
Zone A							
Source control	127,000[5]						
Acid wells	5,600[5]						
Sulfate well	650[5]						
RO plant	10,897		10,897		10,897[6]		
JVWCD process enhancement	319		319				319[7]
Zone B							
RO plant	19,067		19,067		11,790[6]		2,885[8]
JVWCD process enhancement	1,597		1,597				1,597[7]
Shallow wells	9,290	9,290[9]					
TOTALS	**174,420**	**9,290**	**31,880**		**22,687**		**4,801**

Notes:

1. Costs as in Table 9.0A. Actual transfers will be indexed to the CPI for fixed amounts and based on actual expenditures for estimated amounts (excluding ILC)
2. Includes right-of-way acquisition, pilot testing, conceptual design and studies, preliminary design, final design and construction
3. From cash part of Trust Fund
4. From reduction in value of ILC ($39.3 million)
5. Includes expenditures previously made by KUCC
6. Reduction of ILC by Trustee, in favor of KUCC, after "complete and operational" status is reached
7. Amount is limited to smaller of budget or 30% of ILC ($11.79 million)
8. Transfer from JVWCD to KUCC after first year of operation (estimated amount)
9. Transfer from JVWCD to KUCC after first year of operation (fixed amount)
10. Transferred quarterly by Trustee to JVWCD to reimburse actual costs.

Table 9.0C OM&R Cost Disbursement Schedule[1]							
Facility	Total OM&R	Funding During First Year of Operation by:			Fund Disbursements after First Year of Operation by:		
		Trust Fund	KUCC	JVWCD	Trust Fund	KUCC	JVWCD
Zone A							
Source control	28.634						
Acid wells	10.791						
Sulfate well	2.634						
RO plant	12.381		834[2]		8,306[3]	7,905[4]	182[5]
JVWCD process enhancement	567		41[2]				161[6]
Zone B							
RO plant	9,940			649[2]	8,307[3]	9,940[7]	
JVWCD process enhancement	1,895			124[2]			
Shallow wells	4,882			298[2]	1,753[8]		
TOTALS	**71,724**		**875**	**1,071**	**18,366**	**17,845**	**343**

Notes:

1. Costs as in Table 9.0A. Actual transfers will be indexed to the CPI at time of transfer
2. From "Annual O&M Cost" in Table 8.7A, multiplied by 1.03 to index to July 2000 dollars
3. One-half of remaining ILC face amount reduced by Trustee in favor of KUCC
4. KUCC transfer of OM&R funds(estimated) to JVWCD at the end of the stabilization period, for NPV of Zone A OM&R through year 50. KUCC and JVWCD will adjust as necessary at the end of the stabilization period.
5. JVWCD payment to KUCC for avoided O&M cost for 3500 AF/yr (estimated, using ENR index as defined in the Consent Decree); this amount will be indexed and paid annually by JVWCD
6. Payment from JVWCD to KUCC for operation of process enhancement during stabilization period (estimated)
7. KUCC transfer of OM&R funds (estimated) to JVWCD for NPV of Zone B OM&R
8. Remainder of **cash portion** of Trust Fund (estimated), transferred by Trustee to JVWCD for JVWCD's commitment to operate and maintain the Lost Use system for 50 years.

10.0 OPERATION, MAINTENANCE, REPLACEMENT RESPONSIBILITIES

10.1 Zone A Facilities

KUCC would construct, own, operate, maintain and replace the following extraction wells:

- Extraction wells 1193 and 109 (the Zone A extraction wells)
- Well number ECG1146 (the "acid plume" extraction well) and other acid wells to be drilled five to 15 years after initiation of project to continue to capture acid plume
- Well number LTG1147 located near 6200 West 11800 South ("the sulfate extraction well").

KUCC will construct, own, operate, maintain and replace any Zone A pretreatment facility to treat the concentrations of metals and sulfate contributed from the acid plume. This facility may be an enlargement of KUCC's existing nanofiltration demonstration treatment plant. KUCC will operate this facility to maintain the concentration of sulfate in the feed water to the Zone A RO system at or below 1200 mg/L.

The collection pipelines from the project extraction wells to the Zone A water treatment plant, the water treatment plant and the concentrate discharge pipeline (to KUCC's tailings line) would initially be owned by KUCC, and operated by KUCC. This operation, likely to last five years, would allow for KUCC to gain operating experience, together with its industrial pretreatment process, and reach a point of stabilization in operational mode. The treated water (permeate) discharge pipeline to the JVWCD system would also initially be owned and operated by KUCC. After the five-year initial period, ownership, together with obligations to operate, maintain and replace the permeate discharge pipeline and RO treatment plant would be transferred to JVWCD for at least 45 years.

10.2 Zone B Facilities (for Deep Groundwater Extraction)

The facilities for extraction of approximately 4,200 AF to yield 3,500 AF of treated water would include extraction wells, collection pipelines, a RO treatment plant at 1000 West 8300 South, a concentrate discharge pipeline to the Jordan River downstream from CVWRF (this concentrate pipeline will convey both deep groundwater and shallow groundwater Zone B concentrate), and a discharge pipeline to the JVWCD system. Following construction and startup testing, ownership of these facilities would remain with JVWCD. JVWCD would commit to operate, maintain and replace these facilities for at least 50 years thereafter.

10.3 Zone B Facilities (for Shallow Groundwater Extraction)

These facilities will include four 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 downstream from CVWRF (this concentrate pipeline conveys both deep groundwater and shallow groundwater Zone B concentrate) and a discharge pipeline to the JVWCD treated water transmission system. Following initial construction and startup testing, ownership of these facilities would remain with JVWCD. JVWCD would then commit to operate, maintain and replace these facilities for at least 50 years.

11.0 ALLOCATION OF PROJECT BENEFITS

Half of the 7,000 AF of treated, principal aquifer groundwater, or 3,500 AF, will result from KUCC's rights shown in Section 7.3, which will be converted to municipal rights and ultimately transferred to JVWCD (in Zone A). The 3,500 AF of treated water that is produced in the Zone A facilities will be allocated by JVWCD to directly benefit the four incorporated communities in the Affected Area. These are: West Jordan City, South Jordan City, Herriman Town (or other valid wholesale customer of JVWCD in Herriman Town, and/or JVWCD retail deliveries to water users in unincorporated areas in the Affected Area in Salt Lake County, including the Herriman/Rose Canyon area) and Riverton City. Figure 11.0A shows the Affected Area as it compares with these four communities, as well as JVWCD retail service areas in unincorporated Salt Lake County lands.

Under this project proposal, JVWCD will use its water rights to receive half of the 7,000 AF of principal aquifer treated groundwater (in Zone B). In addition, it will use its Utah Lake/Jordan River rights for shallow groundwater extraction and treatment (in Zone B). These treated waters will be reserved for the four affected communities under wholesale contract water purchase agreements to be executed between those affected communities and JVWCD. When not contracted for by the four affected communities, these waters will be available for the benefit of all 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 communities. The factors considered in this evaluation were: 1) total population of the affected municipalities; 2) area of each city or town within the overall Affected Area; 3) area of the cities and town within the Zone A Affected Area, and 4) currently approved municipal groundwater rights in the principal aquifer within the overall Affected Area, and within the Zone A

Affected Area. Tables 11.0A, 11.0B, 11.0C and 11.0D show methods 1-4 of comparing and evaluating these factors. The allocation percentages for methods 1-4 are summarized in Table 11.0E. A recommended allocation of Zone A treated water benefits is also shown in Table 11.0E. It is summarized in Table 11.0F.

Table 11.0F
Summary of Zone A Treated Water Allocations

City/Town	Allocation (%)	Annual Volume (AF)	Flow Rate (MGD)
West Jordan City	35	1225	1.2
South Jordan City	30	1050	1.0
Riverton City	20	700	0.7
Herriman Town [(a)]	15	525	0.5

Note: (a) Or other valid wholesale customer of JVWCD in the Herriman/Rose Canyon area, and/or to residents in unincorporated Herriman/Rose Canyon areas served with retail water from JVWCD on lands in the Affected Area.

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 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.

- Riverton City will not withdraw more than 1.25 cubic feet per second (cfs) from its existing well under Water Right #59-1533 within the Affected Area.

JVWCD proposes to provide benefits from treated water resulting from Zone A facilities to the four affected municipalities by providing guaranteed treated water deliveries at greatly reduced water rates. JVWCD would accomplish this by providing this water to the four communities 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 pressure Zone C that normally includes high pumping surcharges.

To give an example, the 1999 wholesale water rates for pressure Zones B and C to West Jordan City, Riverton City and South Jordan City are:

West Jordan City: $290.73/AF (pressure Zone C)
Riverton City: $307.70/AF (pressure Zone C)
South Jordan City: $290.90/AF (pressure Zone B)

In contrast, the 1999 JVWCD rate offered to the four affected municipalities would be as shown in Table 11.0G.

Table 11.0G JVWCD Water Rate for Zone A Water	
Reduced JVWCD Water Rate (1999) for Zone A Water	Unit Cost ($/AF)
• JVWCD base wholesale rate (without pumping or peaking surcharges)	$239.22/AF
• Less JVWCD average water source unit cost	($142.49/AF)
• Less JVWCD 1999 weighted surface water treatment/wells O&M unit cost	($34.62/AF)
• Plus JVWCD "avoided operating cost", as described in section 8.5	$55.15/AF
• Plus JVWCD additional O, M&R cost to reduce TDS to 250 mg/L (Zones A and B average)	$25.56/AF
• Plus JVWCD's amortized capital contribution to the NRD project[(a)]	$59.80/AF
Net 1999 Water Rate:	**$202.62/AF**
Actual 1999 Riverton City Pumped Water Rate:	**$307.70/AF**
Actual 1999 South Jordan City Pumped Water Rate:	**$290.90/AF**
Actual 1999 West Jordan City Pumped Water Rate:	**$290.73/AF**
Note: (a) $4.8 million amortized at 6%, 20 years. Thereafter this will become a replacement sinking fund contribution, at the amortized base, indexed to future years.	

The treated Zone A water would be made available at this reduced rate, as calculated each year under the JVWCD water rate formulas and water rate study, by execution of water purchase agreements with the four communities. This rate would remain in effect for 50 years.

KUCC and JVWCD met with city managers, technical staff and mayors of the four communities during September and October of 1999. Upon invitation by the communities, KUCC, JVWCD and city staff made presentations to the councils of West Jordan City, South Jordan City and Herriman Town during November 1999.

The Herriman town council and the South Jordan City council voted to endorse the project during those meetings. Enclosed in Appendix G are the letter of endorsement from Herriman, 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. A letter of support from West Jordan City has been promised by the City and will be forwarded to the NRD Trustee and to the Remedial Project Manager when received.

12.0 SCHEDULE, DESIGN & CONSTRUCTION, FACILITIES OWNERSHIP

12.1 Proposed Project Schedule

Section 10 of the CDM conceptual design report recommends a schedule for pilot testing, design, construction, and startup/testing. Table 12.1A summarizes this schedule, the proposed schedule for approvals and transfer of Trust Fund balances to JVWCD and/or KUCC, assuming the Proposal is approved by the Trustee.

TABLE 12.1A
Proposed Project Schedule

Activity	Completed By	Transfer of Trust Funds, Facilities and Water Rights
State Trustee and staff evaluation	April 2000	
EPA Remedial Project Manager evaluation	April 2000	
State Engineer evaluation of proposal	April 2000	
State and federal public hearings	June 2000	
Trustee approval of project proposal	September 2000	
EPA Record of Decision	September 2000	
State Engineer change application approvals	September 2000	
Land purchases by KUCC and JVWCD	September 2000	
Pilot testing - Zone A - Zone B	 December 2000 February 2001	 Trustee releases funds to JVWCD for "Lost Use" water project cost
Preliminary design	March 2001	Trustee releases funds to JVWCD for "Lost Use" water project cost
Concentrate discharge permits - Zone A - Zone B	 July 2000 April 2001	
Final design	December 2001	Trustee releases funds to JVWCD for "Lost Use" water project cost
Division of Drinking Water approval	January 2002	
Award construction contracts	February 2002	Trustee releases funds to JVWCD for "Lost Use" water project cost
Complete construction	September 2003	
Startup, testing, begin operation	December 2003	Trustee credits capital costs against trust fund
Complete first year of operation	December 2004	Trustee credits O&M costs against Trust Fund
KUCC completes Zone A treatment plant operation, after process has stabilized	2008-2009	KUCC transfers ownership of Zone A plant and water rights, and operation of plant, to JVWCD

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	
Project Component	**Designed By**
Zone A Extraction Wells	Existing
Zone A Water Treatment Plant	KUCC (with JVWCD)
Zone A Concentrate Pipeline	KUCC
Zone A Treated Water Discharge Pipeline	JVWCD or KUCC
Zone B Deep Extraction Wells	JVWCD (with KUCC)
Zone B Shallow Wells	JVWCD
Zone B Water Treatment Plant	JVWCD (with KUCC)
Zone B Concentrate Discharge Pipeline	JVWCD
Zone B Treated Water Discharge Pipelines	JVWCD

12.3 Construction

Construction would be performed, by contracting directly with construction contractors, by the same parties that performed the design work shown in Table 12.2A. Startup, testing and beginning operation would be performed by the same parties.

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 Water Treatment Plant	KUCC (transferred to JVWCD after stabilization period of approximately 5 years)
Zone A Concentrate Pipeline	KUCC
Zone A Treated Water Discharge Pipeline	JVWCD
Zone B Deep Extraction Wells	JVWCD
Zone B Shallow Wells	JVWCD
Zone B Water Treatment Plant	JVWCD
Zone B Concentrate Discharge Pipeline for Deep Groundwater (to KUCC property line)	JVWCD
Shallow Groundwater Concentrate Discharge Pipeline	JVWCD
Zone B Treated Water Discharge Pipeline	JVWCD

13.0 LIABILITY AND AGREEMENTS

13.1 Liability

KUCC has certain CERCLA liability in remedial actions for contaminated groundwater. JVWCD has no CERCLA liability. KUCC will not transfer any CERCLA liability to JVWCD. JVWCD will negotiate an agreement with USEPA and the State of Utah that holds JVWCD harmless from third party claims and USEPA/UDEQ claims for environmental liabilities. In addition to this agreement, KUCC will defend, indemnify and hold JVWCD harmless from CERCLA liability or other environmental liabilities resulting from JVWCD's operation of project facilities, except from its own negligent actions.

13.2 Proposed KUCC/JVWCD Agreements with State of Utah and USEPA

KUCC and JVWCD propose to enter into an agreement with the USEPA and the State to implement the Project. The agreement will include provisions to transfer Trust Fund amounts to KUCC and JVWCD in exchange for the KUCC and JVWCD agreement to construct and operate the proposed facilities to provide municipal quality water. KUCC would agree to continue operation of its acid plume well, its sulfate extraction well, extraction wells 1193 and 109, a pretreatment/management process for feed water to the Zone A treatment plant to maintain the sulfate concentration below 1,200 mg/L for 50 years, and to operate the Zone A treatment plant for approximately five years to reach a stabilization in treatment process. Subject to its ability to implement an alternative contingency plan, KUCC will make its tailings pipeline available for conveyance of concentrates from the Zone A treatment plant.

Under the proposed agreement JVWCD would agree to operate the Zone A treatment plant (after KUCC's five years of initial operation, and subject to the on-going feasibility of the Zone A project), the Zone A pipeline, and the Zone B facilities for at least 50 years. JVWCD would maintain, repair and replace these facilities for 50 years. JVWCD would agree to make treated water available to the public, as previously described herein.

JVWCD seeks an agreement with USEPA and the State to provide a covenant not to sue and third party protection from environmental claims relating to or arising from existing contamination. KUCC will be an approving party to this agreement. The agreement will describe the proposed project, and will endorse its concept.

Because KUCC's life of operations is not currently anticipated to extend beyond 2030, the project proposal contemplates that a new concentrate discharge pipeline may need to be extended to a receiving water body rather than to KUCC's tailings pond. Given the underlying assumptions in the NRD Consent Decree, it is

anticipated that UDEQ will reasonably cooperate in permitting to allow for concentrate disposal, whether prior to or after 2030, as necessary.

13.3 Proposed KUCC/JVWCD Agreement

Assuming this Proposal is approved by the NRD Trustee, KUCC and JVWCD propose to enter into an agreement to govern the relationship between KUCC and JVWCD during the right-of-way acquisition, pilot testing, design, construction and operational periods of the project. In general, the agreement will include the following provisions:

- KUCC will perform pilot testing, design, and construct the Zone A plant and associated facilities.

- KUCC will accept concentrate discharge from the Zone A plant until mine closure. Thereafter, KUCC and JVWCD will share in costs to construct and operate alternate conveyance facilities for the duration of the 50-year period.

- KUCC will operate the Zone A plant, together with its pre-treatment facilities and other water sources, for a stabilization period of approximately five years. Thereafter, the Zone A plant and KUCC's associated water rights will be transferred to JVWCD.

- JVWCD will perform right-of-way acquisition, pilot testing, design, construction, operation, maintenance and replacement of all other project facilities, and of the Zone A plant after the stabilization period.

- KUCC will advance certain capital funds during the right-of-way acquisition, pilot testing, design and construction phases of the project. These arrangements are described further in Table 9.0B. JVWCD will operate the complete project facilities for at least 50 years. KUCC will transfer OM & R funds to JVWCD as further described in Table 9.0C.

- JVWCD will pay to KUCC the "avoided OM & R costs" for Zone A treated water (3,500 AF per year at the price defined in the Consent Decree).

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.

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 K60 and K109. The extracted water would be treated by two membrane-filtration plants on KUCC property. Concentrate reject from treatment would be placed in the KUCC tailings line or used in the KUCC mineral processing circuit. (An alternative approach will be developed if this plan for managing concentrate streams becomes infeasible.) Figure 14.1A shows the potential layout of the extraction wells, the possible location of the treatment plants, and the model-computed distribution of sulfate concentrations in 2025 and 2050 based on this scenario.

The sulfate plume would be pumped at 2500 gpm and the acid plume at 1500-2500 gpm. The total extraction rate of a maximum of 5000 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 AF/yr average over a five-year period) in order to remove the main mass of the acid plume in 30 years and extend the time in which the sulfate containment system can extract sulfate at levels below 2000 mg/L. The 1500-2500 gpm extracted from the acid plume would be sent to a nanofiltration (NF) plant for pretreatment, and the permeate from the NF plant (about 600-1000 gpm) would be added to the stream of extracted sulfate groundwater and sent to the RO treatment facility.

The total extraction of 2500 gpm from the extraction wells plus the NF permeate has been modeled to yield at least 3500 AF/year of municipal quality water after RO treatment. The RO/NF concentrate and a small amount of RO lime-treatment sludge would be sent directly to KUCC's tailings line and then to KUCC's tailings impoundment for disposal (Table 5.6A).

KUCC will utilize its existing industrial groundwater rights (part of which it plans to convert to municipal water rights) to extract groundwater from this zone for treatment and will deliver 3500 AF/year of treated, deep groundwater to the JVWCD, who will make the water available to the cities of Riverton, South Jordan and West Jordan and the Town of Herriman. If necessary, KUCC also will provide blend water from the Lark sulfate well to ensure that the Zone A RO plant can produce 3500 AF/year of clean water for at least 50 years and beyond.

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 communities. 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 Town regarding near future wholesale water deliveries from the JVWCD.
- JVWCD has the expertise and staff to operate and maintain Zone A facilities in an efficient manner.

Table 14.1A
JVWCD Water Purchase Contracts With Affected Communities

	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. This is the plume generally dealt with by the NRD Consent Decree. JVWCD will utilize its existing municipal groundwater rights in the Affected Area to extract principal aquifer groundwater for treatment, will receive the 3,500 AF/year of treated, deep groundwater, and will make that water available to all of its member agencies, including the four "affected communities." This water will be reserved for the four Affected Agencies 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 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 infrastructure existing 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 of "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.
- 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

Actions	CD Sect.	Response	Date	Meets Intent	Comments
RI/FS	V.A.	Completed by KUCC	1998	Yes	Reviewed and approved by EPA and TRC; ROD to be 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	$9 million cash and Trust Fund established.
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	2003	Yes	Will produce more than 7000 AF of water annually from Affected Area; and will produce 2300 AF 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	2003	Yes	Treatment system described.
Accepted by M&I Purveyor	V.D.2bi	This proposal	2003	Yes	Water to be accepted by JVWCD, a purveyor of M&I water, with municipal water rights.

TABLE 15.0A					
Actions	**CD Sect.**	**Response**	**Date**	**Meets Intent**	**Comments**
Prevent and Replace Spread of Contamination	V.D.2bii	This proposal	2003-2053	yes	See section 6.3 of proposal.
Substantially water supply for 40 years	V.D.2biii	This proposal	2003-2043	Yes	See section 6.1 of proposal.
Does not materially increase unit cost to produce remainder of 7000 AF	V.D.2biv	This proposal	2003	Yes	This proposal will produce all of the 7000 AF, within the trust fund amount.
Alternative Sources	V.D.2d	N/A	N/A	N/A	Under this proposal alternative sources are not required to meet the terms of the Consent Decree.
Water quality	V.D.2f	This proposal	2003	Yes	Highest quality (500 TDS) guaranteed.
Water quantity	V.D.2f	This proposal	2003	Yes	More drinking water than required under Consent Decree; more than offsets Lost Use.
Beneficial Use	V.D.5	This proposal	2003	Yes	JVWCD agencies benefit; specifically those in affected area. KUCC water rights converted to municipal use.

Table 15.0B compares Trust Fund with proposed project costs.

16.0 MEETING USEPA CERCLA REQUIREMENTS

Based on a detailed screening of remedial alternatives and additional studies after the completion of the Remedial Investigation and Feasibility Study, KUCC has developed a Proposed Remedial Action Plan for groundwater contamination in the southwestern Jordan Valley, Utah. This Plan meshes with and incorporates the proposed Natural Resource Damage settlement plan and the CERCLA remedial action response, which was submitted to the USEPA Remedial Project Manager and TRC in March 2000. This plan is attached (Appendix H).

Description. The Proposed Plan assumes perpetual operation and maintenance of the existing source control measures. Groundwater monitoring would be conducted as long as required by five-year reviews. The Plan also would include administrative controls and restrictions of land and groundwater use and point-of-use management. The Plan assumes that approximately 100 households may require point-of-use management. If municipal water supplies exceed sulfate concentrations of 500 mg/L, then point-of-use management could call upon municipal water supplied under the proposed NRD Plan.

To respond to elevated sulfate in groundwater, the Plan includes installation and operation of a sulfate extraction barrier well system for hydraulic containment of

the elevated sulfate plume (groundwater containing sulfate concentrations above 1,500 m/L), and construction and operation of a RO water treatment plant for treating the extracted groundwater. A total of 2500 gpm (4000 acre-feet per year) will be extracted from the sulfate plume.

Additional non-Kennecott wells will be located in the sulfate plume east of the former Kennecott evaporation ponds. These wells also will produce about 4,000 afy, which would be sent to a non-Kennecott RO treatment plant located near the wells. After treatment, the permeate from the Bingham Creek plume and from east of the former Kennecott evaporation ponds would yield at least 7,000 afy of municipal quality drinking water. This water would be sent to local municipalities for beneficial use as envisioned in the proposed NRD plan. The RO concentrate reject from the Kennecott RO plant would be sent to the Kennecott tailings line. After mine closure, this concentrate would be discharged directly to the Great Salt Lake. RO concentrate reject from the non-Kennecott RO plant would be discharged to the Jordan River.

Active restoration of the acidic portion of the Bingham Creek groundwater plume would occur as follows. Groundwater extraction wells installed in the acidic plume would be pumped at a rate of approximately 1500 – 2500 gpm, which would remove more than 90 percent of the mass of the acidic plume in approximately 30 years. Active pumping of the acid plume would also protect the sulfate barrier well system and RO treatment plant from being compromised by acidic water.

The permeate from acidic water extracted from the Bingham Creek plume and treated by NF would be sent to a RO system for polishing, and the high quality effluent would then be blended with the sulfate plume extraction wells and treated with RO to provide drinking water under the proposed NRD Plan. The RO/NF concentrate reject would be sent to the Kennecott tailings line until mine closure. Subsequent to mine closure, the NF concentrate would be conveyed to:

a) A lined facility in the Kennecott waste rock dumps or tailings impoundment for storage and evaporation, **or**

b) A lime treatment plan, with sludge storage in a lined RCRA facility adjacent to the water treatment plant. The permeate from the lime treatment plant would be sent to the Kennecott RO plant for polishing.

After mine closure, the RO concentrate would be discharged directly to the Great Salt Lake.

Overall Protection of Human Health and the Environment. The Plan provides overall protectiveness of human health and the environment by eliminating human or ecological exposure pathways to contaminants through institutional controls, point-of-use management, and containment of groundwater having contaminant concentrations above levels of concern, and by actively attempting to restore

groundwater in the plume. Delivery of the acid groundwater directly to the tailings line would result in neutralization of acidic groundwater and precipitation of associated contaminants in a contained impoundment and should not represent a human or environmental hazard.

Compliance with Potential ARARs[2]. The Plan would comply with ARARs. A key component of the Plan is hydraulic containment of the acid plume, which will prevent this contaminated groundwater from affecting down gradient drinking water wells. Under this alternative, the acid plume effectively becomes a waste management unit such that the appropriate "point of compliance" for measuring compliance with ARARs is at and beyond the edge of the containment area. At the point of compliance, all levels of concern for pH and metals would be met immediately. Modeling indicates that, for sulfate, natural attenuation would achieve the PRG of 1,500 mg/L[3] outside the containment area within approximately 5 to 10 years and the Utah drinking water standard (500 mg/L) in approximately 20 to 40 years. Institutional controls using the point-of-use level of 500 mg/L will be applied to prevent the ingestion of groundwater exceeding this concentration down gradient of the 1,500 mg/L sulfate barrier well system.

RO/NF concentrate will be delivered to the KUCC tailings impoundment. The concentrate would consist of the byproduct of treated groundwater contaminated by former mining practices and should not be subject to the zero discharge limitations for process wastewater applicable to active mining operations. See 48 Fed. Reg. 7953 (Feb. 8, 1979). Discharges from the tailings impoundment would, however, need to comply with established UPDES permit limits. Alternatively, if the zero discharge limitations were deemed applicable to the delivery option, the associated discharge would qualify for the "equivalent standard of performance" ARARs waiver. Specifically, in accordance with the combined waste stream rule, the volume of effluent recycled from the tailings impoundment would establish compliance with the zero discharge limitations. See 40 C.F.R. § 440.131(a) (1996). In addition, delivery of RO/NF concentrate to the tailings impoundment would require compliance with groundwater protection requirements.

Long-Term Effectiveness and Permanence. The Plan provides long-term effectiveness and permanence by eliminating exposure to contaminated

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[2] Applicable or relevant and appropriate requirements.

[3] There are no clear cleanup standard ARARs for sulfate or TDS under the Utah groundwater corrective action regulations. The presumptive standards for groundwater Corrective Action Concentration Limits (CACLs) are the Utah groundwater quality standards (UAC R317-6-6.15.F); however, there is no such groundwater quality standard for sulfate or TDS (UAC R317-6-2). Where there is no groundwater quality standard for a particular contaminant, CACL is proposed taking into consideration federal MCLGs, health advisories, risk-based contaminant levels or standards established by other regulatory agencies and other relevant information. An Alternate Corrective Action Concentration Limit (ACACL) can be established in place of a CACL if it is protective of human health and the environment and utilizes best available technology. In this case, the health based Preliminary Remediation Goal ("PRG") for sulfate is 1,500 mg/L.

groundwater, by controlling the migration of the acid portion of the plume, and by actively extracting acidic groundwater from the principal aquifer. For some proposed PRGs, the remediation time frame may still be longer than the 30 years. For these reasons, long-term management of the site will be required, and would consist of periodic maintenance of the groundwater extraction wells, groundwater compliance monitoring (for all repositories and the hydraulic containment systems), and operation and maintenance of the water treatment system, all of which will be implemented under this proposal.

Discharge of the NF concentrate or acidic groundwater to the KUCC tailings line may result in increased total dissolved solids in the process system, and will need to be considered in view of operational or permit requirements. Recent studies by KUCC suggest that the level of discharge proposed in this response will not adversely affect KUCC operations and will meet UPDES discharge requirements.

Reduction of Toxicity, Mobility and Volume Through Treatment. The Plan reduces TMV by extracting and treating and (or) discharging contaminated groundwater. Hydraulic containment, although not designed to actively remediate the plume, will permanently reduce the toxicity and volume of the plume and will prevent the portion of the plume currently above PRGs from migrating farther down gradient.

Extraction of acid groundwater followed by delivery to the tailings line would permanently and significantly reduce the volume (and mass) of contaminants in the groundwater through neutralization reactions.

Short-Term Effectiveness. Implementation of the Plan is not expected to result in any serious potential risks for remedial action workers or the community during construction. All construction work (drilling and well installation, pipeline construction, water treatment plant construction) would be conducted following standard health and safety practices associated with each of these activities. If necessary, dust suppression may be employed during construction of the water treatment plant. The Remediation Action Objectives of preventing human and ecological exposure to contaminated groundwater above PRGs would be achieved by institutional controls, point-of-use management of groundwater above these levels, and hydraulic containment, that prevents the migration of the acid plume beyond the containment boundary.

Implementability. The Plan can be implemented technically, but the disposal option will require meeting substantive requirements of permits. Obtaining approval for these new facilities should be possible but may be untimely in relation to construction of the groundwater extraction and water treatment plant. Approval of new facilities under the NRD settlement will require coordination between the State, KUCC and non-KUCC parties.

17.0 PILOT TESTING

Pilot testing will be critical to demonstrate the feasibility of membrane treatment of extracted waters. Satisfactory pilot testing of the Zones A and B RO processes is also a condition precedent to KUCC and JVWCD completing the remainder of the project. CDM has described the concepts for pilot testing in section 8 of their 1999 report. The pilot testing phase will include concentrate quality testing, concentrate discharge permit discussions with the DWQ for Zone B waters, and toxicity/bioassay testing. An updated CDM memo regarding a pilot testing budget for Zone B waters is included in Appendix F.

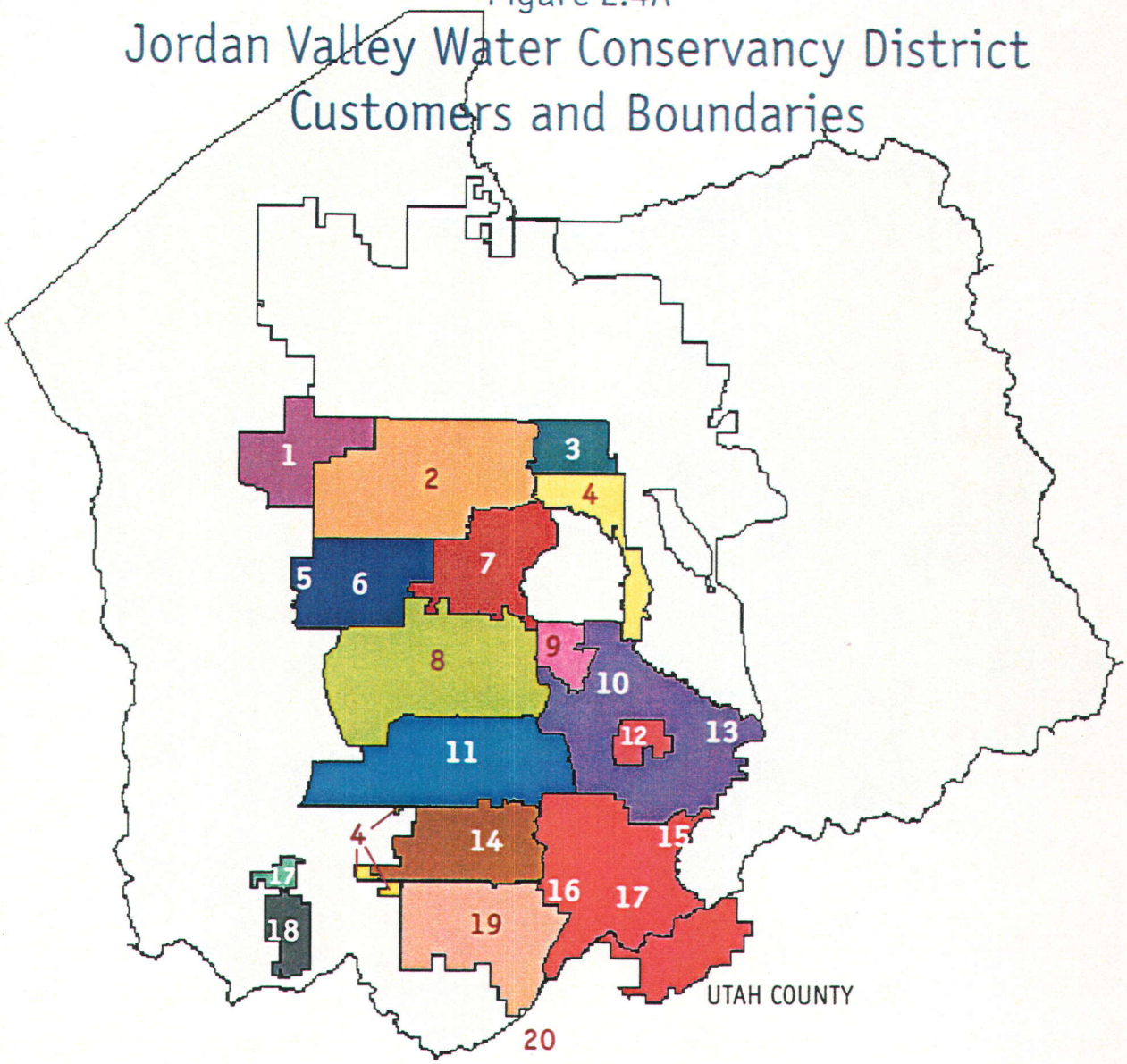
KUCC is currently pilot testing treatment of Zone A waters. JVWCD proposes to construct a new, deep test well at its pump station/reservoir site at 3600 West 10200 South for source water for Zone B pilot testing. This location is representative of the highest concentrations of sulfate in the Zone B sulfate plume area. The pilot-testing unit would be installed at this location. Zone B pilot testing would also be performed at JVWCD's headquarters site at 8215 South 1300 West using the existing JVWCD shallow extraction well water for this pilot testing.

Based upon the CDM memo, and the need to perform pilot testing at two Zone B sites, JVWCD estimates a Zone B pilot testing budget of $300,000. This cost is shown in Tables 9.0A and 9.0B.

FIGURES

Figure 2.4A

Jordan Valley Water Conservancy District Customers and Boundaries

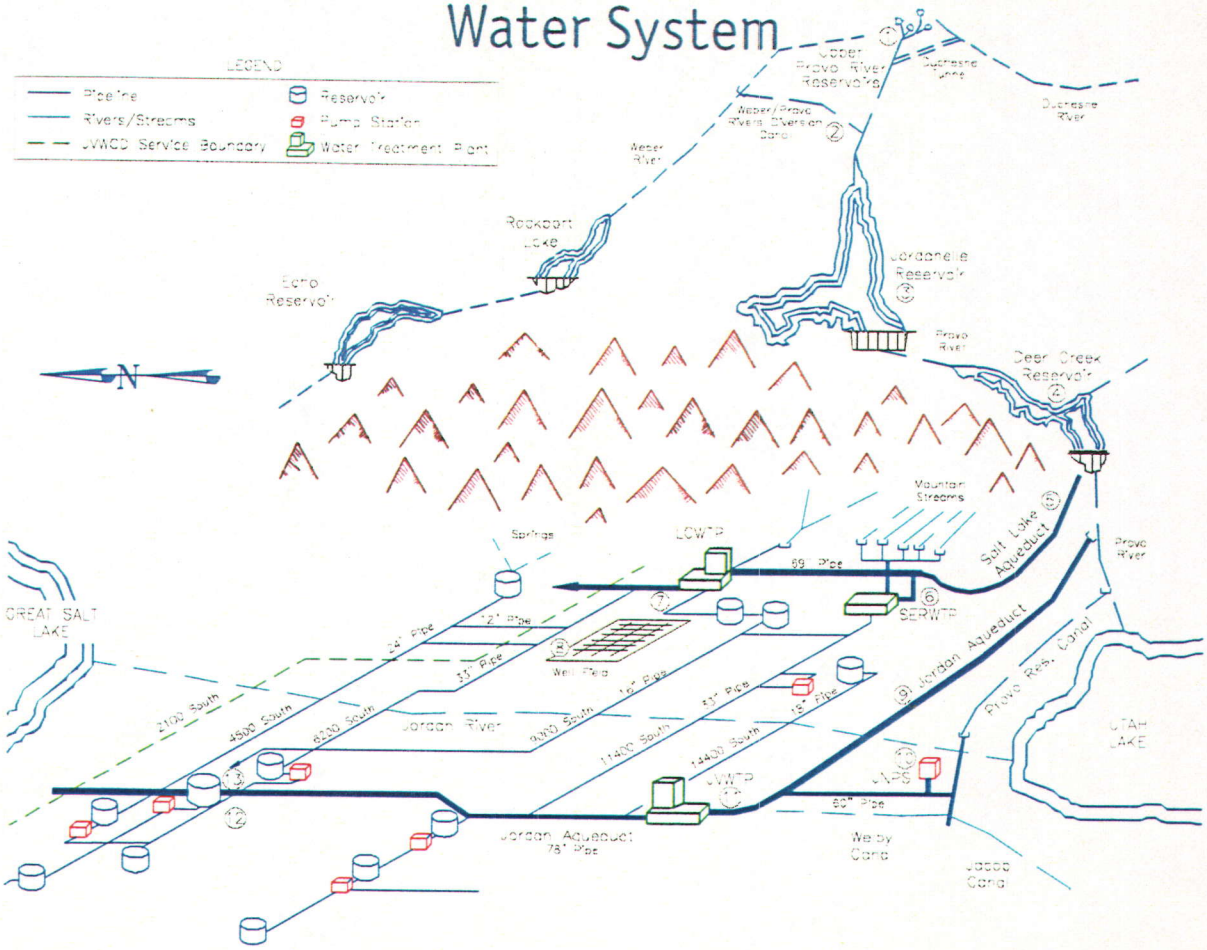


Location of Member Agencies

1 Magna Water Company
2 Granger-Hunter Improvement District (West Valley City)
3 City of South Salt Lake
4 JVWCD retail service area (Granite Park, Holladay, Union Park, Willow Creek and southwest area)
5 Hexcel Corporation
6 Kearns Improvement District
7 Taylorsville-Bennion Improvement District
8 West Jordan City
9 Midvale City
10 Sandy City*
11 South Jordan City
12 White City Water Improvement District
13 Willow Creek Country Club
14 Riverton City
15 Draper Irrigation
16 Utah State Department of Corrections
17 Draper City
18 Hi-Country Estates Phase II
19 Bluffdale City
20 State Department of Public Safety

*by contract through 2001

Figure 2.4B
Jordan Valley Water Conservancy District Water System



1 Upper Provo River Reservoirs. Located at the headwaters of the Provo River, this group of natural lakes has been enlarged for operation as reservoirs. As a major stockholder in the lakes, Jordan Valley Water Conservancy District (JVWCD) receives water directly from storage.

2 Weber/Provo Rivers Diversion Canal. A 12-mile canal with a capacity of 1,000 cfs that conveys water from rights on the Weber River and Echo Reservoir to JVWCD. The canal is also used by the Provo River Water Users Association (PRWUA) for the diversion of Weber River water to supply the Deer Creek Reservoir.

3 Jordanelle Reservoir. As a feature of the Bonneville Unit, Jordanelle Reservoir is the largest storage facility for Central Utah Project collected from the Provo River. Jordanelle has a volume capacity of 320,000 acre-feet (AF). JVWCD anticipates 50,000 AF annually for its municipal and industrial supply.

4 Deer Creek Reservoir. This reservoir is a feature of the Provo River Project. It has a volume capacity of 152,000 AF. JVWCD owns stock in the Provo River Water Users Association, which entitles it to water stored in this reservoir.

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

6 Southeast Regional Water Treatment Plant. JVWCD's 20 million gallon per day (MGD) facility treats water from the Salt Lake Aqueduct and local mountain streams.

7 Little Cottonwood Treatment Plant. Metropolitan Water District of Salt Lake City's 100 MGD plant delivers treated water to JVWCD, 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.

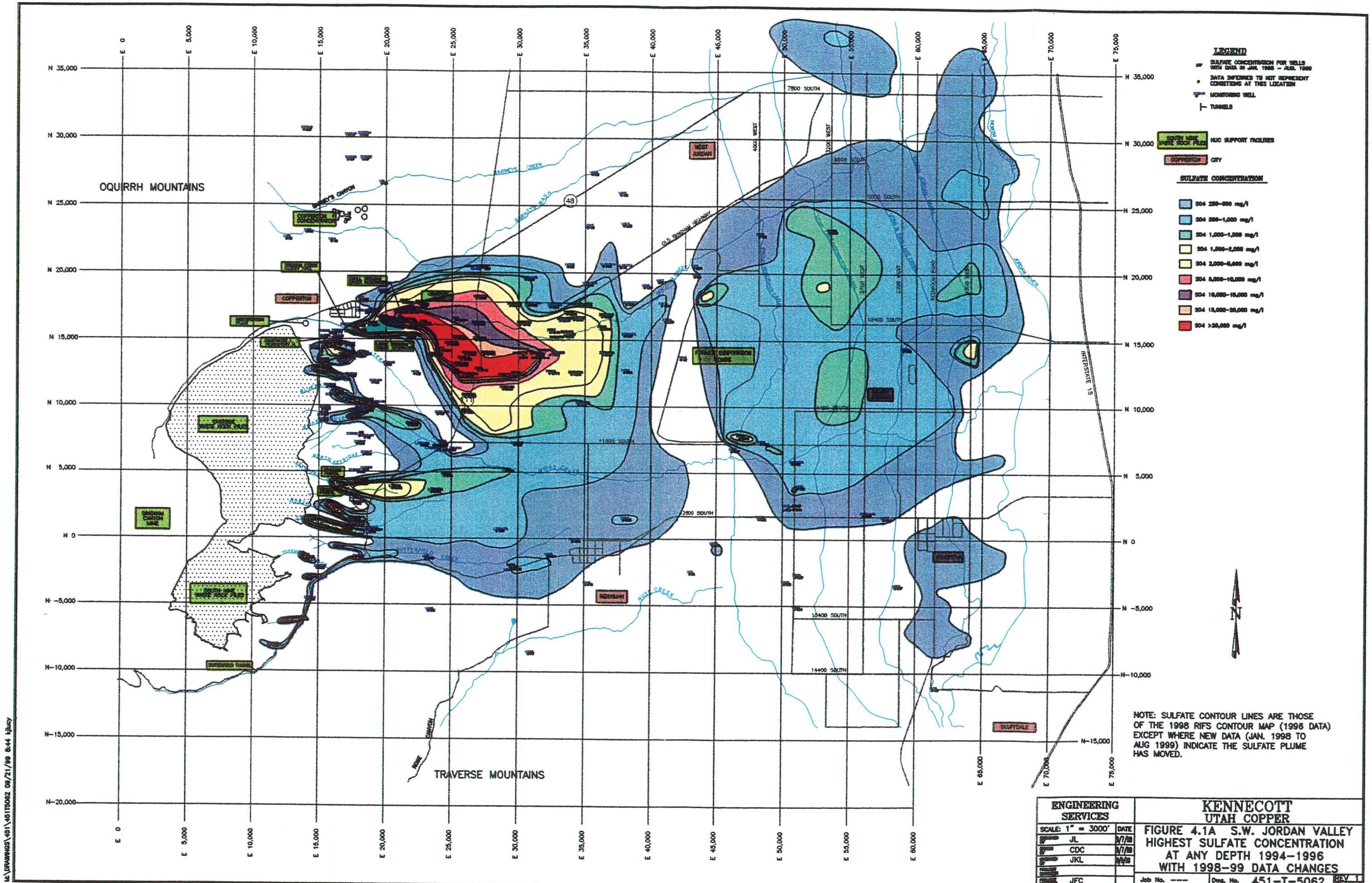
9 Jordan Aqueduct. This 78-inch pipe conveys water from Deer Creek and Jordanelle reservoirs to Jordan Valley Water Treatment Plant. Lower portions of the aqueduct transmit treated water to the JVWCD and MWD service areas.

10 Jordan Narrows Pumping Station. This station is currently used to pump Utah Lake water into the Welby and Jacob canals for irrigation purposes.

11 Jordan Valley Water Treatment Plant. This 180 MGD plant is owned by the Central Utah Water conservancy District and is operated by JVWCD.

12 Reservoirs and Pump Stations. These facilities store water and pump it to JVWCD's customers.

13 Jordan Aqueduct Terminal Reservoir. A 100 million gallon drinking water reservoir.



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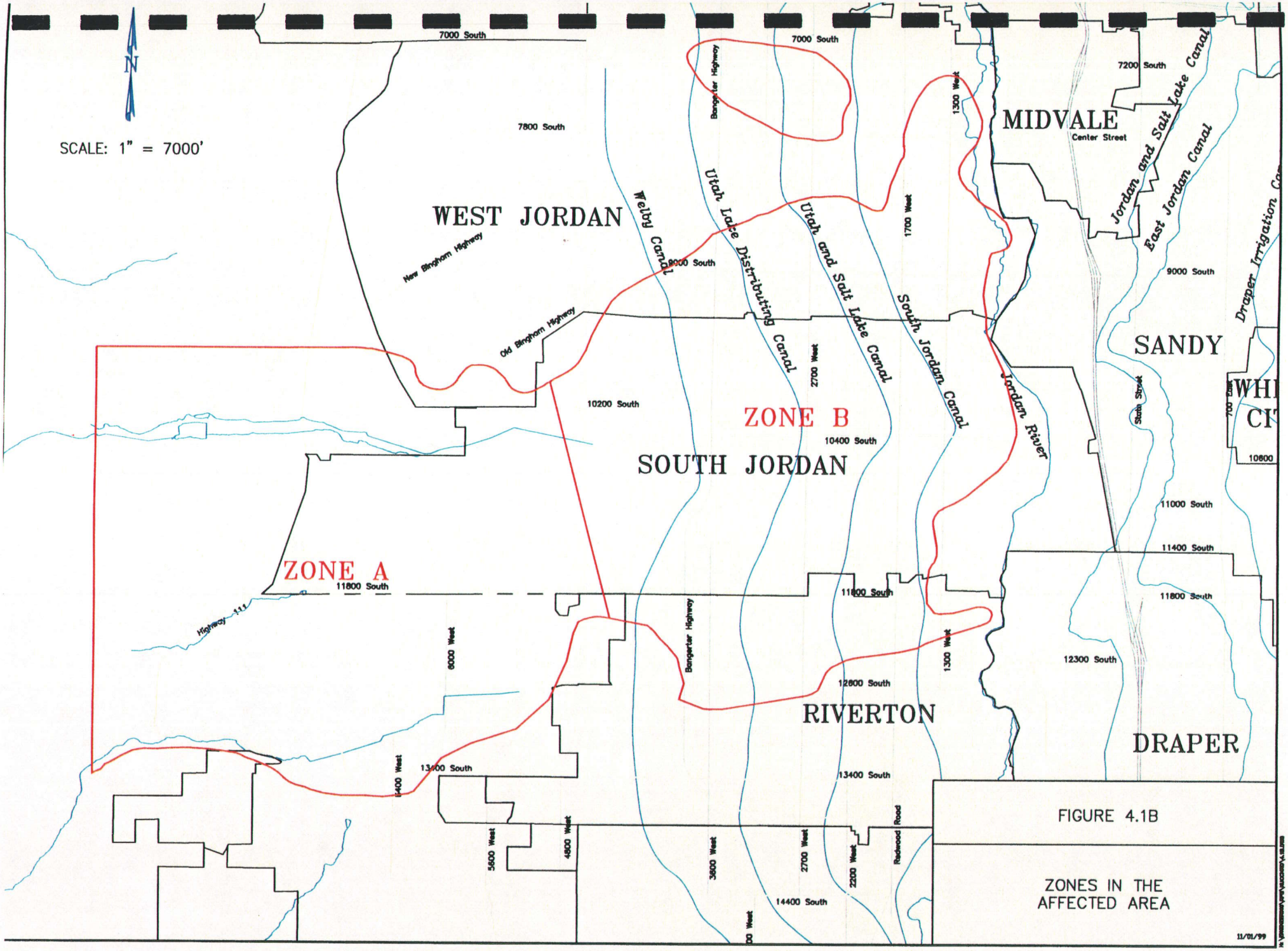
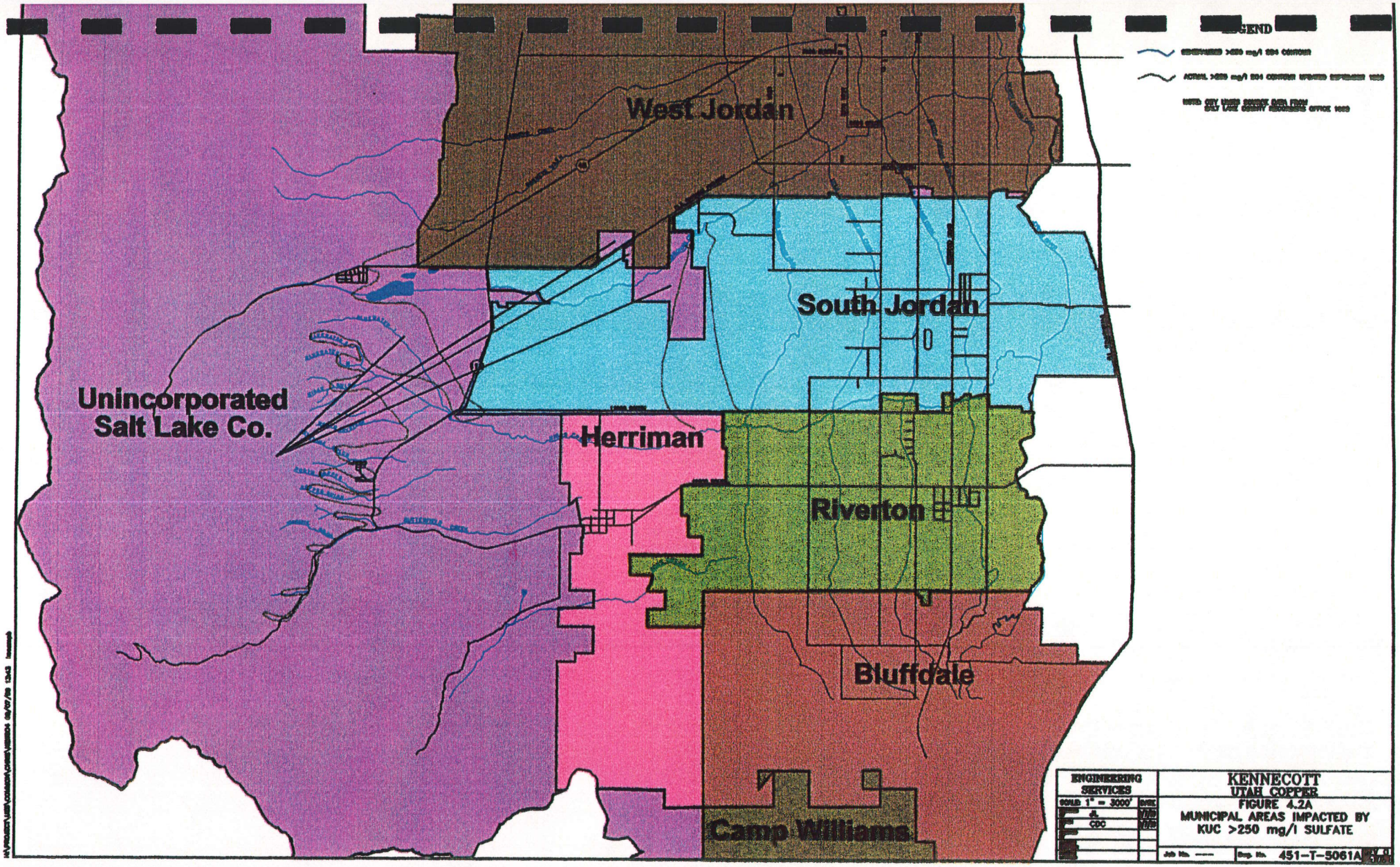

N
SCALE: 1" = 7000'
7000 South
7800 South
WEST JORDAN
New Bingham Highway
Old Bingham Highway
8000 South
10200 South
Welby Canal
Bangerter Highway
Utah Lake Distributing Canal
Utah and Salt Lake Canal
South Jordan Canal
1300 West
1700 West
2700 West
ZONE B
10400 South
SOUTH JORDAN
Jordan River
MIDVALE
Center Street
7200 South
Jordan and Salt Lake Canal
East Jordan Canal
Draper Irrigation Canal
9000 South
SANDY
State Street
700 East
10600
11000 South
11400 South
11800 South
ZONE A
11800 South
Highway 111
6000 West
12300 South
12600 South
RIVERTON
DRAPER
13400 South
6400 West
5600 West
4800 West
3600 West
2700 West
2200 West
Redwood Road
14400 South
FIGURE 4.1B
ZONES IN THE AFFECTED AREA
11/01/99


LEGEND
West Jordan
South Jordan
Unincorporated
Salt Lake Co.
Herriman
Riverton
Bluffdale
Camp Williams
ENGINEERING
SERVICES
SCALE 1" = 3000'
DATE
JL
CDC
KENNECOTT
UTAH COPPER
FIGURE 4.2A
MUNICIPAL AREAS IMPACTED BY
KUC >250 mg/l SULFATE
Job No. ——
Dwg. No. 451-T-5061A

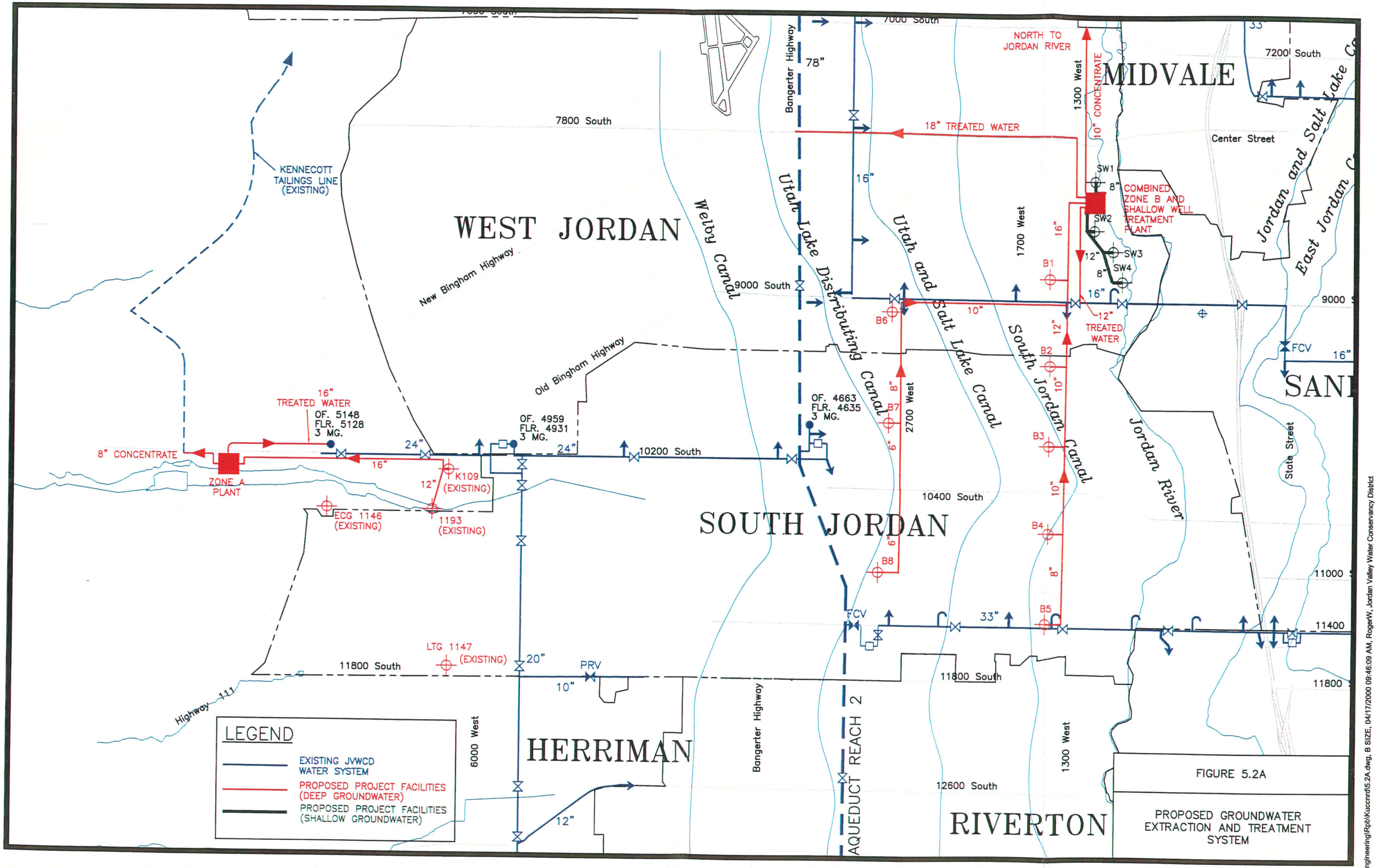


FIGURE 5.2A

PROPOSED GROUNDWATER EXTRACTION AND TREATMENT SYSTEM

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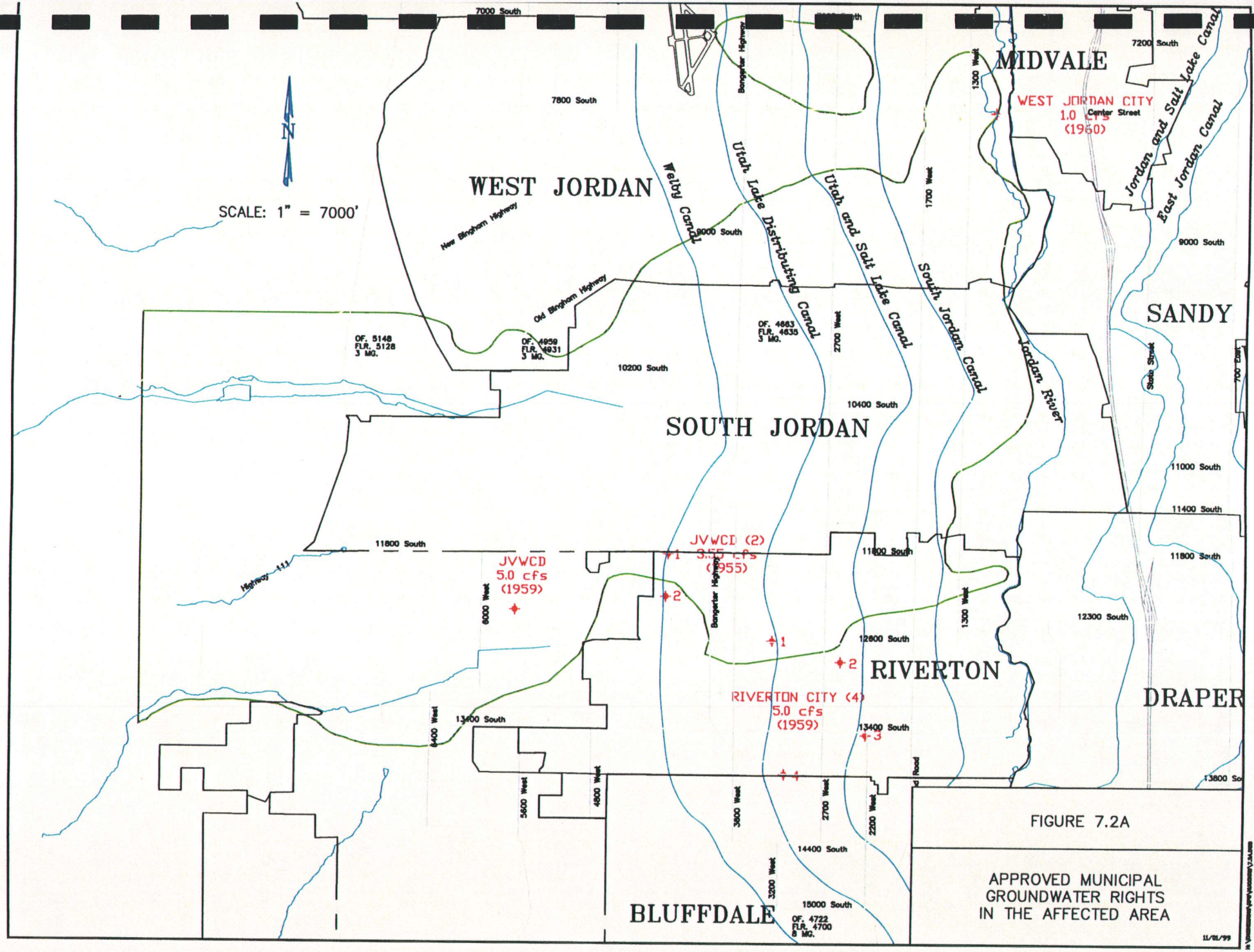

FIGURE 7.2A

APPROVED MUNICIPAL GROUNDWATER RIGHTS IN THE AFFECTED AREA

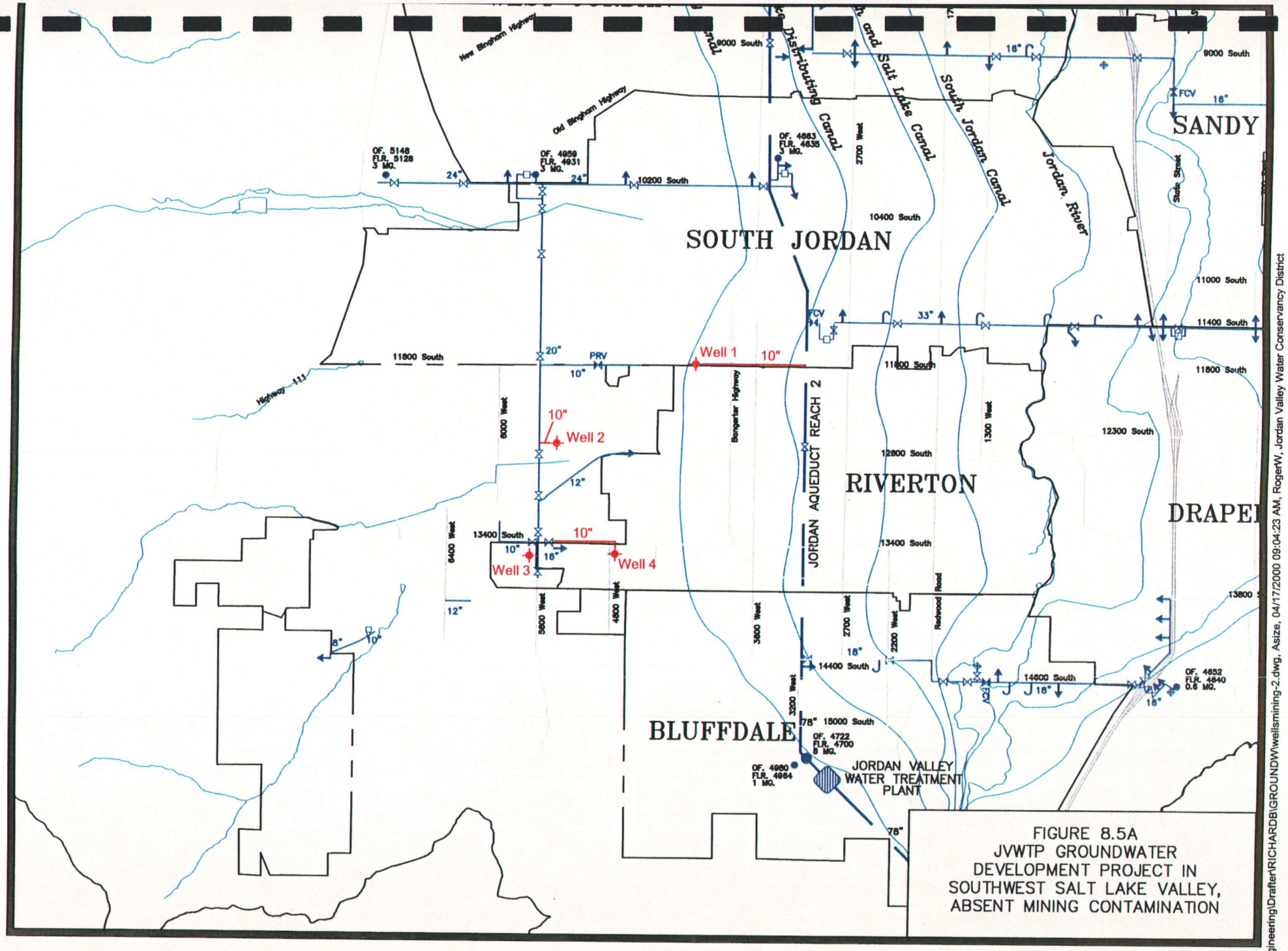

FIGURE 8.5A
JVWTP GROUNDWATER
DEVELOPMENT PROJECT IN
SOUTHWEST SALT LAKE VALLEY,
ABSENT MINING CONTAMINATION

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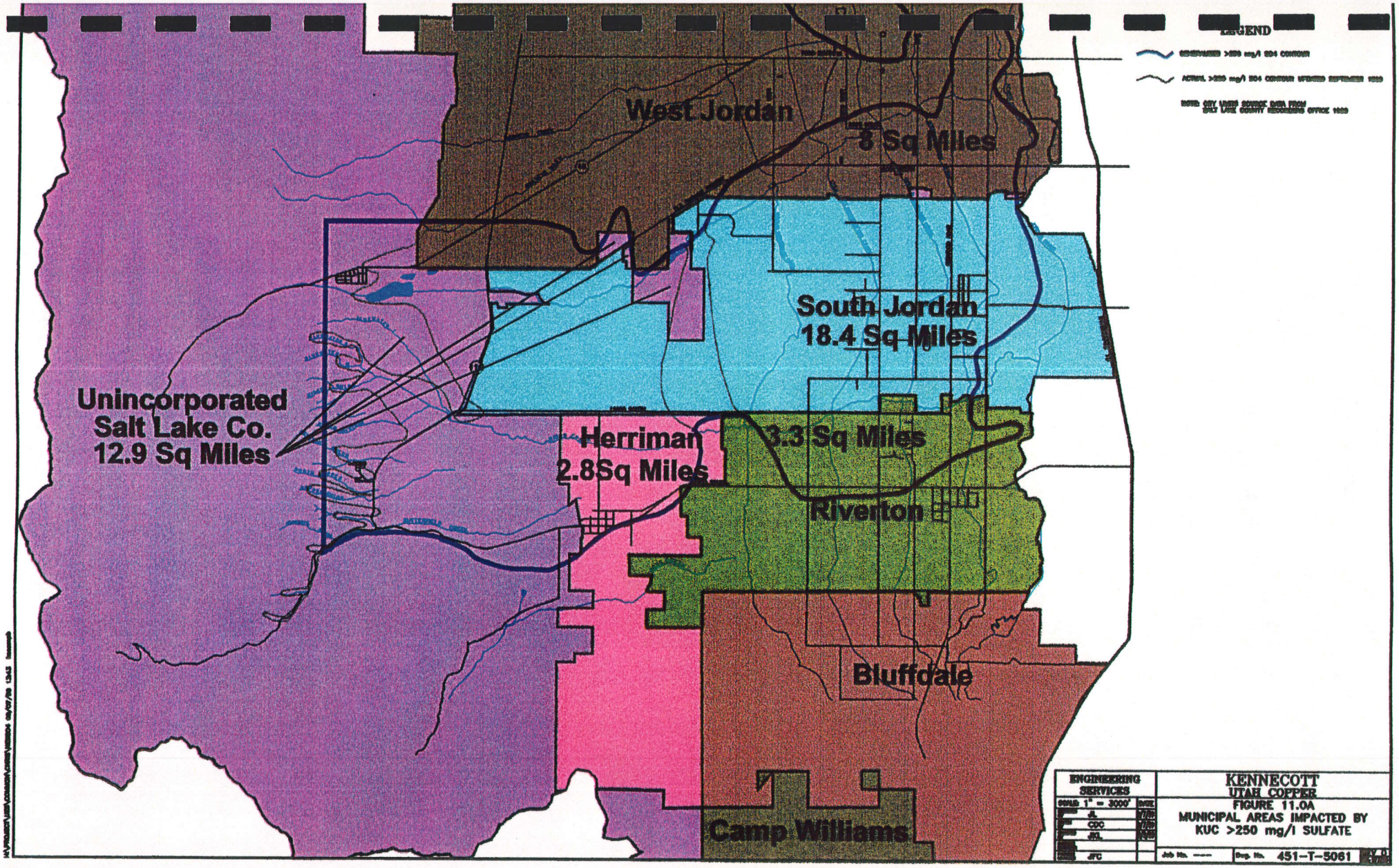

LEGEND
West Jordan
3 Sq Miles
South Jordan
18.4 Sq Miles
Unincorporated
Salt Lake Co.
12.9 Sq Miles
Herriman
2.8Sq Miles
3.3 Sq Miles
Riverton
Bluffdale
Camp Williams
ENGINEERING SERVICES
KENNECOTT
UTAH COPPER
FIGURE 11.0A
MUNICIPAL AREAS IMPACTED BY
KUC >250 mg/l SULFATE
451-T-5061

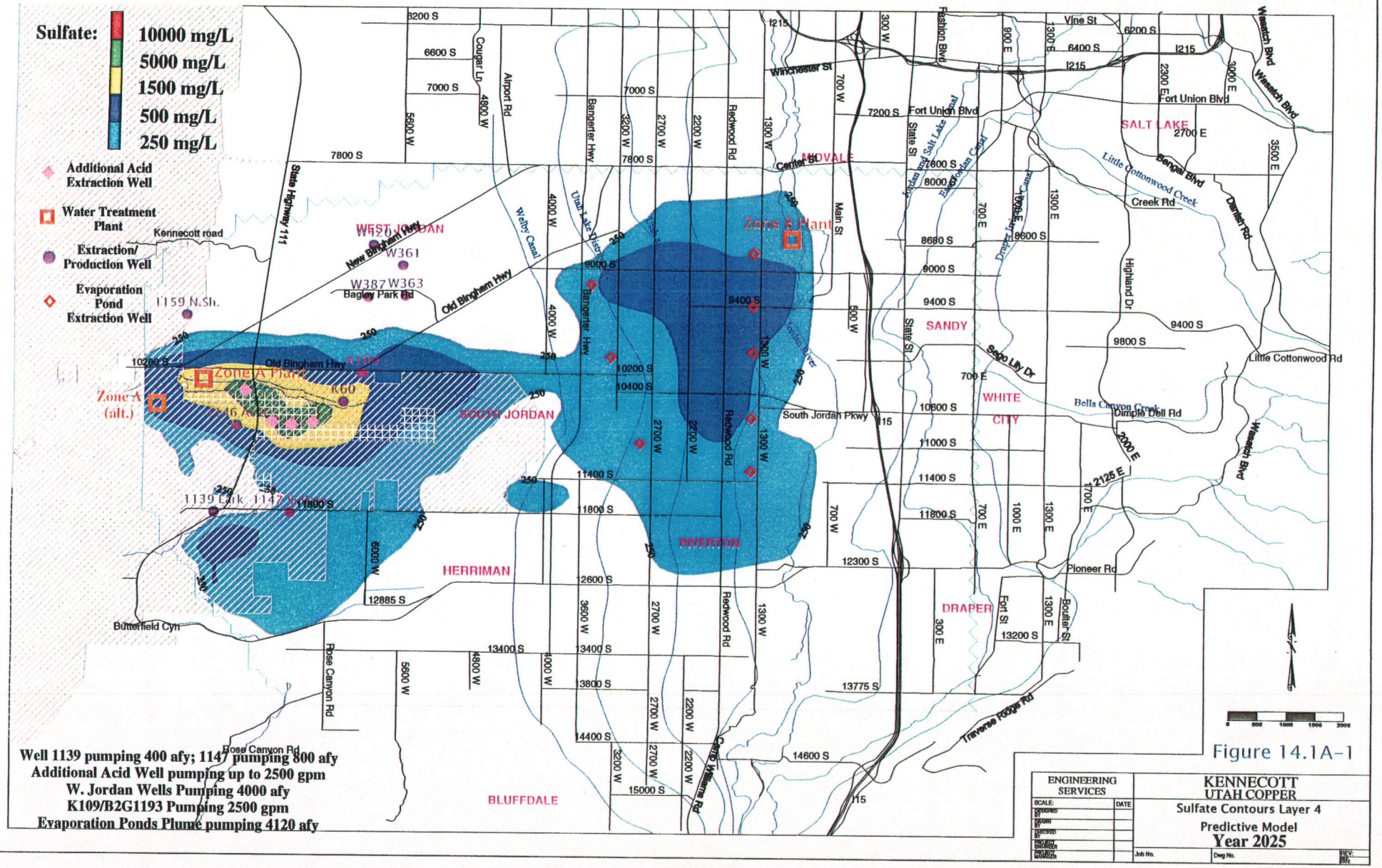
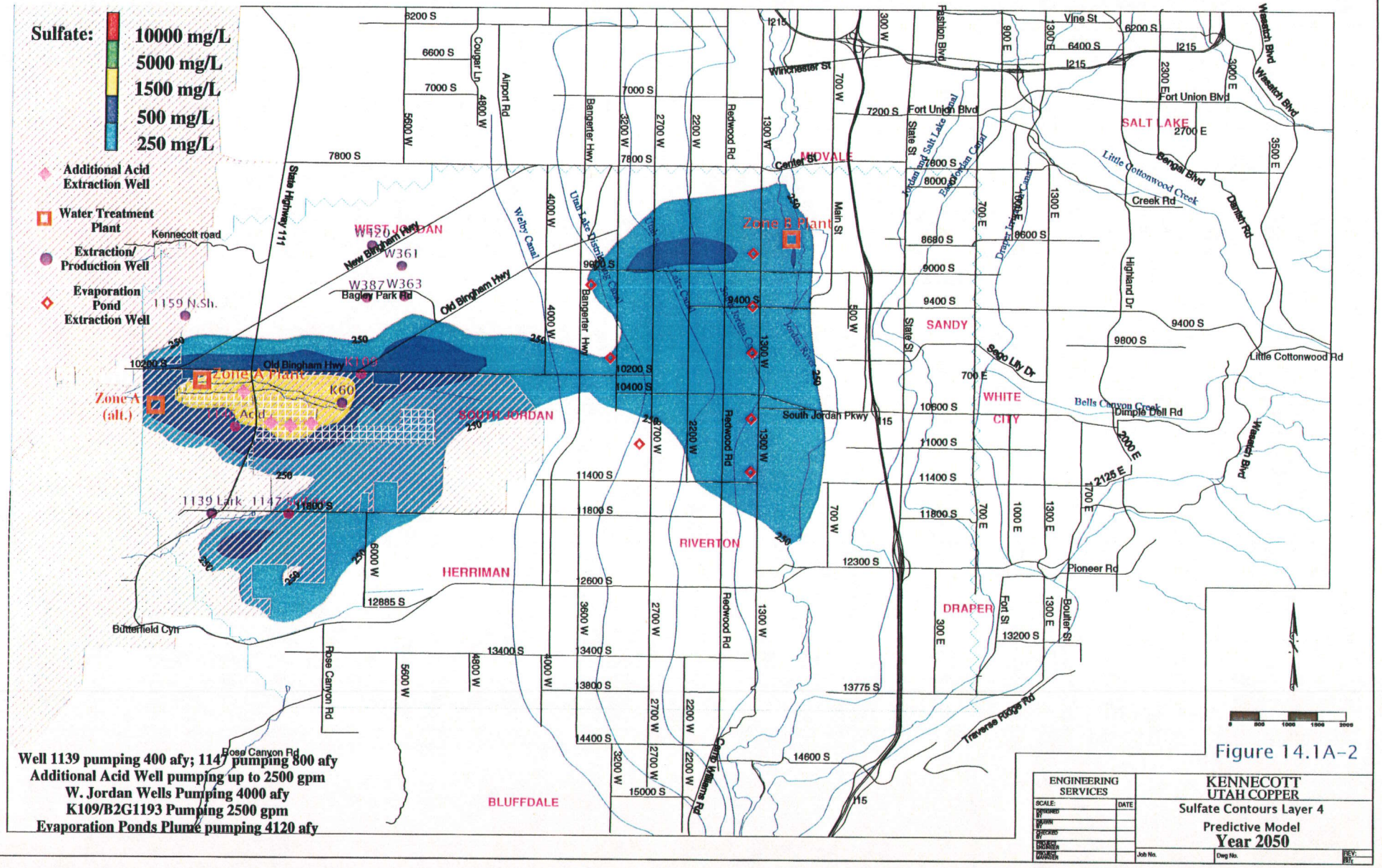


Figure 14.1A-1



Well 1139 pumping 400 afy; 1147 pumping 800 afy
Additional Acid Well pumping up to 2500 gpm
W. Jordan Wells Pumping 4000 afy
K109/B2G1193 Pumping 2500 gpm
Evaporation Ponds Plume pumping 4120 afy

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 $\pm$ 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

SUMMARY OVERVIEW

KENNECOTT SOUTH ZONE, OU2
Southwest Jordan River Valley Ground Water

Site Summary:

1. *Site name and location*: Kennecott South Zone, OU2, Southwest Jordan River Valley Groundwater. The site is located about 10 miles to the southwest of Salt Lake City, Utah, and includes all or portions of the cities of West Jordan, South Jordan, Riverton, and Herriman, and portions of unincorporated Salt Lake County, Utah.

2. *Surrounding land use*: The land use above the contaminated ground water is a mixture of industrial, commercial, residential, agricultural, recreational, mining, and open space land uses. Land use distribution is typical of suburban communities.

3. *Contaminant history or operational history*: The ground water contamination was caused by the release of acid mine drainage and acid leachates from mining activities in the Bingham Canyon (West Mountain) mining district. Contamination consists of low pH, high metals, and high sulfates.

4. *Media addressed by proposed action*: This action addresses only contaminated ground water. The sources of the ground water contamination and other surface contamination have been addressed by other actions.

5. *Operable units addressed*: The action addresses solely OU2 of the Kennecott South Zone site. OU2 is the ground water operable unit of the Kennecott South Zone.

6. *State's position*: The state supports the preferred alternative.

7. *Stakeholders' positions*: The city councils for West Jordan, South Jordan, and Herriman have all voted to support of the preferred alternative. Riverton's city manager and city engineer also support the concept. The Jordan Valley Water Conservancy District, a quasi-governmental entity and the major water provider, also supports the preferred alternative and will eventually operate the treatment facilities. Negotiations with non-municipal water purveyors are underway. The PRP, Kennecott Utah Copper, a wholly owned subsidiary of Rio Tinto (a multi-national mining conglomerate headquartered in London), supports the preferred remedy.

Risk Summary:

1. *Actual risks* of drinking the contaminated ground water were not calculated because the ground water in the affected area is not used currently for municipal supplies. Water to service the local communities is imported from other areas of the state. Instead of calculating risk, the degree of contamination was estimated by comparison with Utah's Drinking Water Standards, a major ARAR. Use of the ground water today is limited to

irrigation of crops by private well owners. Other well owners who previously used the water for culinary purposes were either tied into municipal systems or are provided bottle water until municipal service can be provided.

2. *Risk Drivers*: The following table demonstrates the degree of contamination at the site. It was calculated by taking the ratio of the highest concentration reported in 1996 divided by the appropriate drinking water standard. For example in the case of cadmium, the concentration of cadmium in the groundwater exceeds the drinking water standard by a factor of 398.

Constituent	Concentration in ground water (mg/l)	Drinking water standard or other action level (mg/l)	Ratio (conc./std.)
pH*	3.27	6.5	1698
As	0.063	0.050	1.26
Cd	1.990	0.005	398
Cu	168	1.3	129
Pb	0.692	0.015	46.1
Ni	29.2	0.10	292
SO4	36,400	500	72.8

* pH is on a logarithmic scale, ratio is given in arithmetic form.

Remediation Goals:

1. Minimize the potential for off-site human risk by limiting exposure to contaminated ground water and limiting migration of contaminants into unaffected ground waters.

2. Minimize the potential for off-site environmental risk by limiting migration of constituents to surface water.

3. Additional goals which were stated or implied in the NRD settlement between the PRP and the state trustee:

   a. Prevent further contamination of the aquifer by controlling or remediating the sources

   b. Prevent further spread of the contamination downgradient in the aquifer

   c. Provide municipalities with safe drinking water to compensate them for the loss of their natural resources (ground water).

Description of Alternatives: The FS described the various alternatives considered. Please note that some of these fail to meet the remediation goals and/or ARARs.

Description of Alternative	Cost (includes both capital costs and operational costs (net present value) for a 30 year operational period)	Time to achieve goals
Alternative 1 - No further action (source control and monitoring only)	$26M	Does not contain plume. Would not prevent exposure. Natural attenuation would take in excess of 800 years.
Alternative 2 - Institutional controls, such as purchase of water rights (also source control and monitoring)	$42M	Does not contain plume. Effectiveness in preventing exposure questionable. Natural attenuation would take in excess of 800 years.
Alternative 3 - Point of use management, such as in home RO treatment units (also institutional controls, source control and monitoring)	$45M	Does not contain plume. Natural attenuation would take in excess of 800 years.
Alternative 4* - Hydraulic containment, such as pumping acid waters at leading edge of plume and treating waters for delivery to municipalities	$216M - $251M (depends on treatment residual disposal technique)	100s of years for sulfate 10s of years for acids
Alternative 5* - Active pumping of acid waters, such as wells in the center of the plume, treatment or disposal of the waters	$177M - $223M (depends on treatment or disposal technique) $197M with nanofiltration treatment	10s of years
Alternative 6* - Combines 5 with lime treatment of treatment concentrates	$360M	10s of years
NRD Settlement proposal - Active pumping of acid waters and sulfate waters, treating waters for delivery to municipalities	$232M (~$187M of this is duplicative with alternative 5 - nanofiltration)	10s of years

*Alternatives using treatment assumes use of nanofiltration for pretreatment and reverse osmosis for treatment. Pilot tests indicate that pretreatment is needed because RO membranes foul with calcium sulfate too quickly.

#shading indicates preferred alternative

Preferred Alternative:

In 1995, the PRP, Kennecott Utah Copper, reached a settlement of a Natural Resources Damage Claim filed by the State Trustee. Under the terms of the resulting Consent Decree, Kennecott provided the state with a cash settlement and also set up a Trust Fund to be used by the State Trustee to restore the aquifer and provide treated water for beneficial uses by the municipalities. The State Trustee and EPA agreed to develop a unified plan to satisfy both the terms of the NRD Consent Decree and the CERCLA issues. To provide community and agency participation in the CERCLA process, a Technical Review Committee was formed. Membership included participants from each city government, the major state agencies involved (including the CERCLA staff, the ground water permit staff, surface water staff, and the water rights staff), county health, city engineering departments, engineers from the major water purveyor, the major federal agencies (EPA technical experts, and USGS ground water experts), the TAG group, environmentalists (Sierra Club), and the PRP and their consultants. The Trustee requested that this group of experts also be asked to evaluate the NRD related portions of the plan. The Technical Review Committee agreed to perform this additional task. Recognizing that the general public might not understand (or care) which authorities were being used for the portions of the plan, EPA and the Trustee also agreed to present a unified plan to the public. The plan presented in this summary is the unified plan.

For the truly curious, in general, the portions of the plan which address the "acid plume" which is characterized by low pH, high metals, and high sulfates clearly fall in CERCLA authority. The part of the plan dealing with waters containing elevated sulfates only falls within the NRD settlement provisions. (The distinction arises from a legal dispute. Kennecott asserts that sulfate is not a hazardous substance and is therefore not covered by CERCLA. EPA and Utah argue that the sulfate arose from the release of a hazardous substance - sulfuric acid - and is covered. All agree that sulfate is a pollutant or contaminant and did damage a natural resource of the state.) Separating out costs associated with CERCLA and those associated with the NRD settlement is difficult because some of the facilities are used for both jurisdictions. See the full briefing package for a table which describes which funding is paying for each portion of the plan.

The preferred CERCLA-NRD remedy is Alternative 5 coupled with a plan recently presented to the State Natural Resources Trustee by the PRP and the region's major water purveyor, the Jordan Valley Water Conservancy District. The combined plan contains the following elements:

Objective	Activity	Estimated Costs
Pollution Prevention	O+M of source control infrastructure (also required in a state ground water permit)	$19,227,000 (CERCLA)
Exposure Prevention	Institutional Controls, until aquifer is restored	$16,051,000 (CERCLA)
	Point of use management for private well owners, until aquifer is restored	$ 2.394,000 (CERCLA)
	Monitoring of plumes to detect movement in unpredicted directions	$ 7,116,000 (CERCLA)
Plume migration prevention (Acid Plume)	Installation of a barrier well system	$ 28,212,000 (CERCLA and NRD)
Plume migration prevention (Sulfate Plume)	Installation of 8 wells in the central part of the sulfate plume	$ 3,133,000 (NRD)
	Installation of 4 wells in the shallow aquifer near the Jordan River	$ 237,000 (NRD)
Acid Plume Remediation	Installation of 4 wells in the central part of the acid plume	$ 11,720,000 (CERCLA)
Pretreatment of acidic waters	Conveyance of acidic waters to a nanofiltration plant	$45,441,000 (CERCLA)
Treatment of barrier well water and nanofiltration permeate	Conveyance of waters from acid plume barrier wells and permeate from nanofiltration to a reverse osmosis plant with the treated waters delivered to municipalities	$41,659,000 (CERCLA and NRD)
Treatment of waters from the sulfate plume	Conveyance of waters from the sulfate plume wells to a second reverse osmosis plant with the treated waters delivered to municipalities	$ 38,864,000 (NRD)

Disposal of concentrates - pre mine closure	Conveyance of concentrates from nanofiltration to KUC's tailings line	costs included in treatment
	Conveyance of concentrates from reverse osmosis plant in the acid plume area to KUC's tailings line	costs included in treatment
	Conveyance of concentrates from reverse osmosis plant in sulfate plume area to the Jordan River	costs included in treatment
Disposal of concentrates - post mine closure	3 alternatives now under consideration (needs to be integrated with mine closure plan)	no cost estimates available
TOTAL	both CERCLA and NRD activities	$248,528,000 (2000 dollars)

The time to reach the goals of preventing further plume migration and exposure to human health and the environment will be reached quickly upon construction completion. Although calculations indicate that most of acid waters will be extracted within 50 years, it will take longer to restore the aquifer itself because solids created during neutralization in the aquifer matrix will continue to redissolve back into the system. All parties assume that the treatment plants will have to operate until the ground water reaches drinking water standards, essentially in perpetuity. This classifies as a Long-Term Remedial Action.

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NATIONAL REMEDY REVIEW BOARD
PRESENTATION PACKAGE

KENNECOTT SOUTH ZONE OU2
SOUTHWEST JORDAN VALLEY GROUND WATER PLUMES

April, 2000

Site name, Location, and Brief Description

The Kennecott South Zone site is located about 10 miles to the southwest of Salt Lake City, Utah. Mining began at the site in 1863 and has continued ever since. Waste management was not high on the priority list of early miners and wastes were dumped directly into mountain creeks or stored next to streams. The streams carried the waste down into Salt Lake Valley, which was then largely ranch and farm land. Now the valley is part of the suburbs surrounding Salt Lake City. Miners also discovered that additional minerals could be obtained by spraying their waste dumps with water and acid. The wastes contained sulfides which reacted with the water to form sulfuric acid. The acid leached minerals from the waste rock. The miners then collected the metal bearing acidic waters as they emerged at the toe of the dump. The early collection systems allowed substantial acid waters laden with metals and sulfates to escape and contaminate the ground water. This has rendered a large area of the ground water useless for drinking water, a serious matter in the semiarid West.

The Kennecott South Zone site is composed of surface areas contaminated by mining wastes which migrated from source areas into down gradient cities and of subsurface areas contaminated by acid leachates from the mining district.

The proposed action at the Kennecott South Zone site involves Operable Unit 02, the ground water operable unit. Surface contamination was addressed by other actions. An area map showing Operable Unit 02 study area and its relationship to nearby mining activities are given in Figure 1-1 (reprinted from the Remedial Investigation Report).

Site History and Enforcement Activities

Significant enforcement actions (involving OU 02) are listed in the following table:

ENFORCEMENT ACTIONS AT OU2*

Date	Action	Status
1986	Utah Department of Health filed a complaint against Kennecott in Federal Court seeking damages under NRD provisions of CERCLA.	Trial was put on hold while the parties collected more information about the extent of contamination.
1990	Settlement was reached between Kennecott and Utah Department of Environmental Quality. A proposed consent decree was lodged with Federal Court.	After substantial negative comment during the public comment period, the Federal Court rejected the Consent Decree. Appeals to both the Court of Appeals and the Supreme Court failed to overturn the rejection.
1991	EPA and UDEQ opened site-wide remediation Consent Decree negotiations with Kennecott	Negotiations failed in late 1993; there were too many unknowns for all parties.
1994	EPA proposes both the Kennecott South and North Zones for the NPL	The zones are still proposed for the NPL.
1995	After substantial changes and inclusion of water purveyors in the negotiations, a new consent decree for the NRD claims of the state trustee was lodged in Federal Court.	The Consent Decree was entered by the Court. The Decree called for a cash settlement plus establishment of a trust fund to pay for treatment facilities. Kennecott could apply for monies from the trust fund if expenditures were eligible. A plan for use of these funds was submitted to the state trustee in late1999.
1995	EPA, Kennecott and UDEQ sign a Memorandum of Understanding which required Kennecott to perform a RI/FS at OU2 (and other cleanups) in exchange for EPA taking no further action regarding final listing	The RI/FS for OU2 required by the MOU was submitted by Kennecott in March, 1998.

*Does not include early enforcement actions or actions by UDEQ Water Division

For OU2, the sole PRP is Kennecott Utah Copper Corporation, a wholly owned subsidiary of Rio Tinto, an international mining conglomerate headquartered in London.

Scope and role of operable unit or response action:

When proposed for listing on the NPL, the Kennecott properties were divided into two zones (Kennecott South Zone and Kennecott North Zone) because the two areas were 10 miles apart. However, in reality, the two zones are technically managed as one site because Kennecott continues to mine ore and process minerals at both sites and they are functionally connected via several pipelines, roads, and rail lines. For example, wastes produced by Kennecott's Copperton Concentrator located in the South Zone are slurried to an area in the North Zone. Waters generated in the North Zone are sent by pipeline to the South Zone for use in processing. For this reason, activities at either site can affect operations at both sites. There are 22 Operable Units within the Kennecott zones.

The descriptions of operable units related to OU2 and the status of each are given in the table below:

RELATIONSHIP OF OPERABLE UNITS TO OU2

OU No	Description and relationship to OU2	Status
OU1	Surface contamination in Bingham Creek and floodplain. A potential source of ground water contamination to OU2.	Cleanups completed by three removal actions, one fund lead, two PRP enforcement actions. Final ROD issued 1998. Consent Decrees 1999.
OU2	Ground water plumes in the South Zone	RI/FS work completed in 1998, in accordance with the MOU. ROD anticipated 2000.
OU3	Surface contamination in Butterfield Creek and floodplain. A potential source of ground water contamination to OU2	Cleanups completed by three removal actions, two PRP enforcement actions, one mixed funding. ROD anticipated 2000.

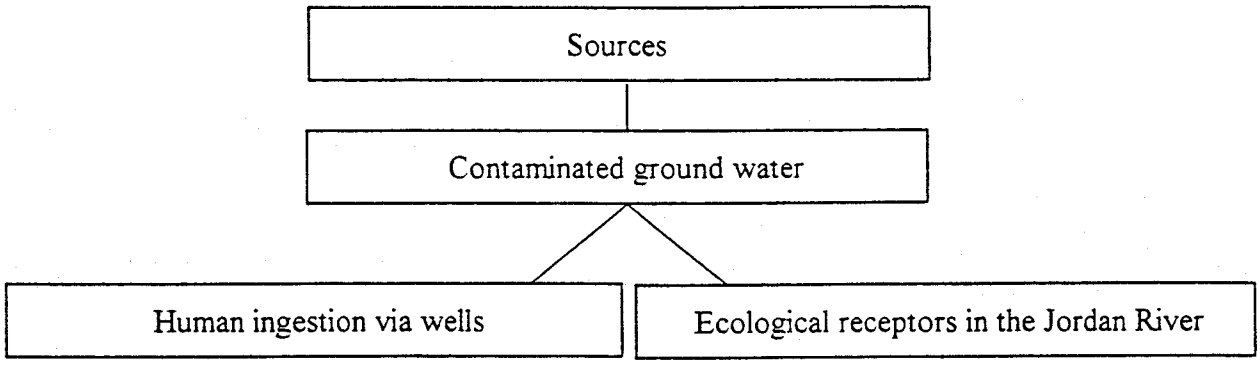
OU4	The Large Bingham Reservoir. This reservoir leaked about 1180 gpm (1 MGD) into the underlying aquifer. The most serious source of ground water contamination to OU2	Old reservoir retired and cleaned under provisions of a removal AOC and a state ground water permit. A new lined reservoir went into service in 1994. Final ROD issued 1998. Consent Decree 1999.
OU5	ARCO Tails. Surface contamination produced by non-Kennecott mines in Bingham Canyon. Degree of contribution of ground water contamination unknown. The site is immediately downgradient from the Large Bingham Reservoir and is above some of the highest concentrations in the ground water.	Cleanup completed under terms of a removal UAO about 1997. Final ROD issued 1998. Consent Decree entered for O+M, 1999.
OU6	Lark Waste Rock and Tailings. Surface contamination produced by mines and mills near the former town of Lark, Utah. A known source of ground water contamination to OU2	Cleanups completed (1994) under an AOC. ROD anticipated 2000.
OU7	South Jordan Evaporation Ponds. Surface contamination produced by disposal of mine waters from Bingham Canyon. A known source of ground water contamination to OU2	Cleanups completed under an AOC 1995. ROD anticipated 2000.
OU10	Copperton Soils.	Contamination not severe enough to warrant action. ROD issued 1998.
OU11	Bingham Canyon. Surface and subsurface contamination. A suspected source of ground water contamination.	With minor exceptions, most of these sites were buried or excavated by later mining operations. No further action needed. ROD issued 1998.
OU12	Eastside Collection System. This system was constructed to recover acid leachate from mine dump leaching operations. A known source of ground water contamination.	The system was reconstructed in 1993-1996 under provisions of a state ground water permit.

OU16	Bingham Canyon Underflow. This is a plume of acidic waters flowing in the alluvium underneath Bingham Creek in Bingham Canyon. A known source of ground water contamination.	This flow was intercepted through construction of a cutoff wall keyed into bedrock under the provisions of a state ground water permit.
OU17	Bastian area. Surface contamination resulted through the use of contaminated irrigation water. The site overlies the ground water plume emanating from the Large Bingham Reservoir.	Surface contamination was not severe enough to warrant further action except in an historic ditch. Cleanups of the ditch were performed by enforcement actions at OU5 and OU6. ROD issued in 1998.
OU15 (North Zone)	Magna Tailings Pond. Tailings generated by two mills are stored in this facility at the North End. The pond is likely to be used as an integral part of the OU2 action while mining operations continue.	Surface discharges from the pond are subject to a UPDES permit. Subsurface discharges are covered under a state ground water permit. No actions using CERCLA authority are anticipated.
OU22 (North Zone)	Great Salt Lake. The Great Salt Lake is the receiving water for discharges from Magna Tailings Pond and other Kennecott waters	There are no numerical water quality standards for the Great Salt Lake at present. The standards are narrative. Relevant ecological studies were performed as a part of the CERCLA North Zone studies.
OU20	Pine Canyon. Kennecott lands on the west slope of the Oquirrhs are a part of the Kennecott South Zone. However, drainage is to the other side of the mountains and this area is not a source of ground water contamination at OU2. Non-Kennecott owned land in this area was divested from the Kennecott South Zone to another proposed NPL site, International Smelter	Kennecott lands in Pine Canyon have been given a No Further Action Status. As a part of the newly proposed areas of Pine Canyon, negotiations with the other party for a RI/FS are underway.

In summary, all the mining sources of contaminated ground water at the Kennecott South Zone have now been addressed, largely through use of removal authorities and state permits. EPA hopes that the proposed action for ground water at the South Zone will be the final remedy decision at the site. Construction completion is estimated to be December, 2003.

Site characteristics:

Conceptual Site Model:



Description of elements in the Site Conceptual Model:

Sources: The major source of the contaminated ground water was leakage from the Large Bingham Reservoir. Other sources included acid leachate leaking or escaping capture from the Eastside Collection System (includes Butterfield Creek and Bingham Creek underflow), historic tunnels at Lark, the South Jordan Evaporation Ponds, and several non-mining sources. The sources have all been addressed by previous response actions.

Contaminated Groundwater: For administrative purposes the ground water plumes have been divided into two categories. The "acid" plume (sometimes referred to as the CERCLA plume, or Zone A) contains low pH waters and high metals with sulfates exceeding the CERCLA recommended risk based action level of 1500 ppm. The "sulfate" plume (sometimes referred to as the NRD plume, or Zone B) contains waters exceeding the secondary drinking water standard for sulfate at 250 ppm. Although these waters do not rise to the level of a health risk, they are not useable for public drinking water supplies without blending or treatment. The acid plume originates largely from the Large Bingham Reservoir; the sulfate plumes originate from South Jordan Evaporation Ponds and other sources.

Human ingestion: Human ingestion is the major pathway of potential human exposure. There are some other minor concerns which include using the water for irrigation and stockwatering purposes. Two irrigation studies were performed. The first, conducted by Utah State University for EPA, found no deleterious effects on common cash crops when the sulfate is less than 1500 ppm in irrigation waters. The second, performed by Kennecott, also found no deleterious effects on grass used for lawns, ornamental shrubbery, and garden vegetables at these sulfate levels.

Ecological receptors: The ground water in this area flows from the mountain recharge areas towards the Jordan River which represents the discharge point. Present concentrations of sulfate in the ground water nearby are in the same range as the water quality of the Jordan River.

Overview of the site:

Size of the site: The contaminated ground water underlies a 72 square mile area. The acid plume is about 2 square miles in size.

Geographical and topographical information: The site is located in the Southwest portion of the Jordan River Valley. On the western edge of the site is the Oquirrh Mountain Range which has been an important mining area in the State of Utah since 1863. Several creeks begin in these mountains and historically flowed eastward toward the Jordan River. These creeks include Bingham Creek, Midas Creek, and Butterfield Creek. Today, because virtually all the water coming from the mountains is captured for use as industrial or irrigation waters, the creeks do not flow except during major rain events. Each of these creeks has an associated flood plain, but the size of the current flood plain is much smaller today due to water impoundment. Buried channels of these creeks often serve as preferential flow pathways for subsurface waters. Because of the availability of water during historic times, several farming communities were founded along the creeks. With the growth of urban development in Salt Lake Valley, most of these communities are now suburban in character. Except in and near the mountains, the valley floor is relatively flat gently sloping toward the Jordan River. The Cities of West Jordan, South Jordan, and Riverton, the Town of Herriman, and portions of unincorporated Salt Lake County overlay the contaminated ground water.

Surface and subsurface features: Proceeding from west to east, surface features in the Oquirrh Mountains and foothills include mining operations of the Kennecott Utah Copper Corporation. The facilities which were implicated in groundwater contamination are described later. Adjacent to the mountains is a band of agricultural lands either owned by Kennecott and leased to farmers or privately held farms. Over the eastern edge of the site are three cities. In addition, transecting the site from north to south are several irrigation canals which transport Provo River, Utah Lake water, and Jordan River water inland for use by farmers and residents for irrigation of lawns, crops, and gardens. Subsurface features are largely associated with infrastructure of the cities, such as sewers, water lines, gas station tanks, etc.

Areas of archaeological or historical importance: There are numerous areas of historical significance including the mining district itself and early structures built by the Pioneers. Areas of historical significance would not be affected by the proposed action.

Sampling strategy: Samples of ground water were collected in order to determine the lateral and vertical extent of the contamination, monitor plume movement over time, provide data needed to calibrate the modeling, characterize aquifer materials, determine if private well owners

needed immediate relief, and provide early warnings should municipal water supplies be threatened. Samples of ground water were also used in studies to assess potential impacts to various water uses such as irrigation and industrial waters. Ground waters were also used in pilot testing of proposed remedies and characterization of potential waste streams. Routine monitoring of some wells is required as a part of the state ground water permit to determine if leakage from operating facilities is occurring. Many of the wells were used in a multivariable statistical approach for the determination of background concentrations. Some were used for isotopic tracing and age dating purposes.

All private and municipal wells were monitored at least once. Wells close to the sources were monitored quarterly and others less frequently. The historic database on ground water quality dates back to the early 1960s, but most of the wells were installed in the late 1980's. Several of the recently installed wells in the heart of the plume have multiple completions.

Describe known or suspected sources of contamination. The locations of known or suspected sources of the ground water contamination relative to the plumes are shown in Figure 4.4 (from the Remedial Investigation Report). The major source of contamination to the ground water of the acid plume was the Large Bingham Reservoir, formerly used to collect leach waters and runoff from the Bingham Canyon open pit mine, associated waste rock dumps, and flow from Bingham Creek. The former Large Bingham Reservoir was constructed in 1965, and retired from service in 1991. (See Photo A.) It is suspected that during the entire history of the operation of this reservoir, leakage rate to the underlying aquifer was about 1180 gpm (1 MGD). The waters in the reservoir were characterized by low pH, high metals, and very high sulfate. This area was designated OU4 of the Kennecott South Zone site. The sludges, tailings, and underlying soils were removed in 1992-1993 and a new lined reservoir with three basins was constructed in 1994-5. The work was performed under CERCLA removal authorities and provisions of a state ground water permit.

Another source of groundwater contamination in this area was Bingham Canyon alluvial flow, sometimes referred to as Bingham Creek underflow. In Bingham Canyon, the flow of Bingham Creek is only partially at the surface. A substantial flow travels in the alluvium at the interface between the bedrock and the channel alluvium. (See Photo B.) This water was also characterized by low pH, high metals, and high sulfate. Recent data suggests that this flow discharged into the principal aquifer at a rate of at least 300 gpm. Kennecott installed some wells to intercept this flow in 1989 (not entirely successful), and in 1996 built a cutoff wall keyed into bedrock to capture the total flow. This later work was performed under provisions of a state ground water permit. It is OU 16 of the Kennecott South Zone.

A major source of groundwater contamination of the sulfate plume in the valley was the South Jordan Evaporation Ponds. These ponds were used intermittently from 1936 to 1986 to dispose of excess water from Bingham Canyon. The waters were acidic and high in sulfate. The original ponds were not lined and had sand and gravel bottoms. During the later period of operations, some of the ponds were lined and waters were treated with lime. Infiltration rates

varied depending on the amount of water in the ponds, with estimates of 150 gpm to 1800 gpm. (See Photo C.) The ponds were retired from service in 1986. The ditches leading to the ponds were cleaned as a part of the Bingham Creek removal action and the sludges remaining in the pond area were addressed as part of the South Jordan Evaporation Pond Removal Action during the 1994-1997 time frame. This area was OU 07 of the Kennecott South Zone.

Another source of ground water contamination was Cemetery Pond (located next to the Copperton Cemetery). It was built in 1984 and used until 1987. It served as a lime treatment basin for treatment of acid waters from the Bingham Canyon Mine and North Ore Shoot. It had a gravel bottom. The leakage rate was estimated at 2000 gpm. The water was generally alkaline, but had elevated sulfates and TDS. The bottom sediments contained elevated arsenic. This pond was retired from service in 1992 and sediments cleaned out. The area was included in the Final ROD for Bingham Creek in 1998.

A potential source of ground water contamination was the Small Bingham Reservoir. It was also built in 1965 and was retired from service in 1988 and reconstructed in 1990 with HDPE linings. It held waters similar in composition as the Large Bingham Reservoir. Since it had only 4% of the capacity of the Large Bingham Reservoir its leakage rate was probably small in relation. This area was included in the Final ROD for Bingham Creek in 1998.

Another source of ground water contamination is the waste rock dumps and Eastside Collection System. Early miners noticed that acidic copper laden waters were produced when rain water came in contact with sulfides in waste rock dumps. (See Photo D.) The sulfides were oxidized to form sulfuric acid and the acid then leached metals out of the waste rock (Note: waste rock does have some metal content but not enough to economically process.) Miners began to collect the acidic metal laden waters and process them to recover the metals. (See Photo E.) Kennecott enhanced this process by actively spraying the tops of the dumps with recycled water starting in 1942. A system of canals were built to collect the water at the toe of the dumps as the metal rich water emerged. Initial activity was centered largely in Bingham Canyon. Excess waters were sent to the South Jordan Evaporation Ponds. The collection system was expanded in 1965 so that leaching operations could be extended to the Eastside Dumps. This was upgraded in about 1982 using ponds and concrete ditches. Beginning in 1991, the collection system was again upgraded to install cutoff walls keyed into bedrock in order to capture any underflow through the alluvium. There are some remaining concerns about the waters escaping via flow in the bedorck. This flow cannot be estimated at this time, but studies by USGS and Kennecott are being planned. The flow is probably small, but varies with location. It is hoped to use the information gained in this new study to refine the ground water model.

A known source of contamination was acid discharges from historic mine tunnels along the east side of the Oquirrh Mountains. An area of poor quality ground water is located down gradient of the portals of two tunnels in the Lark area. The Mascotte Tunnel was originally constructed in 1902-3 to access the ore body in the Oquirrh Mountains. It was also used as an outfall for waters infiltrating into the mines. Water was pumped from the shafts into the tunnel.

At one time, the waters contained enough metals that the miners set up metals recovery launders within the tunnel itself. The water was discharged into the Lark Tailings area until 1942. At that time a pond was constructed (Mascotte Pond) and the water was used for irrigation. During active pumping of the shafts serviced by the tunnel, flow rates were 1000 - 3000 gpm. After 1952, discharges from Mascotte Tunnel were intercepted by the new Bingham Tunnel nearby. (See Photo F.) Bingham Tunnel water, when it was not used for irrigation in Herriman, was discharged to Midas Creek until 1988. The current flow is 600 - 1000 gpm and is now routed into the Eastside Collection System described earlier.

Also a potential source of ground water contamination in the Lark area was the Lark Tailings and Waste Rock site. This area was used as a disposal site for tailings and wastes of various mining operations in the area. The waste rock had acid generating potential. (See Photo G.) There has been no estimate of flow rate. In 1993, the tailings with high metals were relocated to the Bluewater Repository and the waste rock was relocated to Kennecott's main waste rock dumps (behind the Eastside Collection System). There was one seep in the Lark Tailings area which had moderately contaminated water. The seep was used for experimentation using artificial wetlands for treatment of high sulfate waters. The Lark area is OU 06 of the Kennecott South Zone. Cleanup was performed by Kennecott using removal authorities.

A potential source in the Bingham Creek area was the ARCO Tailings (also called Copperton Tailings and Anaconda Tailings). This tailings impoundment was constructed about 1910 to capture tailings from mining and milling operations of Utah Apex and other nearby facilities. Tailwaters were used by local farmers for irrigation purposes. The impoundment was located immediately down gradient of Kennecott's Large Bingham Reservoir. The tailings did have acid generation potential, but it is unknown how much acid waters made it to the underlying aquifer. This area was capped by ARCO under provisions of a removal Unilateral Order in 1993-1997. (See Photo H.) The final ROD was issued in 1998. The area is OU 05 of the Kennecott South Zone.

Because the mining activities in the area have been ongoing since 1863 and continue today, the sources of ground water contamination from these activities were numerous. An intensive effort to contain or remove these sources was the first order of business at the Kennecott South Zone site. Currently, all of the above known and potential sources associated with mining activities have been contained or removed.

There are other non-mining related sources that impact ground water. Some of these are natural such as natural leaching of mineralized areas in the mountains and geothermal activity. Others are man-made such as irrigation water, canals and runoff from urban areas.

Types of contamination and the affected media: Because the ground water was contaminated through the release of acidic metal-laden waters emanating from mining activities, the COCs are largely inorganic chemicals, particularly metals and sulfates. Mobility of the metals and sulfates is enhanced in the presence of low pH waters near the sources. For operational and

legal reasons the groundwater has been divided into two plume areas, the acid plume and the sulfate plume. The COCs are different for the two plumes. For the acid plume, an example of the concentrations of the COCs in the groundwaters close to the major source in comparison with primary and secondary drinking water standards are given in the following table:

COMPARISON OF ACID PLUME GROUND WATER WITH DRINKING WATER STANDARDS

COCs	Drinking water standard (primary or secondary) mg/l	Max. concentration in acid plume (down gradient of Large Bingham Res.) (from the RI report) mg/l	Ratio of concentrations (acid plume/standard)
Arsenic	0.05	4.1	82
Barium	2	0.9	0.45
Cadmium	0.005	9.34	1868
Chromium	0.1	0.99	9.9
Copper	1.3 (action level)	192	147
Fluoride	4	16.2	4.05
Lead	0.015 (action level)	0.85	56.6
Nitrate	10	4.5	0.45
Selenium	0.05	0.9	18
Nickel	0.1 (Utah)	850	8500
Aluminum	0.05 - 2(secondary)	4690	1173 - 93800
Chloride	250(secondary)	539	2.1
Copper	1.0 (secondary)	192	192
Fluoride	2.0 (secondary)	16.2	8.1
Iron	0.3 (secondary)	1222	4073
Manganese	0.05 (secondary)	1100	22000
pH	6.5 - 8.5 (pH units)	2.6 (minimum pH)	7943*
Silver	0.10(secondary)	0.24	2.4

Silver	0.10(secondary)	0.24	2.4
Sulfate	250 (secondary)	59,000	236
TDS	500 (secondary)	77,574	155
Zinc	5 (secondary)	544	109

*Note pH is measured on a logarithmic scale.

For the sulfate plume, a different picture emerges. Again, an example of the COC concentrations close to the major source compared to the drinking water standards is given in the following table:

COMPARISON OF SULFATE PLUME GROUND WATER TO DRINKING WATER STANDARDS

COCs	Drinking Water Standard (primary or secondary) mg/l	Max. concentration in sulfate plume (downgradient of the South Jordan Evaporation Ponds) mg/l (from RI report)	Ratio sulfate plume/std.
Arsenic	0.05	0.089	1.78
Barium	2	1.3	0.65
Cadmium	0.005	0.065	13
Chromium	0.1	0.08	0.8
Copper	1.3 (action level)	3	2.3
Fluoride	4	3.86	0.97
Lead	0.015 (action level)	0.13	8.6
Nitrate	10	12	1.2
Selenium	0.05	0.142	2.84
Nickel	0.1 (Utah)	1.37	13.7
Aluminum	0.05 - 2 (secondary)	50	25 - 1000
Chloride	250 (secondary)	714	2.8
Copper	1.0 (secondary)	3	3

Iron	0.3 (secondary)	22	73
Manganese	0.05 (secondary)	14	280
pH	6.5 - 8.5 (pH units)	4.7	63
Silver	0.10 (secondary)	0.03	0.3
Sulfate	250 (secondary)	2790	11.2
TDS	500 (secondary)	5005	10.0
Zinc	5 (secondary)	10	2

According to the EPA Office of Ground Water and Drinking Water, the effects of drinking water exceeding the primary standards are given in the following table:

HEALTH EFFECTS OF ELEVATED INORGANIC COMPONENTS IN DRINKING WATER

Drinking water component	Potential Health Effects from ingestion of water
Arsenic	Skin damage, circulatory system problems, increased risk of cancer
Barium	Increase in blood pressure
Cadmium	Kidney damage
Chromium	Allergic dermatitis
Copper	Gastrointestinal distress, liver or kidney damage
Fluoride	Bone disease, mottled teeth
Lead	Delays in mental development, kidney problems, high blood pressure
Nitrate	blue baby syndrome
Selenium	hair or fingernail loss, numbness, circulatory problems
Sulfate	diarrhea

The Remedial Investigation estimated the volume of contamination using different criteria. A summary table follows:

VOLUME OF PLUMES

Contamination range	Volume (acre-feet)
Sulfate concentrations > 1500 mg/l	171,000
Bingham Reservoir Area	168,000
Remaining areas	3,700
Sulfate concentrations> 20,000 mg/l	19,000
pH < 4.5	54,000

RCRA hazardous wastes: Acid leachate from mining operations is not a RCRA waste (Bevill Exemption).

Describe location of contamination and known or potential routes of migration. The location of the contamination relative to the sources is shown on Figure 4-4 (reprinted from the Remedial Investigation Report). This figure demonstrates sulfate concentrations. In general, the low pH and high metal concentrations are located in the areas designed by reds and orange on this figure. This portion is known in various documents as the "acid plume", the "CERCLA plume" and "Zone A". Most of this plume originated from leakage from the Large Bingham Reservoir. Minor sources were leaks from the dumps (shown as fingers of contamination coming down the western gulches).

The other portion of the plume to the east is characterized by lower sulfate concentrations with only a few hot spots of metals and low pH. This portion is known in various documents as the "sulfate plume", the "NRD plume" and "Zone B". The major source of sulfate contamination in this area is the South Jordan Evaporation Ponds.

Both of these plumes were modeled in the RI/FS and the NRD Settlement proposal to determine plume movement under different scenarios. An example of one such scenario is given in Figures 5-9, 5-10 and 5-11. These figures give the predictions assuming no action and illustrates the movement of sulfate in 25 years, 50 years, and 150 years. In general, the plume continues to move to the east away from the mountains toward the Jordan River. The model results point out three areas of concern to the agencies. (1) After 50 years, the plume has reached the West Jordan municipal well field, the major source of water for the city. (2) After 150 years, high concentrations of sulfate begin to approach the flood plain of the Jordan River presenting a threat to the aquatic ecology of the river. (3)The highest concentrations of the plume will move off existing Kennecott property after 50 years.

Lateral and vertical extent of contamination: The lateral extent of contamination along with the known sources is shown on Figure 4.4. As mentioned previously, there are two main areas of ground water contamination. The western area, sometimes also known as the "acid plume", is where the highest concentrations of contaminants are found. The area exceeding drinking water standards measures about 5 miles by 5 miles. Within this western area is the major plume immediately down gradient of the Large Bingham Reservoir, and minor plumes originating near the toe of the waste rock dumps in various gulches including Bluewater I Gulch, Bluewater II Gulch, Bluewater Gulch, Midas Gulch, Keystone Gulch, Keystone Gulch (near the Bingham Tunnel portal), North Copper Gulch, Copper Gulch, Yosemite Gulch, and two gulches in Butterfield Canyon.

The depth to ground water ranges from 50 to 400 feet in the most heavily contaminated zone near the Bingham Reservoir. The contamination persists in the top 100 - 600 feet of the principal aquifer. In the Lark area (plume starting at the Bingham Tunnel) the contamination is in the top 50 to 150 feet of the principal aquifer.

The contamination in the eastern area has much lower concentrations of contaminants, with sulfate being the major problem. For this reason, this area is sometimes known as the "sulfate plume". This plume starts immediately down gradient of the former South Jordan Evaporation Ponds site and extends nearly to the Jordan River. It is about 6 miles by 5 miles in size. There are other non-mining related sources of sulfate in this area including irrigation canals.

The depth to ground water is about 200 feet in the area of the South Jordan Evaporation Ponds area. Both the shallow unconfined aquifer and the principal aquifer were contaminated by leakage from these ponds.

Current and potential future surface and subsurface routes of human or environmental exposure: As illustrated previously, modeling of the ground water plumes suggest that the contamination will continue to migrate eastward toward the Jordan River if nothing is done to contain or treat the plume. It may also migrate northward toward the West Jordan municipal well field depending on pumping rates by West Jordan. A well inventory was conducted during the RI/FS. The inventory located 1688 wells. Of these wells 523 were monitoring wells, 559 were in use, and 606 were not in use, damaged or missing. Of the 559 wells in use, 347 were used for culinary purposes (either solely or in conjunction with other uses), and 212 were used for other purposes such as stockwatering, irrigation, commercial. Although most of these well owners now have access to municipal water supplies, many continue to use their wells for lawns and agricultural uses.

Some preliminary ecological risk calculations were performed to assess ecological risk. The two places where the plume could discharge to the surface are at the Jordan River and at the Great Salt Lake. In both cases, the sulfate inputs are minor in comparison to the sulfate already present in these water bodies. Note that this describes the current condition, not the future threat

which modeling suggests might occur in 150 years.

Likelihood for migration for COCs It is a certainty that the contaminants of interest will continue to move eastward if nothing is done to contain or treat the plume. The leading edge of the plume has already moved 5 miles from its original source in the last 35 years. Although the pH will be neutralized and the metals removed into the solid phases of the aquifer, sulfate is totally soluble in water up to about 2000 ppm at neutral pH. As the water moves at about 500 feet/year, the sulfate will move with it.

Human and ecological populations that could be affected: Although current exposures are limited to those with private drinking water wells, the site is located in a semi-arid climate where water resource availability is a serious issue to all residents in the area. In addition to the private well owners, there are two municipal well fields just outside the area of the contamination. There is valid concern that, depending on the pumping scenarios, contaminated water could be drawn in the direction of these fields limiting their future use as a water supply. Most of the other residents in this area are served by public water suppliers which import the water from surface reservoirs in the mountains. The ground water underlying these cities is a valuable resource which has not yet been exploited by the municipal water purveyors due to the expense of dealing with the contamination. Thus the entire population of this area is affected either directly by ingestion of the water or indirectly by the extra cost of providing water from outside the area. The population was estimated to be 117,059 in 1997 and is projected to grow to 286,905 by 2020.

Ecological receptors are limited to aquatic species in the Jordan River. This is presently not a major concern because the water quality of the Jordan River as it leaves its headwaters in Utah Lake is not pristine and already contains substantial quantities of sulfate. This could change in the future if the higher sulfate areas of the plume are not contained.

Aquifers affected or threatened by site contamination, types of geologic materials, approximate depths, whether aquifer is confined or unconfined. There are three aquifers that are affected or potentially affected by the mining related contamination. The following is a description of these aquifers starting with the bottom. (See also Figure 4-8, reprinted from the Remedial Investigation Report).

The bedrock aquifer underlies the entire valley at varying depths. The bedrock is close to the surface in the Oquirrh Mountains plunging to a depth of about 5000 feet below ground surface in the middle of the valley. The bedrock is composed of Paleozoic bedrock with a layer of Tertiary volcanic rock above it. Both provide recharge water to the Principal Aquifer. Hydraulic conductivity is low relative to the principal aquifer, but is highly variable depending on the presence or absence of fractures. The Eastside waste rock dumps are located on the Tertiary volcanic rock. When the water percolating through the dumps encounters the bedrock, it flows at the interface and emerges at the toe of the dumps. The rate at which the acid laden waters enters the bedrock aquifer has been estimated at 150 gpm along the Eastside Dumps. The

flow at which the bedrock aquifer discharges to the principal aquifer is unknown. The USGS and Kennecott are beginning to develop a model which may provide further insight on specific locations. Hydraulic conductivities are 0.03 - 0.8 feet/day. The direction of flow is variable depending on the direction of the fractures. About a mile from the front of the Oquirrh Mountains, the bedrock is overlain by the Jordan Valley Narrows Unit originating during the Oligocene-Miocene period. It is described as interbedded clays and tuff and is considered by most experts to be an aquitard. Its conductivity is estimated at 0.1 -0.3 feet/day. This is the bottom of the principal aquifer. The bedrock aquifer discharges to the principal aquifer.

The principal aquifer overlies the bedrock layers near the mountains and the Jordan Valley Narrows Unit farther out in the valley. It consists primarily of Plio-Pleistocene alluvial fan deposits of quartzitic and volcanic gravel. In the central part of the basin, the aquifer is relatively thick (up to 1000 feet) and is composed of quartzitic gravels. The upper 200-300 feet of the aquifer is particularly productive with hydraulic conductivities of 3 - 83 feet/day at the western part and over 100 feet/day east of the Evaporation Pond site. At the southern part of the site near the mountains, the principal aquifer is mostly volcanic gravel interbedded with clay and silt. The hydraulic conductivities in this area range 1 - 12 feet/day. The Bingham Reservoir and the Lark tunnel portals are both located in the recharge zone of the principal aquifer at the edge of the mountains. The relatively high hydraulic conductivities allowed the contamination to spread quickly. The flow of the principal aquifer is generally eastward with minor directional changes in the presence of buried channels and municipal well fields. The flow bends toward the northeast near the Jordan River boundary (toward the direction of the Great Salt Lake). The principal aquifer is considered to be unconfined in the area near the mountains, but is thought to be confined between the Evaporation Ponds and the Jordan River. The confining layer has not been thoroughly investigated and may not be continuous. The principal aquifer eventually discharges to the Jordan River and the Great Salt Lake.

The shallow unconfined aquifer is found east of the Evaporation Ponds and consists of quartzitic gravel intermixed with silt and clay. They are Bonneville and Provo lacustrine deposits (Late Pleistocene and Holocene). The conductivity is low at about 1 ft/day. The flow direction is toward the east. The South Jordan Evaporation Ponds contaminated both the shallow unconfined aquifer and the principal aquifer. The shallow unconfined aquifer is also affected by several unlined irrigation canals which traverse the area. The shallow aquifer discharges to springs and seeps along the Jordan River.

Features at the site which affect the quality of the ground water include the mining-related sources and several non-mining related sources. Mining related sources include the former Small and Large Bingham Reservoirs (now reconstructed with triple linings and leak detection), the former Eastside Collection System (now reconstructed with cutoff walls keyed into bedrock and above ground HDPE pipes), the Bingham Tunnel portal (whose discharge now goes into the reconstructed Eastside Collection System), the Lark Tailings and Waste Rock (now remediated), and the South Jordan Evaporation Ponds (retired from service, remediated, and partially redeveloped as residential property). The major non-mining related sources are a series

irrigation canals which are in use during the growing season with waters.

An example of the stratigraphy with location of the contaminated plume is given in Figure 4-8 (from the Remedial Investigation Report). The monitoring well map is given in Figure 3-5a (also from the Remedial Investigation Report).

Current and Potential Future Site and Resource Uses:

Land Use: The contaminated ground water plume underlies a suburban area of Salt Lake City, particularly the eastern portion of the site. The western portion is still largely agricultural and mining, but suburban development pressure is marching westward into these areas too as more infrastructure such as highways and water service becomes available. Several of the cities in the area have already annexed these western lands in anticipation of the development. A map of current land use is given in Figure 3-6 (from the Remedial Investigation Report). The Wasatch Front Regional Council estimates that the population density above the plume was 1.06 persons/acre in 1998. They estimate that the density will increase three fold by 2020. Growth rate is estimated at 6% per year for the next 20 years.

Current ground/surface water uses on the site and in its vicinity: There are three creeks which traverse the site from their headwaters in the Oquirrh Mountains and discharge into the Jordan River. The Jordan River, in turn, discharges to the Great Salt Lake. Kennecott has a reservoir at the mouth of the Bingham Canyon which captures all the flow of Bingham Creek. The water is used in mineral processing at the Copperton Concentrator. The headwaters of Midas Creek are now buried by waste rock from the Bingham Canyon Mine and waters which formally flowed this way have also been diverted by the mining company for use in mineral processing. The total flow in Butterfield Creek along the southern boundary of the site is diverted by the Herriman Irrigation Company and used for irrigation of agricultural lands and residential yards in and near Herriman. Most of the creeks are essentially dry by the time they leave the foothills of the Oquirrhs. The county flood control district has relocated some of them to provide better drainage following rains. Flows from the Jordan River are diverted by canals to irrigation districts. The outfall of the local waste water treatment plant is located just downstream of the site on the Jordan River.

There are four cities which overlay the contaminated plumes. Two of the cities, West Jordan and Riverton, have their own municipal well fields but also augment their water supplies with water provided by the Jordan Valley Water Conservancy District (JVWCD). One of the cities, South Jordan, depends entirely on drinking water supplied by the JVWCD. The Town of Herriman currently depends on private wells and a private water supply company, the Herriman Pipeline Company. There are also some areas which are in unincorporated Salt Lake County. These areas are serviced by private wells, the Copperton Improvement District, and the Jordan Valley Water Conservancy District.

The Jordan Valley Water Conservancy District obtains its water largely from surface sources outside the site including Jordanelle, Deer Creek, and Echo Reservoirs, high Uinta lakes, Provo and Weber Rivers, five Wasatch Front mountain streams, and Wasatch Front springs. The JVWCD does own water rights in the plume area although these have not been developed.

West Jordan's municipal well field is located just to the north of the plume and there is concern that excess pumping by the city could draw the contamination into that direction. Also

there is concern that excess pumping as a part of any remedy could drop the water table in the area so low as to reduce the capacity of West Jordan's wells.

Riverton's municipal well field is located just to the south of the plume and one well has already been impacted with waters exceeding 250 ppm sulfate. South Jordan has no water rights and has not sought to procure any because of the poor quality water. The Town of Herriman's main water source is the Herriman Pipeline Company which obtains its water from wells outside the plume. Town officials are concerned that the town will outgrow this water source and new supplies may be needed. They are already in negotiations with JVWCD to provide this additional water. Herriman is largely rural and several properties are served by private wells owned by individuals and small water companies. Several of these wells have declining water quality with sulfate concentrations at 250 - 1000 ppm. The Copperton Improvement District well is located outside the plume and is not threatened by the contamination.

A summary of municipal water use provided by the various suppliers is given in the following table:

POTABLE WATER SUPPLY SOURCES IN THE AREA

Supplier	Surface water (acre-feet/year)	Ground water (acre-feet/year)
Copperton	0	337.2
Dansie Water Co (Herriman)	0	75.0
Herriman Pipeline Co.	166	156.3
Hi-Country Estates I	0	35.6
Hi-Country Estates II	0	53.2
Riverton	493.1 (from JVWCD)	3,366.3
South Jordan	5,153.3 (from JVWCD)	0
West Jordan	5,217.8 (from JVWCD)	6,601.2

The annual water use is 21,631 Acre-ft/yr (1995 data).

The water in the study area is used for a variety of purposes as approximated in the following table (Water use in units of acre-feet/year):

WATER USE

Supplier	Domestic	Commercial	Industrial	Irrigation	Other
Copperton	178.0	159.2			
Dansie	36.8			3.1	33.8
Herriman	217.9			104.4	
Hi-Country I	35.3				0.3
Hi-Country 2	53.2				
Riverton	3,471.9	383.6			
S. Jordan	3,973.0	477.5			
W. Jordan	9,972.3	153.4	1,534.2	184.1	

Kennecott conducted a Well Inventory as a part of the Remedial Investigation/Feasibility Study. Of the 1,688 wells inventoried at the site, 523 were monitoring wells (31%), 559 were in use (33%), and 606 were not in use, damaged, or missing. Of the 559 wells in current use, 347 were for culinary use and 212 for other uses. Other uses include irrigation, stockwatering, commercial and industrial uses.

Anticipated Use: It is quite clear that the water needs of the area will increase. The Jordan Valley Water Conservancy District estimates that the water demand of their service area will double in the next 20 to 25 years. Their current water supply for their entire service district is about 70,000 acre-ft/yr. By 2020, the district projects it will need about 160,000 acre-ft/yr. If the same growth is used for the impacted area, the water needs above the contaminated aquifer could rise from 22,000 acre-ft/yr to 50,000 acre-ft/year. Although the contaminated groundwater is currently not being utilized except by Kennecott for industrial waters and by a few private well owners for irrigation, full utilization of the impacted groundwater is desired by the cities and the water purveyors because the water is near the population. Since the safe annual yield of the aquifer is estimated at 7,000 acre-ft/year, alternative sources of water from distant reservoirs will be needed as well. To compound this shortfall, remedial action to withdraw the plume is likely to cause the water levels in the area to drop one or two feet per year. This will reduce the safe annual yield of the aquifer for other users.

Summary of Site Risks:

Potentially exposed populations in current and future scenarios: Theoretically, any citizen, municipality, or business that has a water right in the impacted ground water area could cause their household, customers, and workers to be exposed to unacceptable concentrations of acids, metals, and sulfate in their drinking water. If nothing is done to prevent the continued movement of the plume, more and more wells would degrade in their quality. At least one municipal well field, perhaps two, are also threatened. The situation would only get worse.

Any sensitive populations: There are two sensitive populations to excessive levels of sulfate, the most pervasive chemical of concern. Excessive levels of sulfate in drinking water produces diarrhea, a problem which is annoying, but not particularly life threatening, except in infants. Infants with diarrhea can quickly become dehydrated. For this reason, pediatricians warn against making infant formula with waters high in sulfate. Medical evidence shows that others can build up a tolerance to high sulfate with repeated exposures. Therefore, visitors to any area with elevated sulfates in the drinking water would feel the effects to a greater degree than the resident population. Visitors would include household guests, and tourists patronizing local hotels, restaurants, tourist attractions, and commercial establishments.

Route of exposure: The route of exposure is ingestion of contaminated ground water for adults, children, infants, and visitors.

Assumptions: The risk assessment conducted for this operable unit recommended that the preliminary remediation goals for metal should be the primary (health based) drinking water standards. Drinking water standards have already been developed by EPA and adopted in regulations by the State of Utah. Therefore, the assumptions used at the site are the assumptions used to derive the national and state drinking water standards.

Unacceptable risks: The concentrations of contaminants in the ground water were compared to drinking water standards which were used as a benchmark. Most of the metals in the ground water of the acid plume were in excess of drinking water standards, sometimes by a factor of thousands. Effects of excessive concentrations of the various contaminants in drinking water were previously described.

Integration of CERCLA and NRDC Actions

The preferred plan presented later is the result of integration of a standard CERCLA process and the provisions of the Consent Decree involving a Natural Resources Damage Claim reached between the State of Utah Trustee (plaintiff) and Kennecott Utah Copper (defendant). The State Trustee and EPA Region VIII reviewed the plan as a total package to ensure that the plan is seamless. The advantage of this approach is that it will be possible to share the infrastructure thereby saving construction and operating costs, and eliminating duplicative oversight.

The State Trustee and EPA have already combined their technical resources for review of the joint plan. Although a Technical Review Committee was formed in 1992 to provide a forum for discussion of the CERCLA response, in 1998 the State Trustee asked the Technical Review Committee to expand its duties to include review of the joint CERCLA - NRD plan. In addition, the State Trustee and EPA plan to present the integrated package to the public prior to final decisions by the two agencies. Although the National Remedy Review Board is an internal process conducted by EPA, the State Trustee has requested that the NRDC related portions of the plan be considered as well. In this case, the NRRB comments would be optional and advisory on that portion of the plan. According to the Consent Decree, the State Trustee is the final decision-making authority for NRD settlement-related items.

For the purposes of clarity in the NRRB review, parenthetical comments are added to the remainder of the text to indicate whether the concern, goal, or action originates from CERCLA or from the NRDC settlement with the State Trustee. This approach is consistent with the overall management strategy of the site. The site is currently being managed using a mixture of EPA and State authorities as a part of the site's enforcement pilot status.

Remedial Action and NRDC Settlement Objectives and Remediation Goals:

1. Minimize or remove the potential for human risk (by means of ingestion) by limiting exposure to groundwater containing chemicals of concern exceeding risk-based concentrations or drinking water Maximum Contaminant Levels. (CERCLA)

2. Minimize or remove the potential for environmental risk (by means of flow of groundwater to the Jordan River) to receptors of concern. (CERCLA)

3. Contain the acid and highly elevated sulfate plume from enlargement (CERCLA)

4. Contain the sulfate plume from enlargement (NRD)

5. Remediate the aquifer over the long term (CERCLA and NRD)

6. Place the water to beneficial (municipal) use (NRD)

7. Restore and replace the equivalent of the affected natural resource for the benefit of the public in the affected areas (NRD)

8. Provide plan which is comprehensive and efficient in groundwater development and water delivery, taking into account operational and political issues. (Community concern)

9. Improve treated water quality beyond requirements of CERCLA and NRD to be consistent with existing water quality (Community concern)

10. Restore and replace groundwater from the affected area which is lost as a concentrate stream (community concern)

11. Provide existing facilities for concentrate disposal to create additional cost savings and permitting efficiency. (CERCLA, NRD, community)

12. Better meet the water supply needs of growing municipalities as they expand westward toward higher elevations (community)

The remediation goals of the plan are as follows:

1. Provide treated water which meets National Drinking Water Primary Standards and does not exceed the health based concentration of 1500 ppm for sulfate. (CERCLA)

2. Provide treated water which meets the State of Utah Drinking Water Primary Standards and does not exceed the state's limit of 250 - 500 mg/l sulfate or 500 - 1000 mg/l TDS. (ARAR, Financial incentives in NRD)

3. Provide treated water which is compatible with the quality of existing municipal supplies which meets State of Utah Drinking Water Primary Standards and does not exceed 250 mg/l TDS. (Community concern, Financial incentives in NRD).

4. Provide pretreated water to the treatment plants which do not exceed 1200 ppm TDS to allow routine operations of the treatment plants in a conventional manner (CERCLA, NRD, Community, Long Term Operation and Maintenance).

5. Operate system to prevent further migration of any waters exceeding drinking water standards for metals and in excess of the health protection goal of 1500 ppm sulfate. This may require pumping in perpetuity (CERCLA)

6. Maintain remedy until water can be withdrawn from the aquifer which can be put to beneficial use by the municipalities without treatment for metals or sulfate. (Long term goal of NRD settlement and CERCLA, desired outcome of communities)

Description of Alternatives

The Remedial Investigation/Feasibility Study evaluated six (6) alternatives. A number of others were rejected in the screening process. A summary of each of the six retained alternatives is given below:

Alternative 1 - No Further Action

- Source controls already implemented by Kennecott
- Monitoring of effectiveness of source controls as required in a State Groundwater Permit.
- Monitoring of migration of the plume.

Alternative 2 - Institutional Controls

- Restrictions on use of existing wells
- Restrictions of drilling of new wells
- Modifications of restrictions as plume migrates in future
- All the measures in Alternative 1.

Alternative 3 - Point of Use Management

- Replace private well water by connecting residences to existing municipal water supply systems.
- Install household water treatment units (such as reverse osmosis) to treat water supplied to residences by private wells
- If municipal systems are impacted in the future, alternative water supplies would be required or a treatment plant installed.
- All the measures in Alternatives 1 and 2.

Alternative 4 - Hydraulic Containment, RO Treatment, Delayed Acid Plume Extraction, NF Treatment and Delivery

- Installation of a barrier well containment system
- Installation of a well or wells in the heart of the sulfate plume (near SJEP)
- Treatment of the water using reverse osmosis (RO) for the first 10 years
- After the first 10 years, pretreatment of the water will be necessary as the acid migrates to the barrier well system. Nanofiltration (NF) is proposed for pretreatment.
- Treated water is delivered to a municipal water purveyor.
- Concentrates are disposed by insertion into Kennecott's tailings line or into Kennecott's mineral processing water circuit.
- All the measures in Alternatives 1, 2, and 3.

Alternative 5 - Hydraulic Containment, RO Treatment, Active Pumping of the Acid Plume and Delivery

- Installation of a barrier well containment system
- Installation of a well or wells in the heart of the sulfate plume (near SJEP)
- Installation of a well or wells in the heart of the acid plume so that highly acidic waters do not migrate to the barrier wells
- Pretreatment of acid waters using nanofiltration
- Treatment of pretreated acid waters, barrier well water, and waters from the SJEP plume by reverse osmosis
- Treated water is delivered to a municipal water purveyor.
- Concentrates are disposed by insertion into Kennecott's tailings line or into Kennecott's mineral processing water circuit.
- All the measures in Alternatives 1, 2, and 3.

Alternative 6 - Hydraulic Containment, RO Treatment, Active Pumping of the Acid Plume and Lime Treatment

- Same as Alternative 5, except acid waters are treated with lime.
- Treatment residuals from lime treatment stored in a lined repository close to the treatment plant.

NRDC Settlement Proposal (Fits best with Alternative 5)

- Pumping of existing production wells in the acid plume
- Installation of 8 wells in the sulfate plume
- Installation of 4 wells in the shallow aquifer near the Jordan River to replace waters lost in treatment
- Construction of two treatment plants (reverse osmosis) and pipelines to the plants. One treatment plant to be used for treating the waters from the sulfate plume and the shallow wells. The other treatment plant will be used for treating acidic waters. It will include a pretreatment plant.
- Treated water provided to Jordan Valley Water Conservancy District system which serves the four affected municipalities.
- Disposal of treatment concentrates for the acid and sulfate plumes to Kennecott's Tailings Pipeline. Disposal of sulfate plume shallow aquifer well concentrates will be to the Jordan River downstream from a regional wastewater treatment plant. RO concentrate may be discharged to the Jordan River as well. This proposal is currently being reviewed by the state.

Alternatives for NF concentrate disposal following cessation of mining and milling operations in 30 years (tailings pipeline would no longer have tailings flows).

- pump the concentrate to a lined facility on the waste rock dumps for evaporation, disposal of the sludges in the dump or in a lined storage facility.
- use former tailings pipeline to convey concentrate to shallow ponds on the top of the new tailings pond. Lining depends on impact of low pH on tailings.
- same as above, but create solar ponds to create electricity; electricity could be used to help evaporate water during the winter months. Sludge storage also necessary.
- lime treatment and disposal of residuals in an on-site RCRA-like repository.
- Alternatives are currently under evaluation by EPA and the state. A preferred alternative will be selected, for use in case of a sudden closure, with provisions for re-examination of alternatives at closure time approaches.

Alternative for RO concentrate disposal following mine closure in 30 years:

- direct disposal in the Great Salt Lake via a new pipeline and outfall.

Additional Alternative for Well Head Protection

- Install injection wells between the acid plume and the West Jordan municipal well field.
- Inject sufficient water into aquifer to prevent excessive water level drops near West Jordan well field and prevent acid plume migration in that direction.
- Water would come from uncontaminated sources of water in the nearby mountains

Treatment methodology alternatives:

The treatment technology used for producing drinking water for supplying municipalities is Reverse Osmosis. It is a proven technology and has been pilot tested for waters of this plume. Conventional operation requires an input stream of water with less than 1200 mg/l TDS. This may require some blending with water from other sources.

In order to treat more contaminated waters, pretreatment is required. The technology proposed for pretreatment is nanofiltration. Nanofiltration is described as an "emerging technology" in EPA drinking water guidance. It too has been pilot tested at the site with some success. Another treatment technology that reached final consideration was conventional lime treatment. It too is proven technology. Kennecott has substantial experience with this technique and is commonly used in the mining industry for treatment of process waters.

Technologies screened out during the Feasibility Study included the following:

REJECTED TECHNOLOGIES FOR PLUME WATER TREATMENT

Treatment technologies screened out	reason for rejection of technology
All forms of in-situ treatment	heterogeneity of aquifer substrate, well screen clogging problems, size and depth of plume.
Ex-situ treatment technology	
Air stripping	not effective on site contaminants
Steam stripping	not effective on site contaminants
Freeze crystallization	unproven on site contaminants and scale
Incineration	infeasible due to plume volume
Adsorption	not effective on site contaminants
oxidation	not effective on site contaminants
ion exchange	not effective on all site contaminants, not demonstrated at scale of this site
electrodialysis	not demonstrated on high concentrations and this scale
solvent extraction	not effective on all site contaminants
selective precipitation	requires multiple steps, not demonstrated at this scale
biological treatment	requires multiple steps, not demonstrated at this scale

Barrier methodology alternatives:

The barrier technology proposed to prevent further downgradient migration of the plume is withdrawal wells at the leading edge of the plume. If wells are installed in the central portion of the plume, this too may halt forward progress of the plume as water levels drop in the area. Barrier wells then become a "safety net". If wells are not installed in the central portion of the plume, the barrier wells become the only line of defense.

Other barrier technologies were considered but were rejected during preliminary screening:

REJECTED BARRIER TECHNOLOGIES

barrier technology screened out	reason for rejection of technology
Soil based vertical barrier	plume too deep, not feasible to evenly distribute
Deep slurry trench wall	plume too deep
cement based vertical barrier	plume too deep
sheet pile vertical barriers	difficult to install at this depth, impossible to seal
jet and deep grouting	plume too deep
chemical barriers	speculative at this scale, plume too deep
chemical barrier Fe Cl 3	not effective for sulfate, needs carbonate, plume too deep
neutral barriers	not demonstrated except in laboratory, does not create an impermeable barrier
silica lime encapsulation	not feasible at this scale
CO 2 injection	does not create an impermeable barrier and might not neutralize sufficient quantity
hydraulic screening	"leap frogs" clean water from head to tail of plume, never addresses the plume itself, requires long term commitment
injection wells	likely to require more injection wells than extraction wells to completely contain plume and requires significantly more O+M. Feasible for selected areas

Delivery alternatives:

A variety of delivery alternatives were examined from delivery of treated water to municipalities for beneficial use to disposal of the untreated water into the Great Salt Lake. The options involving untreated water disposal were ultimately rejected as inconsistent with the NRD Settlement Consent Decree.

Cost for Alternatives 1 - 6, NRDC, and following mine closure:

Alternative 1 - No further action

Activity	Capital costs	O+M costs for 30 years	net present value
Source controls (already implemented by Kennecott)	$127M already expended, not included in cost	$19.2M	$19.2M
Monitoring		$7.1M	$7.1M
TOTAL (discount rate = 7%)		$26.3M	$26.3M

Alternative 2 - Institutional Controls

Activity	Capital costs	O+M costs for 30 years	net present value
Activities in Alternative 1		$26.3M	$26.3
Water rights and land purchase	$16M (2 years)		$16.5M
TOTAL	$16M	$26.3M	$42.3M

Alternative 3 - Point of Use Management

Activity	Capital costs	O+M costs for 30 years	net present value
Activities in Alternatives 1 and 2	$16M	$26.3M	$42.3M
Municipal connections	$0.901M		$0.901
Household treatment units (400)	$2.60M	$0.64	$3.2M
TOTAL	$19.5M	$26.9M	$44.8M

Alternative 4 - Containment

Activity	Capital costs	O+M costs for 30 years	net present value
Installation of barrier wells, pump stations and infrastructure	$20.8M	$2.2M	$23.0M
Reverse Osmosis facility	$23.3M	$2.3M	$25.6M
Nanofiltration pretreatment plant after first 10 years	$30.M	$2.9M	$32.9M
Additional barrier wells and upgrades after first 10 years	$15.8M	$2.9M	$18.7M
TOTAL	$86.2M	$103.8M	$217.2

Alternative 5 - Active Pumping and Containment

Activity	Capital costs	NPV Operating	Total
Pollution Prevention - O+M of source control infrastructure	0	$19,227,000	$19,227,000
Exposure Prevention- institutional controls until aquifer is restored	$16,051,000	0	$16,051,000
Exposure Prevention- point of use management for private wells until aquifer is restored	$1,480,000	$914,000	$2,394,000
Exposure Prevention- monitoring of plumes to detect movement in unpredicted ways	0	$7,116,000	$7,116,000

Plume migration prevention (acid plume) - install barrier well system at toe of acid plume	$8,983,000	$19,229,000	$28,212,000
Acid plume remediation - install 4 wells in heart of acid plume	$10,225,000	$1,495,000	$11,720,000
Beneficial use - pretreatment of acid waters using NF	$12,936,000	$32,505,000	$45,441,000
Beneficial use - treatment of acid plume using RO	$2,921,000	0 (included in pretreatment)	$2,921,000
Beneficial use - treatment of barrier well water using RO	$17,481,000	$21,257,000	$38,738,000
Disposal- NF concentrates to KUC tailings line	$4,382,000	$21,020,000	$25,402,000
SUM CERCLA PLUME	**$74,459,000***	**$122,763,000#**	**$197,222,000**

* Capital costs include 20% engineering and construction management, 25% contingency and 7% discount rate (1998 dollars)

Operations and Maintenance costs include 5% engineering and construction management, 25% contingency, and a 7% discount rate (1998 dollars).

Alternative 6: Active Pumping and containment, lime treatment

Activity	Capital Costs	O+M/30 years	net present value
Alternative 5 (except method for disposal of concentrate)	$74.5M	$122.76M	$197.2 M

Treatment residuals treated with lime and sludge storage	$16.4M	$149.8M	$276.6M
TOTAL	$87.7M	$272.5M	$360.4M

Alternative NRDC settlement

Activity	Capital Costs	O+M/50 yrs	replace costs	present value
Pretreatment of acid plume*	$127M	$26.3M	$2.3M	$155.6M
Acid plume well*	$1.4M	$3.4M	$0.13M	$5.0M
Sulfate extraction wells*	$0.65M	$2.6M	$0.06M	$3.3M
RO facility for pretreated water*	$10.9M	$10.9M	$0.94M	$22.7M
Process enhancement	$0.31M	$0.47M	$0.06M	$0.86M
RO facility for sulfate water	$17.7M	$9.6M	$1.0M	$28.3M
Process Enhancement	$1.6M	$1.6M	0.19M	$3.4M
Shallow wells	$7.5M	$3.5M	$0.70M	$11.7M
Asset management	$0.66M			$0.66M
TOTAL	$168M	$58M	$5.3M	$232M

* duplicative with costs in Alternative 5

Alternatives after mine closure: costs not yet available

Comparison of alternatives:

Summary Table of Alternatives

Criteria	Alternative 3 Point of Use Mgt	Alternative 4 Hydraulic Containment	Alternative 5 Active Pumping	Alternative 6 Active Pumping - lime treatment
Threshold criteria - protection of human health and the environment	Would protect human health, but potentially not the environ.	Would protect human health and environment	Would protect human health and environment	Would protect human health and environment
Threshold criteria - meet ARARs	Would not meet Utah groundwater cleanup standards in reasonable time frame (800 yrs+)	Would achieve ARARs, but might take 100s of years	Would achieve ARARs, but might take greater than 50 years	Would achieve ARARs, but might take greater than 50 years.
Long term effectiveness and permanance	Relies heavily on institutional controls for long term protectiveness, essentially in perpetuity	While relying heavily on institutional controls for long term protection, the plume does not move into new areas and eventually shrinks. Concern that acid plume might get by the barrier.	While relying on institutional controls for long term protection, the plume does not move into new areas and shrinks substantially in 50-100 yrs. It is safer because the acid plume never reaches barrier.	Same as 5

Reduction of TMV through treatment	no treatment, no reduction of TMV	treatment reduces toxicity, mobility, and volume	treatment reduces toxicity, mobility and volume over a shorter timeframe	Same as 5
Short term effectiveness	no action, no problems (but no progress)	no serious problems during construction	no serious problems during construction	Same as 5
Implementability	no action, no problems with implementation. Does require aid of state agencies	technology available, few problems encountered	technology available, few problems encountered	technology available, few problems encountered, except disposal of sludges produced by lime treatment would require lots of land (and lime supplies could get scarce).
Cost	Low	High	High, but 15% less than Alternative 4	Very High

Institutional Controls: All the alternatives depend on institutional controls to a certain degree. All of the remedies will require a long period of time to achieve remediation goals. Even the fastest one could take 50-100 years. For this reason, institutional controls will be needed to prevent exposures to contaminated ground water while the cleanup is underway. The institutional controls being considered include a combination of the following: land purchases (over the most polluted parts of the plume to allow location of wells in the most advantageous spots and prevent others from drilling wells even without water rights); water rights purchases (for those owners with water wells already impacted or in the path of the plume); moratorium of new well drilling in the area by the State Engineer's Office; water rights exchanges; and development of secondary water systems in the area to reduce the demand for potable water. The time frame for implementation of these varies: alternative 3 could take 800 years or longer; alternative 5 could take 50 - 100 years, or longer. Because of the long time frames, maintenance of institutional controls in perpetuity must be assumed.

Monitored Natural Attenuation:

Alternatives 1, 2, and 3 depend on natural attenuation as the primary method of aquifer restoration. These do not comply with EPA policy because a technical impracticability waver is not appropriate in this situation. There are other reasons for rejection of this technique. As the acid plume moves through the aquifer it is slowly neutralized by carbonates in the solid phase of the aquifer. As the acids are neutralized, the metals precipitate out and attach themselves to the solids in the aquifer. Column tests have shown that once the acid plume passes and fresh water is introduced, the metals redissolve back into the ground water. Column testing results suggest that it takes at least 7 pore volumes of fresh water before the metals do not become re-entrained. This problem would be repeated over and over again as the plume moves down gradient.

Principal Threat Waste:

The principal threat waste is the acid plume containing high metal and sulfate concentrations. Alternatives 1, 2, and 3 do not address the principal threat sources in the aquifer itself. Human exposure to the waste is prevented by institutional controls essentially in perpetuity. Alternatives 4, 5, and 6 address the principal threat source by pumping the source from the aquifer, treating the water, and providing the water to municipalities for beneficial use.

Preferred Alternative:

At this time, the preferred alternative of EPA Region VIII is Alternative 5. Alternative 5 contains the following activities:

- Surface source controls (already implemented)
- Institutional Controls while restoration is ongoing
- Point of Use Management for private well owners while restoration is ongoing
- Installation of a barrier well containment system at the leading edge of the acid plume
- Installation of a well or wells in the heart of the sulfate plume near the former South Jordan Evaporation Ponds
- Installation of a well or wells in the heart of the acid plume (there are already two wells which have been installed in this area for pilot testing purposes)
- Pretreatment of acid water using nanofiltration
- Treatment of pretreated acid waters by a reverse osmosis plant
- Treatment of the waters from the sulfate well by a reverse osmosis plant
- Treated water is delivered to a municipal water purveyor
- Concentrates are disposed in Kennecott's tailings pipeline, using the tailings pipeline as a 13 mile linear treatment system. Acids are neutralized and metals precipitate in tailings slurry. Metals are stored along with tailings in the Magna Tailings Impoundment, nearly expanded and renovated.
- An alternative method of NF and RO concentrate disposal will be needed following cessation of nearby mining and milling operations. At this time, evaluation of these alternatives is ongoing. Although a remedy will be specified in the ROD for use should mining cease suddenly, flexibility should be included to examine other alternatives. Actual mine closure might not take place for 30 years. In 30 years, it is anticipated that other technologies may be available, closure of the mine may require infrastructure and O+M which could be used also for the concentrates, and more will be known about the nature of any proposed discharge to the Great Salt Lake and the potential effects thereof.

Alternative 5 is substantially different that Alternatives 1, 2 and 3 because Alternative 5 involves active restoration of the aquifer itself whereas Alternatives 1, 2, and 3 address only limitation of exposure to humans.

Alternative 5 is different that Alternative 4 in that restoration of the aquifer begins right away rather than delaying response for 10 years while the plume catches up to the barrier well system. The barrier well system then becomes the last line of defense rather than a safety net. Even small amounts escaping the barrier wells at these high concentrations could cause substantial degradation down gradient. Alternative 5 pumps the acid plume to such an extent that the forward progress of the plume is halted and the acid plume never reaches the barrier wells. Although both Alternatives 4 and 5 require many years to achieve the remediation goals,

Alternative 5 will take less time. In this case, the first 30 years are very important because mining will continue during this time. It is beneficial to achieve most of the initial water withdrawals during this period while a relatively inexpensive concentrate disposal technique is available.

Alternative 5 is different than Alternative 6 only in the method used for treatment concentrate disposal. Again, Alternative 5 is preferable because it is less costly and Alternative 6 would produce huge amounts of sludges each year which would be a disposal problem. Sludge production is estimated at over 200,000 tons/year.

Alternative 5 is preferred over the other alternatives for several key reasons related to the NCP balancing criteria:

- Long Term Effectiveness: Alternative 5 is projected to reach the goal of restoring the aquifer in the shortest time possible given the type of contamination
- Reduction of TMV: Similar to Alternatives 4 and 6 but achieves this in a shorter time
- Short Term Effectiveness: Similar to other alternatives
- Implementability : No unusual technical problems in implementation
- Cost: Alternative 5 is more cost effective than the other active alternatives

Alternative 5 is preferred over the other alternatives for other key reasons related to expectations in the NCP:

- The principal threats are addressed by treatment.
- Relatively low long term threats are controlled by containment.
- A combination of methods is used to achieve protection of human health and the environment while treatment is underway.
- Institutional controls supplement engineering controls.
- Although innovative technologies were considered, they were not as effective.
- Ground waters are returned to beneficial use within a reasonable time frame given the circumstances of the site.

Alternative 5 has two additional advantages over the other alternatives. (1)It fits together very nicely with the NRDC settlement provisions of the 1995 Consent Decree entered into

between the State of Utah (plaintiff), the Jordan Valley Water Conservancy District (intervenor) and the Kennecott Utah Copper Corporation (defendant). It achieves the CERCLA goals for aquifer remediation while providing waters for beneficial use by the affected municipalities as envisioned by the NRDC Consent Decree. (2)It takes advantage of existing waste handling infrastructure of an operating mining and milling facility to achieve cost savings which would not be available otherwise.

Alternative 5 envisions disposal of much of the treatment concentrates into Kennecott's existing tailings slurry line. This is possible because the tailings are slightly alkaline and the pipeline transporting the tailings slurry is 13 miles long and flows at an average of 40,000 gpm. (See Photos I, J, and K.) The input of the acidic treatment concentrate, by comparison, would be only 1250 gpm. The residence time of materials in the tailings pipeline is about four hours. By the time the tailings slurry reaches the Magna Tailings Pond, the treatment concentrates are neutralized and the metals have precipitated out into the tailings slurry. The supernatant water in the tailings slurry is recycled during dry periods and is discharged into the Great Salt Lake during wet conditions. (See Photo L.) The residence time of supernatant water in the tailings pond is about 22 days which allows sufficient time for settling of solids. The discharge has a UPDES permit administered by the Utah Department of Environmental Quality, Division of Water Quality. The concentrations of metals in the supernatant water of the tailings pond are not affected by the additions of the treatment concentrates because the metals are solids after neutralization in the slurry line and settle out amongst the tailings. The tailings pond was recently expanded. The new tailings pond was constructed on a layer of clay. Groundwater of the area is monitored through provisions of a State Ground Water Protection Permit. The feasibility of disposal of acid waters into the tailings slurry line was studied as a part of the RI/FS process. The concept has been tested now for two years with success.

Schematic diagrams of the preferred alternative for the acid plume are given in Figures 5 and 6. Figure 5 describes the flow of untreated water, treated water, and concentrates in the first 30 years utilizing existing infrastructure of the operating mine facilities. Figure 6 shows the alternatives being considered for disposal of the treatment concentrates following mine closure. The flow diagram for the sulfate plume closer to the Jordan River is simpler. The untreated water goes directly to the reverse osmosis plant; the treated water is delivered to the cities; and the concentrate is disposed via a short pipeline to the Jordan River.

The model's prediction of sulfate concentration distribution for the "no further action" alternative is given in Figure 7, and the analogous prediction for the preferred alternative in Figure 8. The model predicts that 99% of the highest concentrations (exceeding 10,000 ppm sulfate) will have been removed, and 66% of the total sulfate. In the case of the "no further action" alternative, the plume just continues to move to the east, and one of the West Jordan municipal wells is impacted.

The estimated costs associated with the integrated preferred alternative are given in the following table:

SUMMARY OF COSTS FOR PREFERRED ALTERNATIVES
(NRD AND CERCLA INTEGRATED PLAN)

Activity	Capital costs	NPV Operating	Total
Pollution Prevention - O+M of source control infrastructure	0	$19,227,000	$19,227,000
Exposure Prevention- institutional controls until aquifer is restored	$16,051,000	0	$16,051,000
Exposure Prevention- point of use management for private wells until aquifer is restored	$1,480,000	$914,000	$2,394,000
Exposure Prevention- monitoring of plumes to detect movement in unpredicted ways	0	$7,116,000	$7,116,000
Plume migration prevention (acid plume) - install barrier well system at toe of acid plume	$8,983,000	$19,229,000	$28,212,000
Acid plume remediation - install 4 wells in heart of acid plume	$10,225,000	$1,495,000	$11,720,000
Beneficial use - pretreatment of acid waters using NF	$12,936,000	$32,505,000	$45,441,000
Beneficial use - treatment of acid plume using RO	$2,921,000	0 (included in pretreatment)	$2,921,000

Beneficial use - treatment of barrier well water using RO	$17,481,000	$21,257,000	$38,738,000
Disposal- NF concentrates to KUC tailings line	$4,382,000	$21,020,000	$25,402,000
SUM CERCLA PLUME (1998 dollars)	**$74,459,000***	**$122,763,000#**	**$197,222,000**
CERCLA (2000 $s, 4.6% inflation)	**$77,884,000**	**$128,410,000**	**$206,294,000**
Plume migration prevention (sulfate plume) - installation of 8 wells at leading edge of sulfate plume	$3,089,000	$44,000	$3,133,000
Plume migration prevention (shallow aquifer) - installation of 4 wells near Jordan River	$215,000	$22,000	$237,000
Beneficial use - treatment of sulfate plume and shallow aquifer waters using RO (pumping and piping included)	$22,801,000	$16,063,000	$38,864,000
Disposal - treatment concentrates to Jordan River	included in treatment	included in treatment	
SUM NRD PLUME	**$26,105,000@**	**$16,129,000+**	**$42,234,000**
GRAND TOTAL	**$103,989,000**	**$144,539,000**	**$248,528,000**

* Capital costs include 20% engineering and construction management, 25% contingency and 7% discount rate

Operations and Maintenance costs include 5% engineering and construction management, 25% contingency, and a 7% discount rate.

@ Capital costs include 10% design contingency, 13% design engineering, 7% engineering services during construction, 5% on site construction services, 5% change order allowance.

+Operations and Maintenance costs include O+M and 25 year replacement costs.

The NRD Settlement Consent Decree established a Trust Fund which at this time is valued (with accrued interest) at $50.8M. Kennecott can apply for the use of this Trust Fund if certain conditions are met. In general, those conditions require Kennecott to provide 7000 acre-feet/year of treated water to the municipalities. The better the quality of the water (meeting both Utah's primary and secondary drinking water standards) the more financial credit Kennecott can receive. The current proposal under consideration by the Trustee anticipates funding from the following sources:

Kennecott: $164.4M
NRD Trust Fund: $50.8M
Jordan Valley Water Conservancy District: $16.4M

ARARs:

The major ARARs associated with the preferred remedy (Alternative 5) as coupled with the plan to use funds from the Natural Resources Damage settlement trust are described in the section below. Please note that this list is not final. The project has an ARARs Task Force composed of attorneys from the various parties and this task force has not yet met to deliberate on the final list. For this presentation, only those ARARs with significant implications to remedy selection are listed.

Utah Public Drinking Water (Federal Safe Drinking Water Act): establishes MCLs and secondary standards for inorganic chemicals in drinking water. Any municipal water supply treatment plant must meet these standards. In addition, there are construction standards, operations and maintenance requirements, source protection, standards for design, etc. for water supply systems.

Utah Water Quality Standards (Federal Clean Water Act): establishes numeric and narrative standards for discharges into surface waters. Discharges to the Great Salt Lake and the Jordan River would have to meet these standards.

Utah Groundwater Quality Protection Regulations: establishes MCLs (mostly) as the

goals for ground water protection required of active facilities (including treatment plants), but language in the regulations indicate that they are not ARARs for purposes of CERCLA remedies. These are, however, a major goal of the NRD settlement and therefore must be considered in evaluation of any joint plan. Note the degree to which these particular regulations have been used for cleanup decisions has been controversial in the past with regard to CERCLA only remedies.

Utah Underground Injection Program: - specifies conditions for injections underground.

Utah Pollutant Discharge Elimination System (Federal NPDES): limits point source discharges into surface waters. Kennecott has specific concentrations and loadings in their discharge permit to the Great Salt Lake. These limitations cannot be exceeded.

Utah State Engineer Regulations: standards for drilling wells, and limits volume of ground water withdrawals to prevent drops in water levels.

Utah Hazardous Waste Regulations (Federal RCRA): Portions of these regulations are ARARs, but others are not because of the Bevill Exemption.

Utah Solid Waste Regulations (Federal RCRA): requirements for solid waste facilities, design and operations and maintenance. Any treatment residuals requiring storage and disposal, if this becomes necessary would have to meet these requirements.

State OSHA rules (Federal OSHA): applicable to working conditions during actions.

Technical Issues:

Plume behavior: There are a number of uncertainties regarding plume behavior over time, despite the extensive model development and calibration. The model itself is widely used (MODFLOW coupled with MT3D). It was used originally by USGS to develop the Salt Lake Valley Ground Water Model, and later refined in the RI/FS. Flow rates in the aquifer could be verified by several means since historical ground water data were available and the history of releases to ground water were known. Even isotopic tracing techniques were used to provide independent verification. Yet, it is still a model and relies on the validity of the assumptions used in it. Although the assumptions are based on a rather large number of observations, the area affected is quite large and not every square inch of the aquifer was sampled. Undetected buried channels might provide preferential flow pathways causing the plume to move in an unanticipated direction and do so more rapidly than predicted. Hidden clay lenses could serve as a barrier thereby either diverting the plume or cause it to travel more slowly than expected.
This uncertainty common to the application of all ground water models produces an uncertainty in the absolute time it might take for remediation of the aquifer.

A further complicating factor in the case of this particular plume is the variety of chemical

reactions that take place in the aquifer itself. This occurs because the acid plume reacts with the carbonates in the aquifer substrate to form a variety of metal oxides and hydroxides. It is not a matter of simply neutralizing the hydrogen ion because the majority of the acidity is "mineral acidity" largely from the high aluminum concentrations and this must be neutralized as well. These solid precipitates will begin to redissolve back into the ground water when fresh water is introduced. Column testing has shown that it could take at least 7 pore volumes of water before these precipitates are redissolved and flushed away. Calculations suggest that the vast majority of the acid ground water can be pumped out of the aquifer in 30 - 50 years, but the residuals could leach back into the water for many years after the initial plume has been removed. This redissolution problem has not yet been modeled; therefore, the time this would take is highly uncertain and might continue for decades or longer. EPA believes that for planning purposes, treatment will have to continue for perpetuity before the aquifer will produce water which meets all drinking water standards without treatment or blending.

In addition to the uncertainty in time frame required, there is some concern with regard to the direction of plume movement under different pumping rates by the adjacent communities. Of particular concern is the well field of West Jordan located just to the north of the acid plume. The modeling did show that under some pumping scenarios the plume could be drawn in that direction. A monitoring well has been drilled between the acid plume and the West Jordan well field to provide an early warning should this occur.

A similar concern was expressed with regard to Riverton city wells located on the south edge of the plume. Riverton is currently pumping at greater rates than assumed in the model and plume behavior might be affected. Some experts wonder if the plume can be drawn underneath the Jordan River to the municipalities on the east side. Could high pumping from wells in Sandy, Utah, for example, draw the contamination underneath the river? Although modeling suggests that this is unlikely, careful monitoring will be necessary to detect these unexpected changes and to revise time estimates.

Modeling suggests that at the maximum pumping rates needed to remove the acidic waters quickly, excessive draw downs of the water levels in the aquifer will occur locally around the acid wells and the nearby West Jordan municipal well field. Several proposals have been examined to mitigate this problem. One idea is to inject clean water between the acid plume and the West Jordan municipal well field to offset the water level drops. Modeling suggests this idea will work, but some indicate this is an inefficient use of clean water. Another possibility is that freshwater from the mountains could be piped directly to West Jordan City so that the city can reduce their pumping rates. This issue is still under discussion.

Treatment uncertainties: Both the reverse osmosis treatment technology and the nanofiltration technology have been tested in pilot projects. The acid plume waters cannot be treated directly using the reverse osmosis technology due to excessive scaling of the membranes. The technology performs well with the waters from less contaminated wells. Nanofiltration is proposed for pretreatment of the most contaminated waters with the permeate going to further

refinement in the reverse osmosis facility. However, the operational details of the nanofiltration technology have not been optimized and this may vary as the concentrations of the plume changes. It may take 5 years of operating experience with the pretreatment plant before routine operations are feasible.

Disposal uncertainties: Pilot testing of disposal of acid waters into the tailings slurry pipeline have been ongoing for the past year. An initial problem of excessive scaling on the inside of the pipeline originally occurred resulting in a tailings overflow near the point of entry. After acid additions ceased, the tailings scoured the scale deposits out the pipeline, so no cessation of operations was necessary to clean out the pipeline. Experiments then revealed that no scale formed if the sulfate concentrations were less than 5000 ppm when added to the slurry line. Monitoring of the supernatant water in the tailings pond at the terminus of the pipeline did not reveal any increases in metals or TDS concentrations over typical concentrations with the acid additions. Laboratory experiments indicated the metals in the original acid solution had precipitated, and were not simply diluted. The supernatant water is recycled during the summer and the rest evaporates. There is no discharge. In the winter, excess water is discharged to the Great Salt Lake. Since the concentrate flows in the tailings line represent only a very small fraction of the water, no exceedances of the NPDES discharge are anticipated.

There are two difficulties with this strategy. (1) This strategy works only while the Copperton Concentrator (which grinds the ore and separates metal bearing components from the host rock by flotation) is operating. Kennecott plans to shut off the wells during any times when the mills is not operating, such as during maintenance. (2) This strategy will also work only during the life of mining and milling operations at the site. Another method of disposal will be needed upon mine closure. There are several possible alternatives here, some of which might be integrated with other waste water disposal needs following closure. This must be considered in both the Record of Decision and in the Consent Decree.

One of the proposals for disposal after mining ceases in 30 years is direct disposal of the treatment concentrates into the Great Salt Lake. Although technically feasible, there are numerous policy issues which need to be examined before this can be considered. For example, today there are no numerical water quality standards for any constituent in the Great Salt Lake. Therefore, the potential impacts cannot be judged. In the next 30 years, it is hoped that more will be known about the ecology of the Great Salt Lake and the impacts of pollutants on that ecology.

Preliminary Reactions by the State and Local Government and Water Purveyors:

At the very beginning of the RI/FS process, a Technical Review Committee was formed to provide a forum by which federal agencies, different divisions of state government, the county, the affected city governments, water purveyors, university faculty, and environmental activists could express their concerns and make recommendations regarding the scientific, engineering, and policy issues. Goals were discussed in the beginning, and then the participants made suggestions about the content of the work plan. This Technical Review Committee has been meeting regularly to make suggestions and review progress since 1992. Originally, the Committee considered only the CERCLA portions of the study.

In 1998, the State Trustee for Natural Resources requested that the Technical Review Committee expand its role to also review and evaluate any plan which might be submitted to the trustee to fulfil the obligations of a Natural Resources Damages Consent Decree which was entered in federal court in 1995. A joint plan was envisioned to ensure that the plans being evaluated separately by the state trustee and EPA would cover all the concerns of all parties. The Technical Review Committee is not a voting body.

EPA has formed two other committees which aid EPA in evaluating alternatives. The ARARs Task Force is composed of attorneys from the major parties. The Risk Assessment Task Force is composed of toxicologists from the major parties. In this case they suggested a streamlined risk assessment. They recommended that the primary drinking water standards be used as a health-based PRG. Although sulfate is a secondary standard in EPA guidance, the Risk Assessment Task Force examined literature and determined that levels exceeding 1600 ppm sulfate in drinking water could cause health effects. (This Task Force also has performed calculations which have been used to set action levels for soils at various land uses site-wide.) The task forces are also not voting bodies.

The State Trustee and EPA agreed that the joint plan should be presented to the public as one package, mainly because it would be difficult to explain the legal basis of the two plans separately. It would also make more sense to the public to see the whole picture rather than two halves somehow glued together.

The joint plan has already been presented to the Technical Review Committee, the State Trustee, the Jordan Valley Water Conservancy District Board of Directors, and the city councils of West Jordan, South Jordan, and Herriman. It has also been discussed with the city staff of Riverton. A collection of letters, city council minutes, and summaries of conversations are attached.

The joint plan was developed by the PRP, Kennecott Utah Copper, which fully supports the plan and will fund the major portion of it.

Thus far, the only critic of the plan is the owner of the Dansie Water Company, which operates a private water supply system for 7 households near Herriman and has water rights for another 1000 acre feet/year. The company depends on a private well located near the mouth of Butterfield Canyon and the water quality of this well has begun to degrade. Kennecott has already supplied the company's customers with bottled water until more permanent solutions can be negotiated. Although Kennecott has already agreed to fund the cost of extending municipal service to the company and the Jordan Valley Water Conservancy District can provide the Dansie Water Company with culinary water, negotiations have reached an impasse over the price of the water. It is likely that the owner of the Dansie Water Company will protest the entire plan because of this. The State Trustee has informed the owner of his options which include (1) negotiating an arrangement with Kennecott and the Jordan Valley Water Conservancy District to include details concerning the Dansie Water Company within the overall plan submitted to the Trustee; (2) submitting his own proposal from use of the funds held by the Trustee; or (3) pursuing the issue through a private damage claim (the NRD settlement addresses only the claims by the state trustee, not any claims of private citizens). EPA has already offered to mediate any negotiations between the Dansie Water Company and Kennecott. Both parties have accepted the invitation to participate in such mediation should this become necessary. Other alternatives are currently being explored by the two parties.

APPENDIX C

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

MARCH 2000
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. West Jordan 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 1500 and 1000 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) and acid extraction wells (varied extraction rates up to 2500 gpm total). 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.

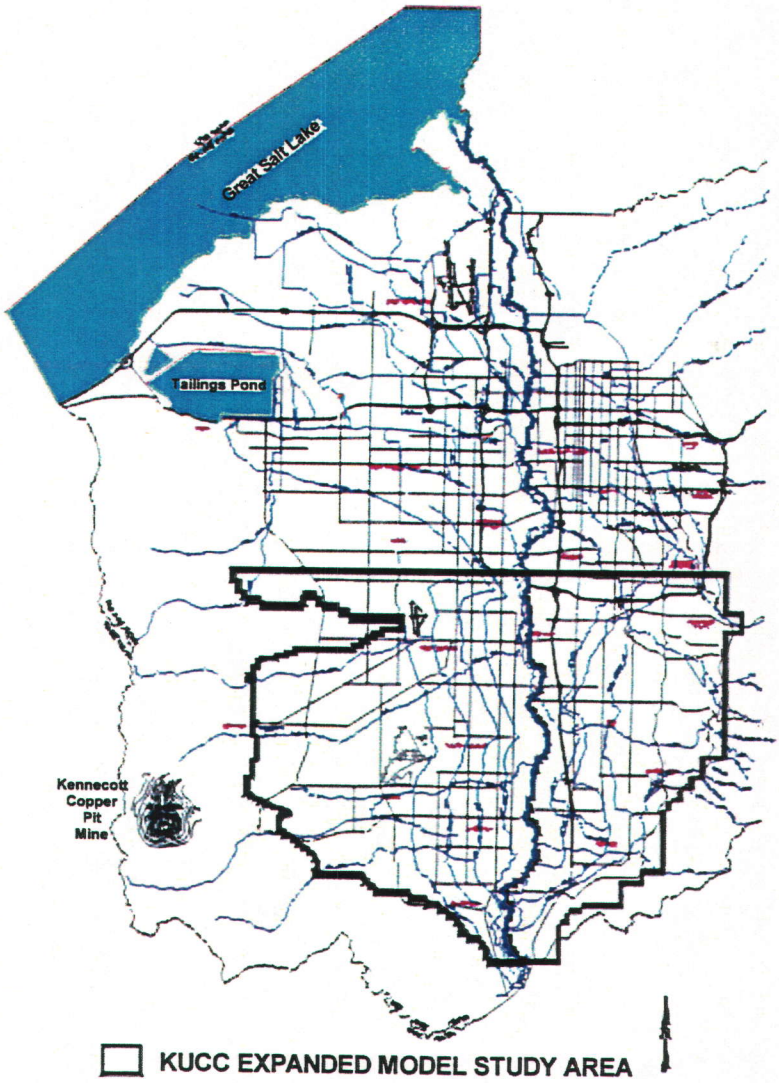

Figure 1: Expanded predictive flow model location map

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.

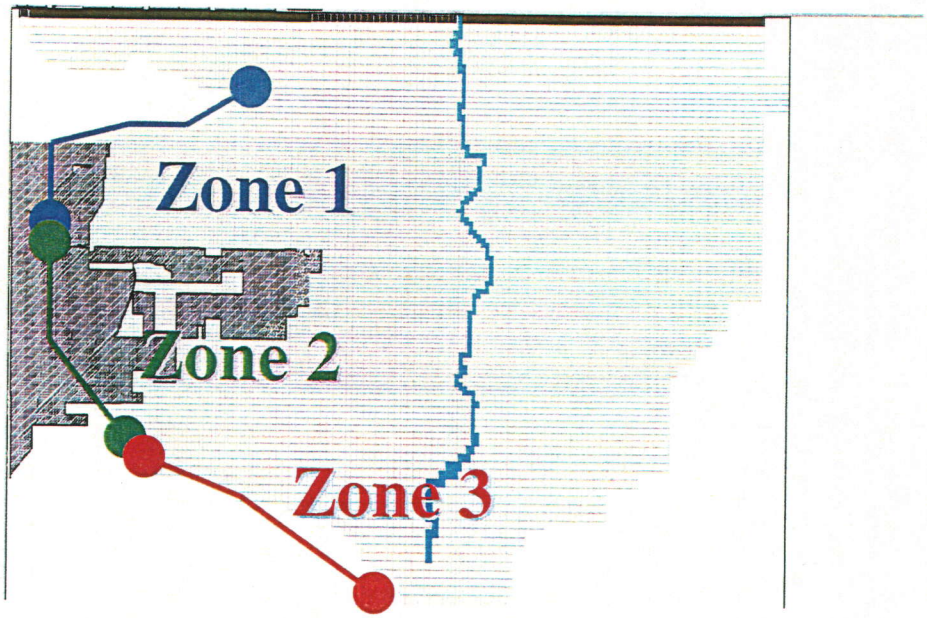

Figure 2: Evaluation zones for flow used in comparing head-dependent vs. specified flux boundaries

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.

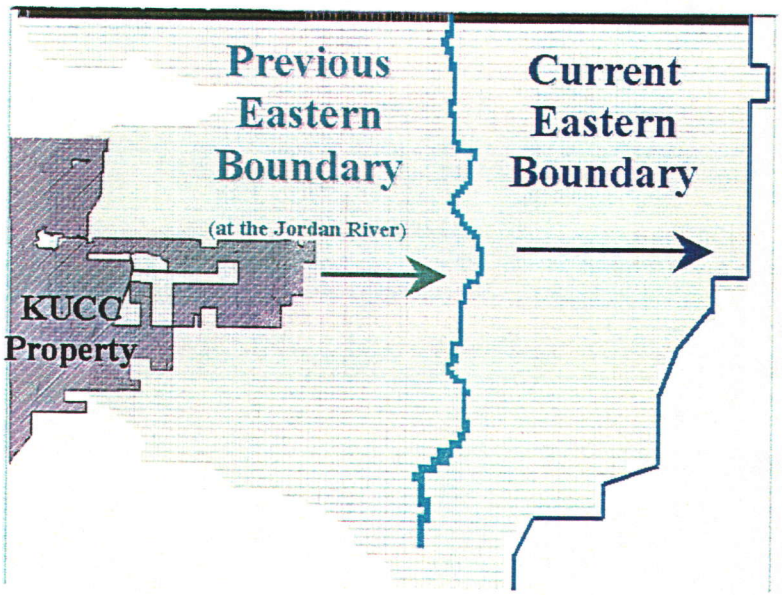

Figure 3: Revised model's expanded eastern boundary

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 Rate Assumptions for the Proposed Remedial Strategy.

Well	Model Layer*	Pumping Rate (gpm)	Years
Acid Well (ECG1146)	4	1500	0-5
New Acid Well #1	4	750	5-15
New Acid Well #2	4	1250	5-30
New Acid Well #3	4	500	5-15
New Acid Well #4	4	1250	15-50
K109	4	250	0-50
K109	5	1000	0-50
K109	6	250	0-50
B2G1193	4	125	0-50
B2G1193	5	875	0-50

* **Layer 3 is 0 – 150 feet below the groundwater table**
Layer 4 is 150 - 300 feet below the groundwater table
Layer 5 is 300 – 450 feet below the groundwater table
Layer 6 is 450 – 650 feet below the groundwater table

Placement of these wells is shown below in Figure 4.

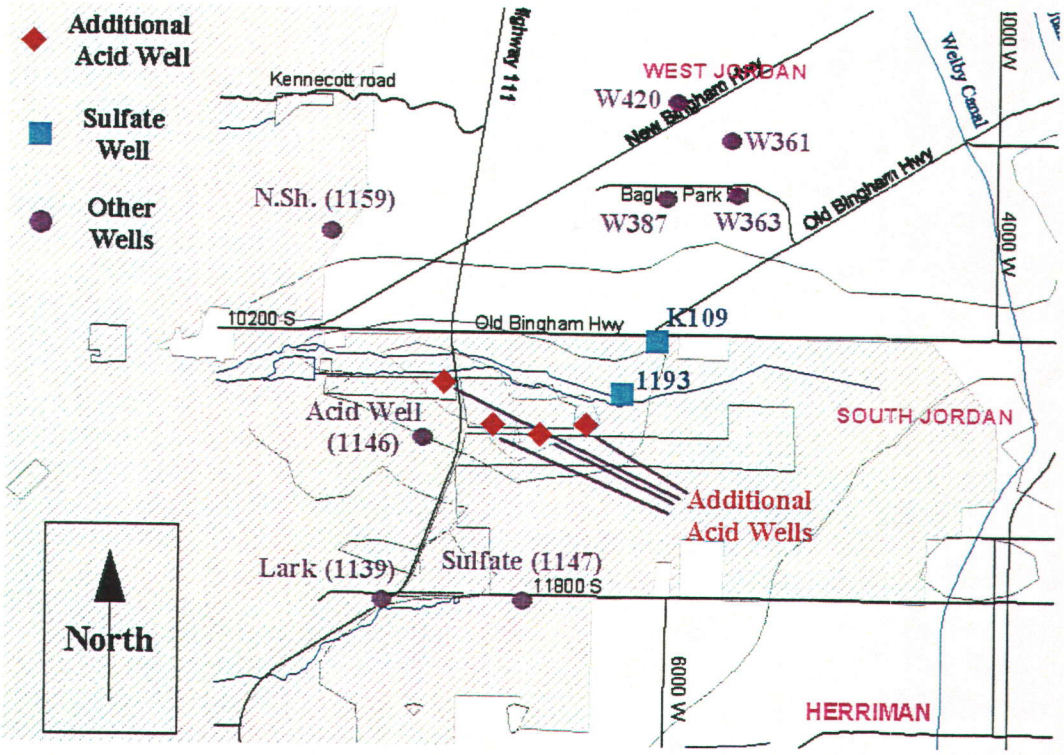

Figure 4: Current modeling scenario well placement locations

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. K109 and B2G1193 were pumped at constant rates of 1500 and 1000 gpm respectively for all scenarios.

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

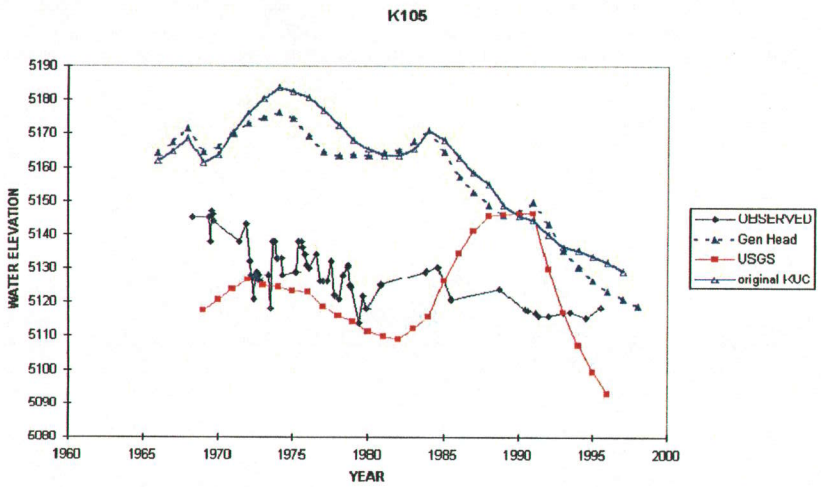

Figure 5. Transient calibration comparison at well K105.

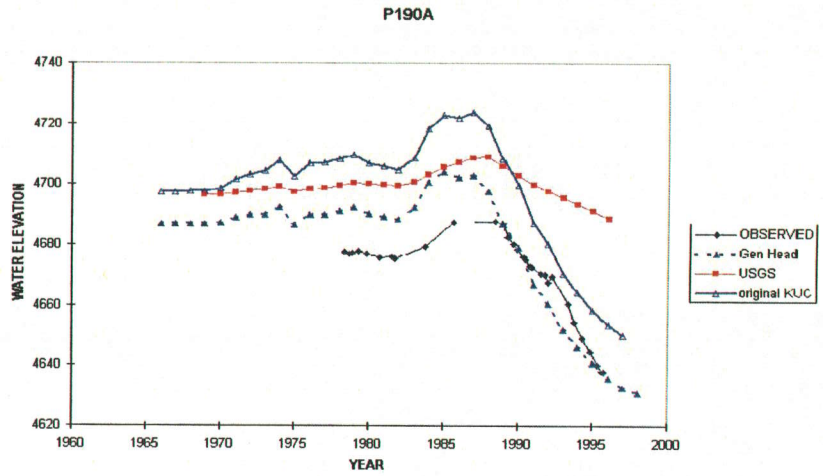

Figure 6. Transient calibration comparison at location P190A.

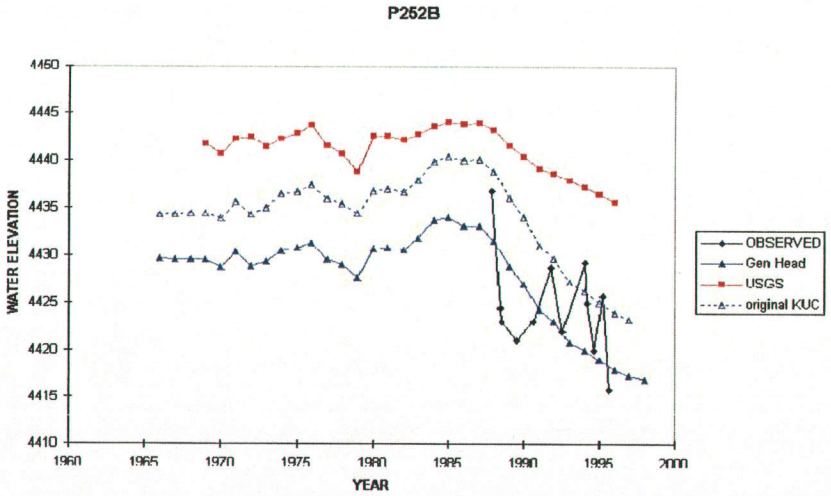

Figure 7. Transient calibration comparison at well P252B.

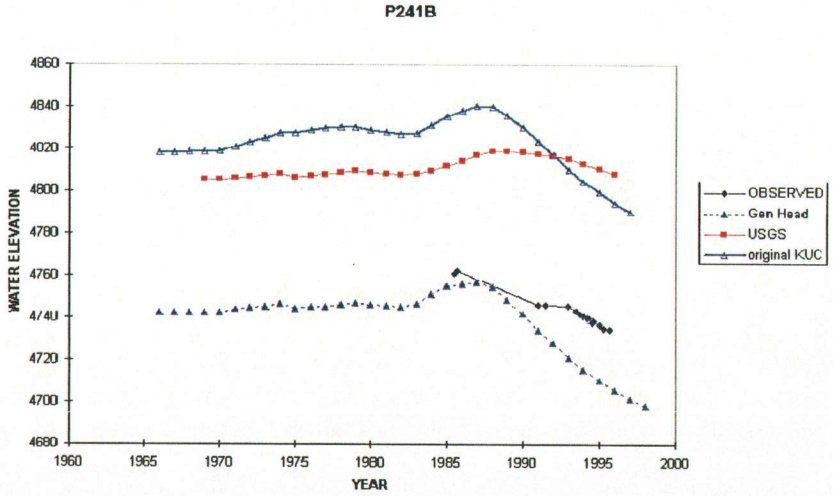

Figure 8. Transient calibration comparison at location P241B.

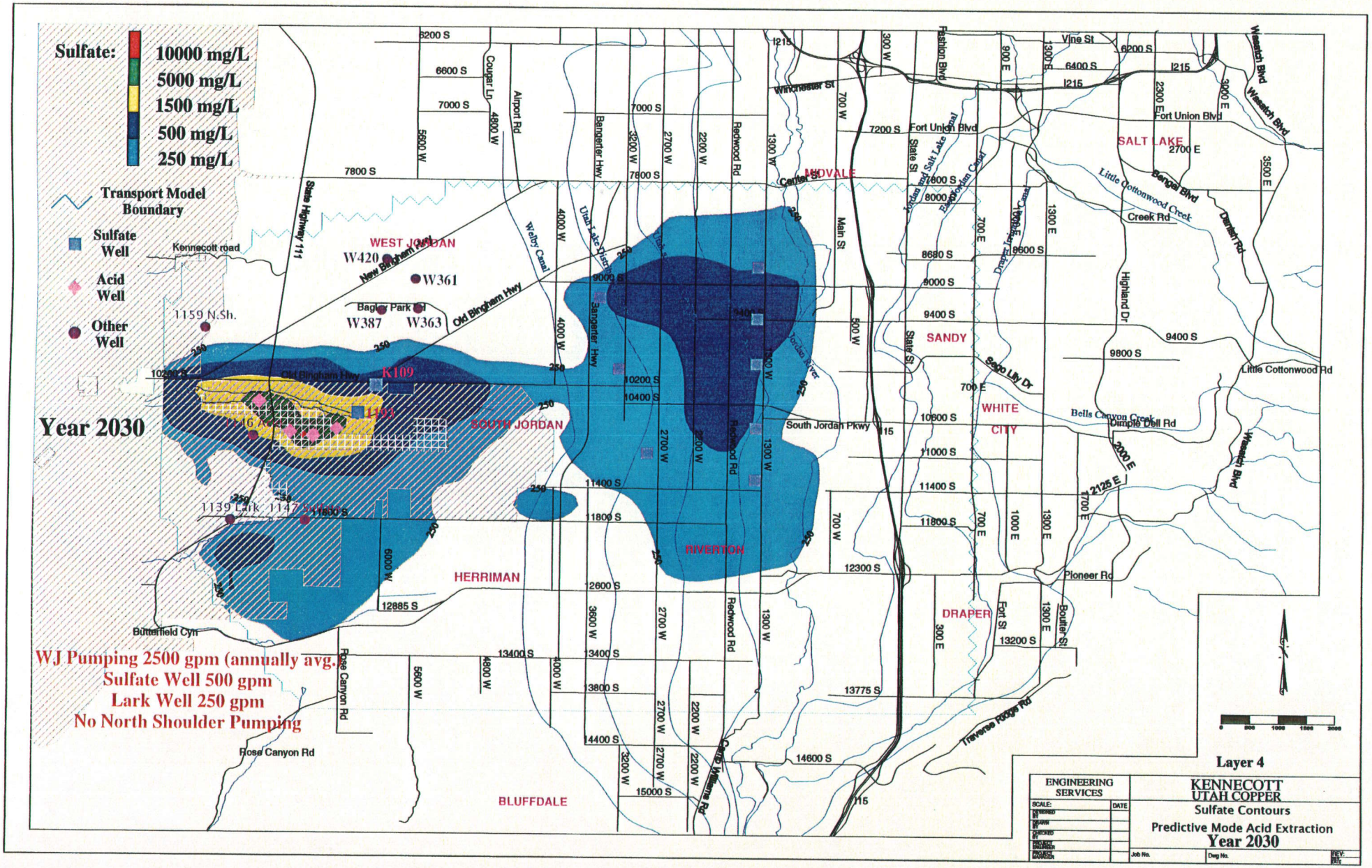

Figure 9: Predictive model sulfate values for the current acid containment scenario in year 2030

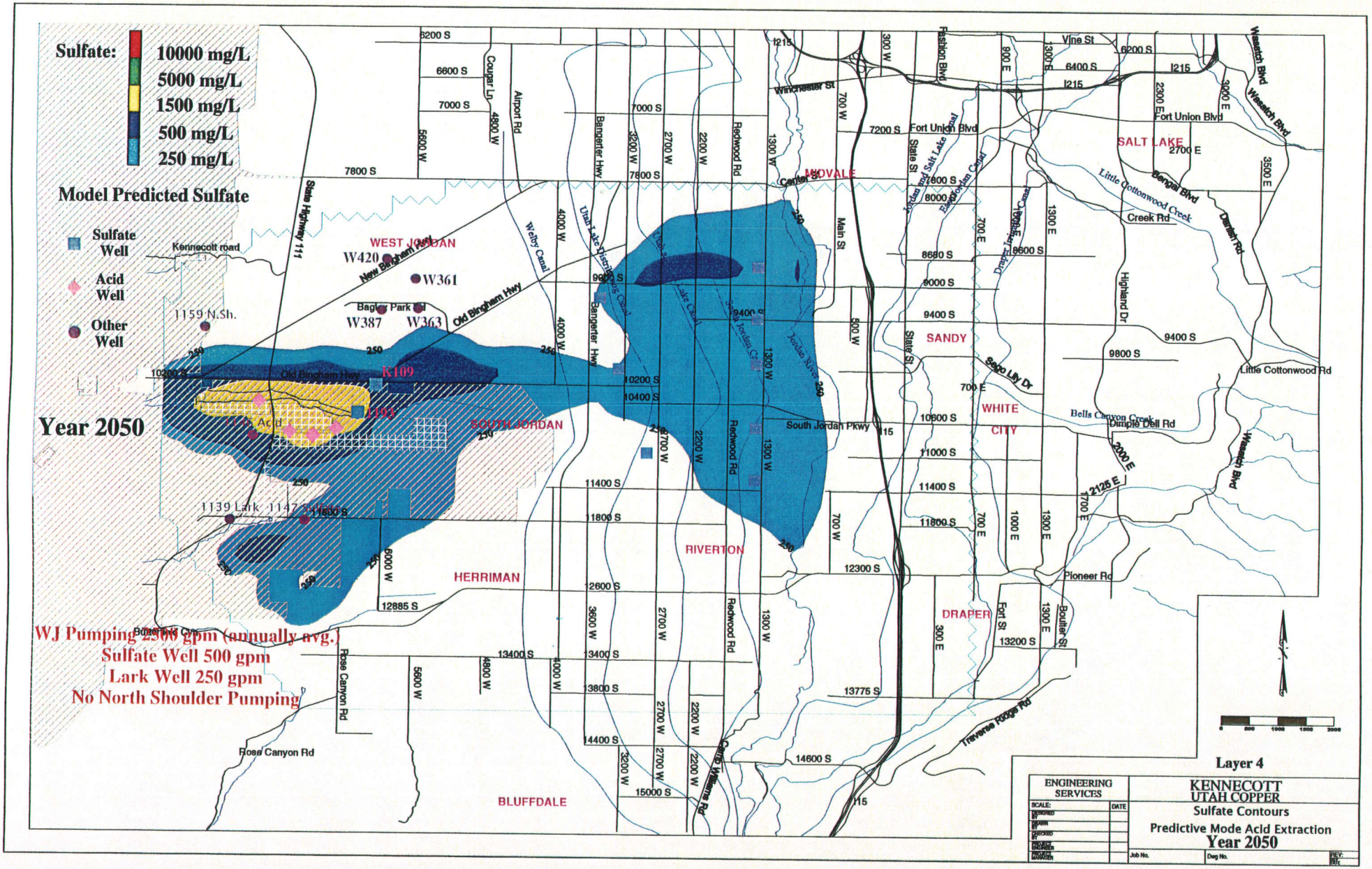

Figure 10: Predictive model sulfate values for the current acid containment scenario in year 2050

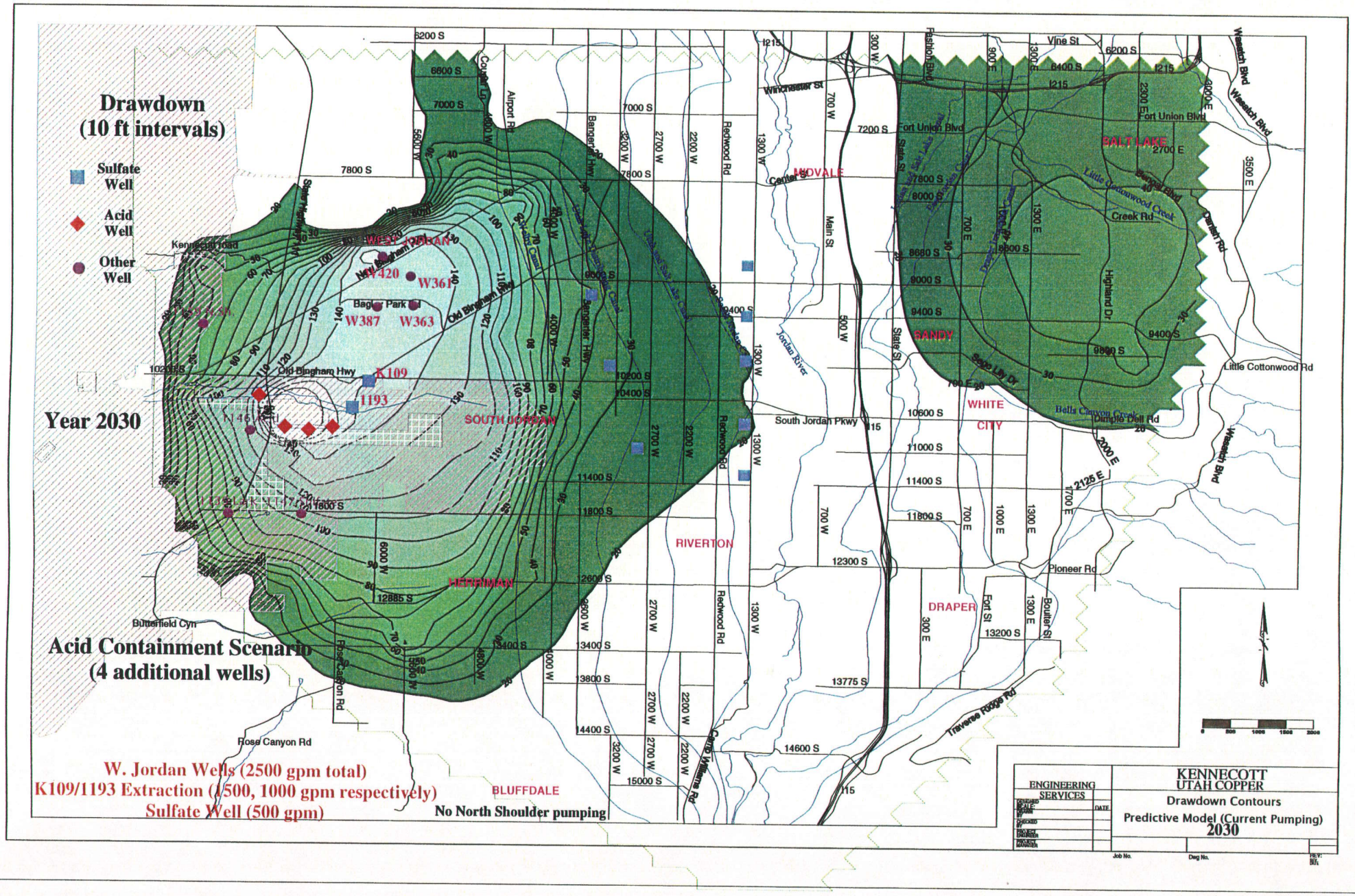

Figure 11: Predictive model draw down values for the current acid containment scenario in year 2030

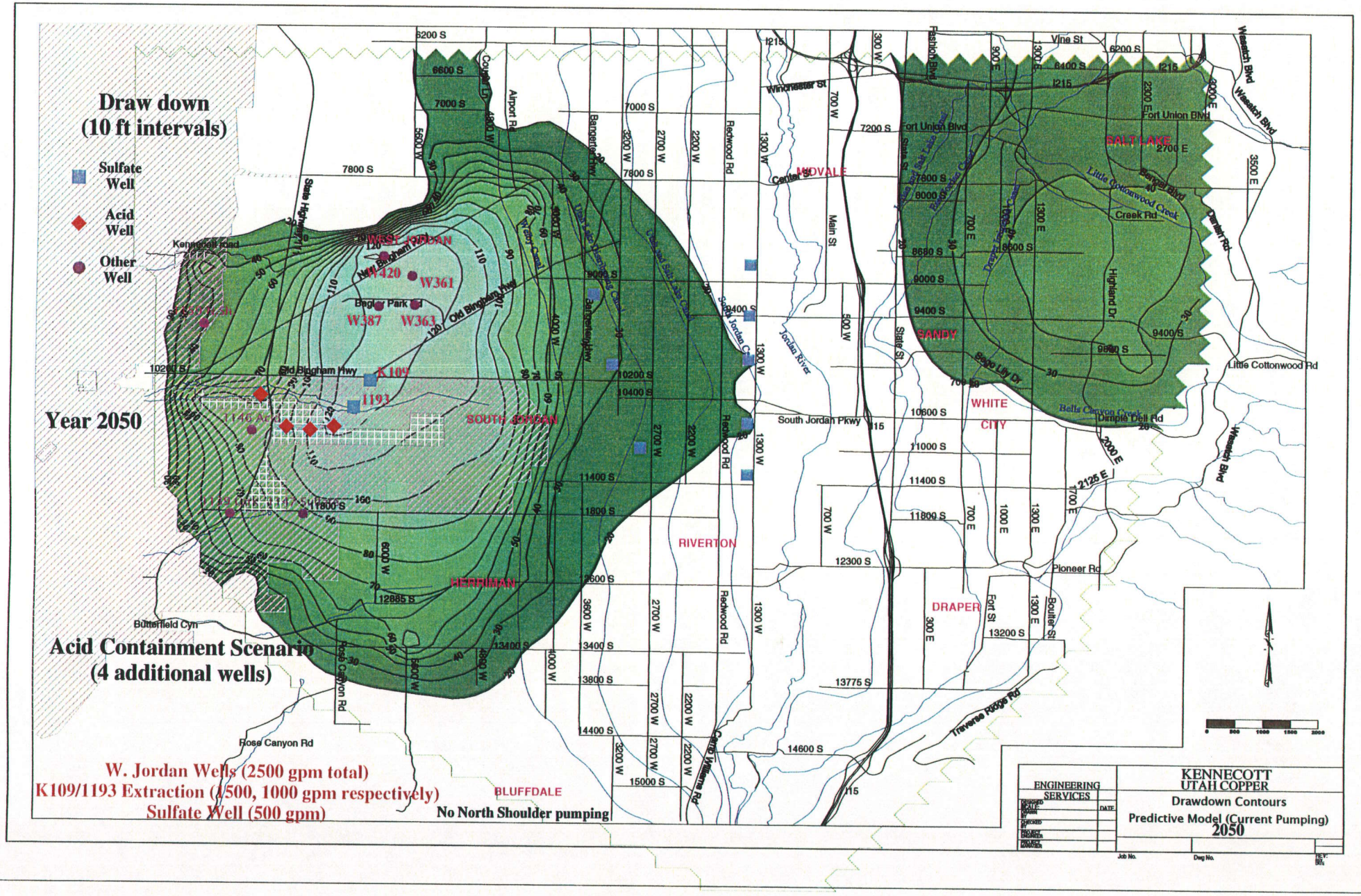

Figure 12: Predictive model draw down values for the current acid containment scenario in year 2050

APPENDIX D

Sorted by owner

OWNER	USES	WRNUM	STATUS	PRIORITY	FLOW (CFS)	LOCATION	AREA CODE
ABEYTA, CANDIDA F. AND LOUISA	IDS	59 4063	APPLLAPD	19740627	0.04500	S 100 E 967 NWSL 3S 1W 4	59
ACCOUNTING AND MANAGEMENT ASSOCIATES		59 2555	UGWCDIS	19330000	0.22000	N 52 E 65 W4SL 3S 1W 2	59
ACCOUNTING AND MANAGEMENT ASSOCIATES		59 2556	UGWCDIS	19330000	0.22000	N 50 E 133 W4SL 3S 1W 2	59
AFCO DEVELOPMENT COMPANY		59 2282	UGWCDIS	18940000	0.02200	N 1270 W 682 SWSL 3S 1W 7	59
AFCO DEVELOPMENT CORPORATION	D	59 4035	APPLLAPD	19740418	5.17000	E 2500 W4SL 3S 1W 7	59
AFCO DEVELOPMENT CORPORATION	D	59 4035	APPLLAPD	19740418	5.17000	S 1450 N4SL 3S 1W 7	59
AKITA, FRANK K.	I	59 1606	APPLCERT	19610521	2.71000	N 1240 W 1305 SESL 3S 1W20	59
ALLDREDGE, CLIFFORD L.	I S	59 4525	APPLCERT	19770707	0.04500	N 2613 E 2910 SWSL 3S 1W14	59
ALLEN, JAMES T.& KATHY E.	IDS	59 4255	APPLCERT	19760716	0.01500	S 125 W 163 NESL 3S 1W31	59
ALLEN, R. THAD	I	59 5217	APPLLAP	19870325	0.01500	N 610 E 965 W4SL 3S 1W11	59
ALLISON, CHARLES L. (JR.)		59 1611	APPLLAPD	19610529	2.00000	S 2616 E 1607 NWSL 3S 1W 5	59
ALLISON, CHARLES, L. (JR.)		59 1683	APPLLAPD	19630130	0.01500	S 2616 E 1657 NWSL 3S 1W 5	59
ALT, RAYMOND (JR.)	IDS	59 4643	APPLLAPD	19780523	0.01500	N 200 E 920 SWSL 3S 1W20	59
ALVERSON, VERNELL		59 1643	APPLLAPD	19610908	0.10000	S 38 W 1447 E4SL 3S 1W 4	59
AMES, STEPHEN L.	IDS	59 4333	APPLCERT	19761115	0.02500	N 706 E 1413 W4SL 3S 1W16	59
ANDERSON, DAVIS N.	IDS	59 5206	APPLCERT	19860917	0.01500	N 625 W 175 S4SL 3S 1W29	59
ANDERSON, MAX W.	I S	59 4418	APPLCERT	19770216	0.23300	S 1137 E 163 W4SL 3S 1W11	59
ANDERSON, MAX W. AND MAURINE M.		59 2524	UGWCDIS	19010000	0.03300	N 1370 E 174 SWSL 3S 1W11	59
ANDERSON, NORMAN K.	I	59 4801	APPLLAPD	19810302	0.01500	S 335 W 2145 E4SL 3S 1W16	59
ANDREASON, WILLIAM K.	ID O	59 3839	APPLLAPD	19720412	0.01500	N 100 W 100 SESL 3S 2W 8	59
ANDREGG, ANNA	IDS	59 4097	APPLLAPD	19741029	0.04500	S 700 E 1580 NWSL 3S 1W16	59
ATWOOD, JAMES		59 1282	APPLDIS		0.01500	S 2435 E 10 N4SL 3S 1W 5	59
ATWOOD, JAMES M.	I S	59 598	APPLNPR	19471007	0.01500	N 200 W 1975 E4SL 3S 1W 5	59
BAKER, JOHN R.	IDS	59 5047	APPLLAPD	19840606	0.01500	S 200 W 1090 N4SL 3S 1W28	59
BALVIN, SUSAN D.	IDS	59 4947	APPLLAPD	19830526	0.05000	N 1300 E 1200 SWSL 3S 1W 5	59
BARKER, CLYDE		59 1117	APPLDIS		0.01500	N 1224 E 90 S4SL 2S 1W34	59
BARLOW, JESSE M.	IDS	59 4749	APPLCERT	19790921	0.01500	N 1184 E 2086 W4SL 3S 1W 4	59
BARLOW, LYMAN J.	I S	59 4472	APPLCERT	19770504	0.01500	N 1501 E 49 S4SL 3S 1W29	59
BASTIAN, E. P.	IDS	59 4118	APPLCERT	19750130	0.01500	S 3286 W 2213 NESL 3S 2W32	59
BATEMAN, DEON R.	IDS	59 4147	APPLCERT	19750609	0.01500	S 332 W 699 N4SL 3S 1W30	59
BATEMAN, GLENN W.	ID	59 4438	APPLCERT	19770304	0.01500	N 1020 E 429 W4SL 3S 1W16	59
BAUER, MERRILL R.	I S	59 3810	APPLCERT	19710603	0.100	S 1330 E 260 NWSL 2S 1W28	59
BECKSTEAD, DALE	I S	59 5473	UGWC	1934	0.00000	S 1255 W 325 N4SL 3S 1W26	59
BECKSTEAD, EDWARD B.		59 2589	UGWCDIS	18990000	0.02200	S 1207 W 166 NESL 3S 1W27	59
BECKSTEAD, EDWARD B.		59 2322	UGWCDIS	19181100	0.00100	S 110 W 670 NESL 3S 1W29	59
BECKSTEAD, STERLING M.	ID	59 4495	APPLCERT	19770601	0.09000	N 1048 E 179 SWSL 3S 1W14	59
BEERS, KENNETH D.	ID O	59 4805	APPLCERT	19810220	0.06700	N 66 E 592 SWSL 2S 1W26	59
BELCHAK TRUSTEES, THOMAS A. & CHRISTINE J.	IDS	59 5138	APPLAPP	19850821	0.10000	N 550 E 800 SWSL 3S 1W 7	59
BELCHAK, THOMAS A.	IDS	59 5251	APPLAPP	19880122	0.01500	N 550 E 950 SWSL 3S 1W 7	59
BELCHAK, THOMAS A. AND CHRISTINE J.		59 5138	APPLAPP	19920205	0.10000	N 550 E 800 SWSL 3S 1W 7	59
BENNETT, BRENT	IDS	59 4192	APPLCERT	19750924	0.01500	N 438 W 145 S4SL 3S 1W29	59
BENTON, JAMES O.	IDS	59 4321	APPLCERT	19760920	0.01500	S 180 E 1292 N4SL 3S 1W32	59
BETTS, REID G. AND LUCILLE B.	DS	59 2375	UGWC	19060000	0.03300	N 2092 W 200 SESL 3S 1W10	59
BIGLER, LOUIS B.	ID O	59 1007	APPLNPR	19520408	0.01500	S 592 W 163 NESL 3S 1W 3	59
BIGLER, LOUIS B.		59 1559	APPLDIS	19600428	1.00000	S 1320 W 1470 NESL 3S 1W 3	59
BIGLER, LOUIS B.	I	59 3246	UGWC	19220000	1.00000	S 827 W 1237 NESL 3S 1W 3	59
BIGLER, LOUIS B.		59 2045	UGWCDIS	19040000	0.01800	S 340 W 198 NESL 3S 1W 3	59
BIGLER, LOUIS B. AND HAZEL A.	I	59 2434	UGWC	19270000	2.00000	N 147 W 706 E4SL 3S 1W 3	59
BIGLER, LOUIS B. AND HAZEL A.	I	59 2075	UGWC	19060000	0.75000	S 330 W 1320 NESL 3S 1W 3	59
BILLS, CECELIA M.	D	59 2404	UGWC	19170000	0.01100	S 2550 W 2445 NESL 3S 1W29	59
BLAND BROTHERS INCORPORATED	ID	59 4783	APPLCERT	19801203	0.06500	S 160 W 638 N4SL 3S 1W 3	59
BLAND, BRIAN AND SHIRLEE	IDS	59 4041	APPLCERT	19740501	0.01500	S 247 W 785 N4SL 3S 1W32	59
BLOOD, KAY H.	S	59 2183	UGWC	19200000	0.03300	N 1940 W 936 SESL 3S 1W20	59
BOARD OF EDUCATION (JORDAN SCHOOL DISTRICT)		59 2003	UGWCDIS	19030000	0.01100	N 112 W 420 SESL 2S 1W33	59

BOARD OF EDUCATION (JORDAN SCHOOL DISTRICT)		59 2849	UGWCDIS	1909	0.01800	S 1152 W 77 NESL 3S 1W15	59
BOARD OF EDUCATION (JORDAN SCHOOL DISTRICT)		59 2491	UGWCDIS	19040000	0.04500	S 466 W 352 E4SL 3S 1W 3	59
BODELL, NOREEN S.	I S	59 1605	APPLCERT	19610511	1.80000	S 1213 E 350 N4SL 3S 2W35	59
BOOTH BRENT T. & KAREN N.	I S	59 5240	APPLCERT	19870903	0.01500	N 1972 W 1219 SESL 3S 1W29	59
BOOTH, WILLIAM H.	ID	59 1302	APPLNPR	19570131	0.01500	N 635 E 145 SWSL 3S 1W 5	59
BOSSHARDT, JOHN	I S	59 1965	UGWC	19330800	0.01100	S 93 E 127 N4SL 3S 1W21	59
BOWLES, ARVID W. AND JOYCE G.	I	59 5359	APPLCERT	19610411	0.00000	S 1218 W 1417 N4SL 3S 2W35	59
BOWLES, ROBERT I.	I	59 4751	APPLCERT	19561008	1.16000	S 353 E 666 NWSL 3S 2W35	59
BOWLES, ROBERT I.	I	59 1156	APPLCERT	19680930	0.61000	N 448 E 1397 W4SL 3S 2W35	59
BOWLES, ROBERT I.	I	59 4751	APPLCERT	19561008	1.16000	S 2531 E 1083 NWSL 3S 2W35	59
BOWLES, ROBERT I.	I	59 4751	APPLAPP	19880304	1.16000	S 300 E 710 NWSL 3S 2W35	59
BOWLES, WILLIAM C. AND KHYVA J.	IDS	59 4309	APPLCERT	19791116	0.01400	N 185 E 1100 SWSL 3S 1W20	59
BOWMAN III, HAROLD I.	O	59 4957	APPLLAPD	19830802	0.05000	S 1420 E 810 N4SL 3S 1W27	59
BRADLEY, JAN	I	59 5248	APPLAPP	19910501	0.01500	N 450 W 450 E4SL 3S 1W28	59
BRADY, L. PEIRCE	I	59 1640	APPLUNAP	19610830	2.00000	N 200 E 10 S4SL 3S 1W29	59
BRECKON, DAVID C.		59 84	UGWC	19361112	0.03400	S 1401 W 290 N4SL 3S 1W15	59
BRECKON, DAVID C.		59 1847	UGWCDIS	191207	0.18900	S 1402 W 2941 NESL 3S 1W15	59
BRIGHT, CHARLES W.	IDS	59 1664	APPLCERT	19620321	0.00400	S 3410 W 202 N4SL 3S 1W29	59
BRIGHTON AND NORTH POINT IRRIGATION COMPANY	C	59 5607	APPLUNAP	19990422	0.00000	S 770 E 1490 NWSL 3S 1W26	59
BRINGHURST, J. OWEN AND KAREN	IDS	59 4076	APPLCERT	19740723	0.01500	N 1127 W 264 S4SL 3S 1W20	59
BRINKERHOFF, CLAUD	I	59 1969	UGWC	19330000	0.00200	N 1050 E 110 SWSL 2S 1W26	59
BRINKERHOFF, MORRIS H. AND BRENDA A.	IDS	59 3845	APPLCERT	19720425	0.01500	N 201 W 542 S4SL 3S 1W20	59
BROADHEAD, ARVIS E.	IDS	59 2154	UGWC	19310600	0.11100	S 3303 W 203 N4SL 3S 1W28	59
BROWN, DARREL H.	S	59 1275	APPLNPR	19560709	0.01500	S 431 E 29 NWSL 3S 1W32	59
BROWN, LULA		59 1951	UGWCDIS	1903	0.02700	N 1445 W 220 SESL 2S 1W27	59
BUHLER, JOSEPH K.	O	59 1116	APPLCERT	19530709	0.03200	N 110 E 1630 SWSL 3S 1W 8	59
BUNKER, RUSSELL M. AND NANETTE D.	IDS	59 3825	APPLLAP	19710503	0.01500	N 418 W 1650 SESL 3S 2W33	59
BURRUP, RONALD L.	ID	59 5215	APPLCERT	19870116	0.05000	S 389 W 1049 NESL 3S 1W16	59
BURTON, MILLAN G.	I S	59 3608	APPLCERT	19700102	0.030	N 330 E 155 W4SL 2S 1W28	59
BUSH, GUSTAVA E.		59 1966	UGWCDIS	1926	0.02200	N 177 W 1547 SESL 3S 1W19	59
BUSHNELL, LEROY C.		59 980	APPLDIS	19510912	0.01500	N 1230 W 895 E4SL 3S 1W16	59
BUTCHER, WANEMA C.	IDS	59 4830	APPLLAPD	19810714	0.01500	S 45 W 490 E4SL 3S 1W16	59
BUTTERFIELD, CINDY B.	IDS	59 5091	APPLAPP	19890622	0.01500	S 200 W 60 N4SL 3S 1W30	59
BUTTERFIELD, CRAIG E.	IDS	59 4386	APPLCERT	19800801	0.01500	S 75 W 237 E4SL 3S 1W30	59
BUTTERFIELD, ELDON		59 3895	APPLLAPD	19771003	0.01500	S 90 W 980 NESL 3S 1W30	59
BUTTERFIELD, ELDON AND SHIRLEY	S	59 2318	UGWC	19330200	0.00000	S 141 W 920 NESL 3S 1W30	59
BUTTERFIELD, JAMES S.	I	59 1188	APPLCERT	19540911	1.18000	N 50 E 40 SWSL 3S 2W26	59
BUTTERFIELD, WAYNE W.	IDS	59 3272	APPLUNAP	19660211	1.50000	N 50 E 850 SWSL 3S 2W35	59
BUTTERFIELD, WAYNE W.	I	59 3404	APPLUNAP	19660916	0.50000	N 50 E 850 SWSL 3S 2W35	59
BYTHEWAY, QUINTIN H.		59 1690	APPLLAPD	19630301	0.01500	S 166 E 2499 W4SL 2S 1W34	59
CAHOON, JAY C.		59 2169	UGWCDIS	19201100	0.02200	S 1178 W 148 N4SL 3S 1W 4	59
CAIN, DONEL D. AND VELMA M.		59 1872	UGWCDIS	1911	0.01300	S 5248 W 2823 NESL 3S 1W15	59
CALLISTER REAL ESTATE AND INVESTMENT CORPORATION	IDS	59 4971	TEMPEXP	19830927	0.01500	N 184 E 1100 SWSL 3S 1W20	59
CALLISTER REAL ESTATE AND INVESTMENT CORPORATION	IDS	59 4970	APPLLAPD	19830927	0.01500	N 184 E 1100 SWSL 3S 1W20	59
CANDALOT, GENE L.	ID	59 3941	APPLCERT	19730418	0.01500	S 173 W 1406 N4SL 3S 1W29	59
CARDWELL, ROBERT L. (FAMILY TRUST)	IDS	59 2256	UGWC	19180000	0.08900	N 1224 W 308 S4SL 3S 1W29	59
CARTER, JAMES W.		59 2644	UGWCDIS	18990000	0.007	S 135 W 2050 N4SL 2S 1W28	59
CARTER, MYRNA B. (FAMILY TRUST AGREEMENT)		59 5581	APPLAPP	19980424	0.00000	N 1330 W 1050 S4SL 3S 2W35	59
CARTER, MYRNA B. (FAMILY TRUST AGREEMENT)		59 5581	APPLAPP	19980424	0.00000	N 1450 W 1230 S4SL 3S 2W35	59
CASH, LAVON ISAKSON		59 2608	UGWCDIS	19050000	0.01100	S 2464 E 1558 NWSL 3S 1W14	59
CAVENDER, THELMA	D	59 404	APPLNPR	19440515	0.01500	N 3068 E 118 SWSL 2S 1W26	59
CHARON, JUNE	I S	59 564	APPLNPR	19470424	0.01500	S 101 E 899 W4SL 3S 1W21	59
CHAVEZ, JOSE		59 420	APPLDIS	19440927	0.01500	S 400 E 1280 NWSL 2S 1W35	59
CHAVEZ, TONY A.	I	59 4357	DIL	1903	4.00000	N 1755 E 1655 W4SL 3S 1W11	59
CHAVEZ, TONY A.	I	59 4280	DIL	1903	4.00000	N 1380 E 1665 W4SL 3S 1W11	59
CHIVERS, MELANIE	IDS	59 3940	APPLCERT	19730404	0.01500	N 1096 E 27 S4SL 3S 2W34	59
CHRISTOFFERSON, JOHN B. AND CHERI	IDS	59 4776	APPLLAPD	19801004	0.01500	N 230 E 390 S4SL 3S 2W34	59

CLARK, NEAL	I		59 5130	APPLLAPD	19850705	0.02500	N 1850 E 150 SWSL 3S 1W14	59
CONDIE, VERNON ELDEAN			59 1731	APPLLAPD	19640805	0.01500	N 1425 E 1177 W4SL 3S 1W14	59
CONDIE, VERNON ELDEAN			59 1739	APPLLAPD	19641228	0.25000	N 1425 E 1177 W4SL 3S 1W14	59
CONTINENTAL COPPER AND STEEL INDUSTRIES INCORPORATED			59 3089	UGWCDIS	19200000	0.03300	S 110 W 50 NESL 3S 1W 5	59
COOK, GRANT O. (DR.)			59 3954	APPLLAPD	19730530	0.01500	S 3220 W 3550 NESL 3S 1W20	59
COOK, JOSEPH E.	IDS		59 3797	UGWC	19340000	0.01500	N 160 W 400 S4SL 2S 1W35	59
COOPER, NEWELL J.	DS		59 2351	UGWC	19060000	0.00900	N 120 E 141 SWSL 3S 1W 2	59
COOPER, WILLIAM A. AND DARLENE	I		59 1838	UGWC	19241000	0.01100	N 610 E 80 S4SL 3S 1W16	59
CRANE, J. REED AND RAE S.			59 2916	UGWCDIS	191200	0.01100	N 2190 E 175 SWSL 3S 2W35	59
CRUMP, STANLEY R. AND ARLENE J.	IDS		59 1406	APPLNPR	19590123	0.01500	S 1560 E 90 N4SL 3S 1W27	59
DAINES, VAUGHN R.	IDS		59 4312	APPLCERT	19760819	0.01500	N 903 E 1609 S4SL 3S 1W29	59
DANSIE, A. BRENT	IDS		59 5565	TEMPAPP	19970501	0.00000	N 1096 E 27 S4SL 3S 2W34	59
DANSIE, A. BRENT AND ALYCE ANN	IDS	O	59 5571	APPLAPP	19980121	0.00000	N 900 E 100 S4SL 3S 2W34	59
DANSIE, A. BRENT AND ALYCE ANN	IDS	O	59 5571	APPLAPP	19770930	0.00000	N 1096 E 27 S4SL 3S 2W34	59
DANSIE, A. BRENT AND ALYCE ANN	IDS	O	59 5571	APPLAPP	19770930	0.00000	N 900 E 100 S4SL 3S 2W34	59
DANSIE, A. BRENT AND ALYCE ANN	IDS	O	59 5571	APPLAPP	19980121	0.00000	N 1096 E 27 S4SL 3S 2W34	59
DANSIE, ARTHUR H.	IDS		59 4073	APPLCERT	19740718	0.01500	N 1096 E 27 S4SL 3S 2W34	59
DANSIE, JESSE	I		59 1249	APPLLAP	19541117	3.79300	S 2600 W 1450 NESL 3S 2W34	59
DANSIE, JESSE	I		59 1249	APPLLAP	19541117	3.79300	S 950 E 1050 E4SL 3S 2W33	59
DANSIE, JESSE	I		59 1249	APPLLAP	19541117	3.79300	N 1900 E 2400 SWSL 3S 2W34	59
DANSIE, JESSE	I		59 1249	APPLLAP	19541117	3.79300	N 1500 E 2000 SWSL 3S 2W33	59
DANSIE, JESSE	I		59 1249	APPLLAP	19541117	3.79300	S 950 E4SL 3S 2W33	59
DANSIE, JESSE	I		59 1249	APPLLAP	19541117	3.79300	N 2300 E 1500 SWSL 3S 2W33	59
DANSIE, JESSE	I		59 1249	APPLLAP	19541117	3.79300	S 50 E4SL 3S 2W33	59
DANSIE, JESSE	I		59 1249	APPLLAP	19541117	3.79300	N 1000 E 2300 SWSL 3S 2W34	59
DANSIE, JESSE	I		59 1249	APPLLAP	19541117	3.79300	S 1500 E 1400 NWSL 3S 2W34	59
DANSIE, JESSE	I		59 1249	APPLLAP	19541117	3.79300	S 1250 E4SL 3S 2W33	59
DANSIE, JESSE	I		59 1249	APPLLAP	19541117	3.79300	S 1500 W 1450 NESL 3S 2W34	59
DANSIE, JESSE H.	ID		59 4619	APPLLAP	19721017	2.58000	N 1000 E 2300 SWSL 3S 2W34	59
DANSIE, JESSE H.			59 1249	APPLAPP	19721017	6.37300	S 50 E4SL 3S 2W33	59
DANSIE, JESSE H.	ID		59 4619	APPLLAP	19721017	2.58000	S 2600 W 1450 NESL 3S 2W34	59
DANSIE, JESSE H.			59 1249	APPLAPP	19721017	6.37300	N 1000 E 2300 SWSL 3S 2W34	59
DANSIE, JESSE H.	ID		59 4619	APPLLAP	19721017	2.58000	S 1500 E 1400 NWSL 3S 2W34	59
DANSIE, JESSE H.	ID		59 4619	APPLWD	19780306	2.58000	N 1500 E 2000 SWSL 3S 2W33	59
DANSIE, JESSE H.	ID		59 4619	APPLWD	19780306	2.58000	N 1900 E 2400 SWSL 3S 2W34	59
DANSIE, JESSE H.	ID		59 4619	APPLLAP	19721017	2.58000	S 50 E4SL 3S 2W33	59
DANSIE, JESSE H.	IDS		59 3177	UGWC	19200000	0.01500	N 1275 W 270 S4SL 3S 2W34	59
DANSIE, JESSE H.			59 1249	APPLAPP	19721017	6.37300	S 2600 W 1450 NESL 3S 2W34	59
DANSIE, JESSE H.	ID		59 4619	APPLLAP	19721017	2.58000	S 950 E4SL 3S 2W33	59
DANSIE, JESSE H.			59 1249	APPLAPP	19721017	6.37300	S 1500 W 1450 NESL 3S 2W34	59
DANSIE, JESSE H.			59 1249	APPLAPP	19721017	6.37300	S 950 E4SL 3S 2W33	59
DANSIE, JESSE H.	ID		59 4619	APPLWD	19780306	2.58000	S 950 E 1050 E4SL 3S 2W33	59
DANSIE, JESSE H.	ID		59 4619	APPLWD	19780306	2.58000	N 1000 E 2300 SWSL 3S 2W34	59
DANSIE, JESSE H.	ID		59 4619	APPLWD	19780306	2.58000	S 50 E4SL 3S 2W33	59
DANSIE, JESSE H.	ID		59 4619	APPLWD	19780306	2.58000	S 1250 E4SL 3S 2W33	59
DANSIE, JESSE H.	ID		59 4619	APPLLAP	19721017	2.58000	N 1500 E 2000 SWSL 3S 2W33	59
DANSIE, JESSE H.			59 1249	APPLAPP	19721017	6.37300	S 950 E 1050 E4SL 3S 2W33	59
DANSIE, JESSE H.			59 1249	APPLAPP	19721017	6.37300	N 2300 E 1500 SWSL 3S 2W33	59
DANSIE, JESSE H.	ID		59 4619	APPLWD	19780306	2.58000	S 950 E4SL 3S 2W33	59
DANSIE, JESSE H.			59 1249	APPLAPP	19721017	6.37300	N 1500 E 2000 SWSL 3S 2W33	59
DANSIE, JESSE H.	ID		59 4619	APPLLAP	19721017	2.58000	S 1500 W 1450 NESL 3S 2W34	59
DANSIE, JESSE H.			59 1249	APPLAPP	19721017	6.37300	S 1500 E 1400 NWSL 3S 2W34	59
DANSIE, JESSE H.	ID		59 4619	APPLLAP	19721017	2.58000	S 1250 E4SL 3S 2W33	59
DANSIE, JESSE H.			59 1249	APPLAPP	19721017	6.37300	N 1900 E 2400 SWSL 3S 2W34	59
DANSIE, JESSE H.	ID		59 4619	APPLWD	19780306	2.58000	S 1500 W 1450 NESL 3S 2W34	59
DANSIE, JESSE H.	ID		59 4619	APPLLAP	19721017	2.58000	S 950 E 1050 E4SL 3S 2W33	59
DANSIE, JESSE H.	ID		59 4619	APPLWD	19780306	2.58000	N 2300 E 1500 SWSL 3S 2W33	59

DANSIE, JESSE H.	ID	59 4619	APPLWD	19780306	2.58000	S 1500 E 1400 NWSL 3S 2W34	59
DANSIE, JESSE H.		59 1249	APPLAPP	19721017	6.37300	S 1250 E4SL 3S 2W33	59
DANSIE, JESSE H.	ID	59 4619	APPLWD	19780306	2.58000	S 2600 W 1450 NESL 3S 2W34	59
DANSIE, JESSE H.	ID	59 4619	APPLLAP	19721017	2.58000	N 2300 E 1500 SWSL 3S 2W33	59
DANSIE, JESSE H.	ID	59 4619	APPLLAP	19721017	2.58000	N 1900 E 2400 SWSL 3S 2W34	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	S 662 E 44 NWSL 4S 2W 3	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	S 758 E 1350 W4SL 3S 2W33	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	S 593 E 1362 W4SL 3S 2W33	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	S 1159 E 2344 W4SL 3S 2W33	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	N 1239 E 872 SWSL 3S 2W34	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	S 52 E 5 W4SL 3S 2W34	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	N 2059 W 492 S4SL 3S 2W34	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	N 279 W 1167 S4SL 3S 2W34	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	N 99 W 327 S4SL 3S 2W34	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	S 2818 W 1395 NESL 3S 2W34	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	S 1363 E 1358 NWSL 3S 2W34	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	N 1485 W 244 S4SL 3S 2W34	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	N 1412 W 7 SESL 3S 2W33	59
DANSIE, JESSE RODNEY	I S	59 1200	APPLCERT	19541117	1.19000	S 740 E 1330 W4SL 3S 2W33	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	S 1428 W 1425 NESL 3S 2W34	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	S 2210 W 1372 NESL 3S 2W34	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	S 1347 W 2614 NESL 3S 2W34	59
DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	19980728	1.62700	S 837 W 48 N4SL 4S 2W 3	59
DANSIE, KENT ALMA	IDS	59 4928	APPLLAP	19830228	0.01500	N 300 W 1950 SESL 3S 2W34	59
DANSIE, RICHARD PAUL	IDS	59 5383	FIXDAPP	19930104	0.00000	N 1300 W 100 S4SL 3S 2W34	59
DANSIE, TOM	IDS	59 4807	APPLLAPD	19810318	0.01500	N 350 W 1850 SESL 3S 2W34	59
DAUSE, BILL	D	59 4100	APPLLAPD	19741107	0.01500	S 100 E 525 NWSL 4S 2W 2	59
DAVIS, F. VAL	I	59 4729	APPLCERT	19790615	0.01500	S 270 E 133 W4SL 3S 1W14	59
DE LIA, JULIAN E.	IDS	59 5440	FIXDLAP	19940511	0.01500	N 418 W 1650 SESL 3S 2W33	59
DEASON, HENRY H AND MAYE W	IDS	59 4624	APPLCERT	19780322	0.01500	S 1910 W 600 N4SL 3S 1W 5	59
DEE'S INCORPORATED	I S	59 1694	APPLCERT	19630322	1.00000	S 530 W 2665 E4SL 3S 1W 5	59
DEGRAW, DAVID L.	I	59 4917	APPLLAP	19821109	0.04500	S 235 E 460 W4SL 3S 1W14	59
DICK, JAMES	I S	59 2815	UGWC	19020000	0.02200	N 600 E 145 SWSL 2S 1W35	59
DICK, JAMES	I	59 4674	APPLCERT	19780919	0.22300	N 606 E 560 SWSL 2S 1W35	59
DIMOND, STANLEY G.	I S	59 1352	APPLCERT	19580122	2.00000	N 1276 E 168 S4SL 3S 1W 5	59
DIMOND, STANLEY G.	I S	59 1671	APPLCERT	19620426	1.00000	N 1276 E 168 S4SL 3S 1W 5	59
DIXIE SIX CORPORATION		59 2281	UGWCDIS	19060000	0.04500	N 187 W 1645 S4SL 3S 1W22	59
DOXEY, SCOTT T.	IDS	59 5185	APPLCERT	19860701	0.01500	S 1300 W 730 N4SL 3S 1W 8	59
DUTSON, BERNARD W.	IDS	59 1661	APPLCERT	19620305	0.01500	S 635 E 145 W4SL 3S 1W29	59
DUTSON, BERNHARD W.		59 1719	APPLLAPD	19640228	0.01500	S 630 E 160 W4SL 3S 1W29	59
DUTSON, LYMAN W.	IDS	59 4717	APPLCERT	19790423	0.01500	S 9 E 53 W4SL 3S 1W29	59
EGBERT, KEITH	IDS	59 4229	APPLCERT	19760415	0.01500	S 155 E 795 N4SL 3S 1W32	59
EGBERT, SUSAN	I	59 13	APPLWD	19880513	0.00000	N 521 E 14 W4SL 3S 1W16	59
EKINS, RONALD W.		59 4963	APPLAPP	19850619	0.01500	S 80 E 590 W4SL 3S 1W29	59
EKINS, RONALD W.	IDS	59 4963	APPLLAPD	19900621	0.01500	S 80 E 590 W4SL 3S 1W29	59
ELLEFSEN, CLARENCE W. (FAMILY TRUST)	I	59 4433	APPLCERT	19770222	0.03000	N 288 E 47 SWSL 3S 1W11	59
ERICKSEN, KEITH A	IDS	59 3813	APPLCERT	19710712	0.01500	N 105 W 537 NESL 4S 2W 4	59
ERICKSON, ERNEST G.		59 2411	UGWCDIS	19210000	0.22200	N 302 W 445 E4SL 3S 1W 5	59
ERNEST, ROBERT AND BARBARA	IDS	59 4069	APPLLAPD	19740708	0.01500	N 720 W 350 SESL 3S 2W34	59
FAILOR, KENNETH L.	IDS	59 4462	APPLCERT	19770422	0.01500	N 161 E 1030 S4SL 3S 1W29	59
FARNSWORTH, RONALD DALE	ID	59 4538	APPLCERT	19770719	0.01500	S 615 E 1235 N4SL 3S 1W15	59
FERAGEN, LEONARD H.	DS	59 1612	APPLCERT	19610605	0.01500	N 2202 E 193 S4SL 3S 1W29	59
FIFE, RICHARD A. AND NORMA D. (JR.)		59 3844	APPLLAPD	19720424	0.06700	S 125 E 685 NWSL 3S 1W16	59
FINLAYSON, MAX A.		59 2414	UGWCDIS	19050000	0.009	N 775 E 805 SWSL 2S 1W28	59
FITZGERALD, DENNIS	IDS	59 5374	FIXDAPP	19921015	0.01500	N 345 W 550 SESL 3S 2W33	59
FLETCHER, JOSEPH L. AND CAROLYN F.	IDS	59 4226	APPLCERT	19760408	0.01500	N 507 W 180 S4SL 3S 1W29	59
FOOTHILL WATER COMPANY		59 1608	APPLEXP	19911217	0.50000	S 758 E 1350 W4SL 3S 2W33	59

FOOTHILL WATER COMPANY		59 1608	APPLEXP	19901109	0.50000	S	758 E 1350 W4SL 3S 2W33	59
FOOTHILLS WATER COMPANY	IDS	59 3879	APPLEXP	19920914	0.00000	S	740 E 1330 W4SL 3S 2W33	59
FORMAN, STANFORD M.		59 2681	UGWCDIS	19020000	0.22300	S	1458 W 140 NESL 3S 1W16	59
FRAUGHTON, EDWARD J.	IDS	59 4250	APPLCERT	19800314	0.16300	N	1600 E 170 W4SL 3S 1W14	59
FRAUGHTON, EDWARD J.	I	59 5529	APPLAPP	19800314	0.00000	S	1100 E 150 NWSL 3S 1W14	59
FREEMAN, ALONZO		59 1614	APPLLAPD	19691121	3.00000	N	75 E 75 SWSL 3S 2W24	59
FULLMER, GENE L. & DELORES H.	I S	59 4364	UGWC	19000000	0.50000	N	1785 E 1578 W4SL 3S 1W11	59
FULLMER, GENE L. & DELORES H.	I S	59 4363	UGWC	19030000	1.00000	N	1755 E 1655 W4SL 3S 1W11	59
FULLMER, LAWRENCE W. & MARY E.	IDS	59 4298	DIL	19170000	0.00400	N	230 W 300 SESL 3S 1W 4	59
GAILEY, GRACE E.		59 2283	UGWCDIS	18960000	0.01100	N	2282 E 1975 SWSL 3S 1W11	59
GAILEY, SHARON	ID	59 4903	APPLLAPD	19860703	0.01500	S	350 W 485 NESL 3S 1W16	59
GARDNER, DAVID I & GAYLE P.	ID	59 1551	APPLCERT	19690229	0.01500	S	921 W 226 N4SL 3S 1W 5	59
GARDNER, DUNCAN R.	S	59 3076	UGWC	19200000	0.03300	N	1005 W 140 SESL 2S 1W34	59
GARDNER, DUNCAN R.	ID	59 2429	UGWC	19220600	0.00800	N	1005 W 141 SESL 2S 1W34	59
GARDNER, EDWIN F. & JOHN R.	I S	59 3909	UGWC	19340000	2.50000	S	1068 E 60 NWSL 3S 1W 2	59
GARDNER, HOWARD D.	ID	59 388	APPLNPR	19431029	0.01500	S	290 W 145 E4SL 2S 1W34	59
GARDNER, JOHN R. AND EDWIN F.	D	59 2526	UGWC	18920000	0.00900	N	525 E 300 SWSL 2S 1W35	59
GARDNER, JOHN R. AND EDWIN F.	I S	59 2525	UGWC	19030000	2.00000	N	1600 E 35 SWSL 2S 1W35	59
GARDNER, RALPH	I	59 4285	DIL	19340000	2.50000	S	1068 E 60 NWSL 3S 1W 2	59
GARDNER, RALPH W.	DS	59 2371	UGWC	19160000	0.02200	N	755 E 1625 SWSL 2S 1W35	59
GASSER, ROBERT	I S	59 3648	APPLCERT	19710226	0.01500	N	279 W 1690 E4SL 3S 1W10	59
GEDGE, NATHAN R. AND GRACE		59 2952	UGWCDIS	1900	0.06600	S	1525 W 250 NESL 3S 1W10	59
GIFFORD, JON TROY	IDS O	59 1091	APPLCERT	19530313	0.08900	S	455 W 212 NESL 3S 1W 3	59
GILBERT, DONALD R. & SUSAN J.	IDS	59 1031	APPLCERT	19620619	0.00200	S	3136 W 256 N4SL 3S 1W29	59
GILES, LEE A. AND KATHY	IDS	59 5070	APPLLAPD	19841114	0.01500	S	250 E 2440 W4SL 3S 1W29	59
GLENMOOR GOLF COURSE INC	I	59 4189	APPLCERT	19591105	1.39000	S	678 E 316 W4SL 3S 1W 7	59
GLENMOOR GOLF COURSE INC.	I	59 4483	APPLCERT	19740418	0.83000	S	678 E 316 W4SL 3S 1W 7	59
GLENMOOR GOLF COURSE INC.	I	59 1521	APPLCERT	19591105	1.11000	S	10 E 254 W4SL 3S 1W 7	59
GLENMOOR GOLF COURSE INC.	I	59 1521	APPLCERT	19591105	1.11000	S	2222 E 257 NWSL 3S 1W 7	59
GLOVER, GEOFFREY	IDS	59 2354	UGWC	19250000	0.02200	S	119 W 339 NESL 3S 1W28	59
GOECKERITZ, RUDOLPH E. & DENISE	I S	59 4027	UGWC	18990000	1.16000	N	400 W 650 S4SL 3S 1W 2	59
GOODRIDGE, JAMES WILLIS	I S	59 3323	UGWC	19060000	0.01100	N	580 E 95 SWSL 2S 1W26	59
GORDON, DAL & REATHA		59 5085	APPLAPP	19970616	0.00000	N	255 W 160 SESL 3S 2W33	59
GORDON, DAL & REATHA	IDS	59 5085	APPLCERT	19850306	0.01500	N	345 W 550 SESL 3S 2W33	59
GORDON, SCOTT	IDS	59 5364	FIXDLAP	19920825	0.00000	N	30 W 400 SESL 3S 2W33	59
GRAHAM, SHIRLENE	IDS	59 3986	APPLAPP	19780128	0.01500	N	1500 E 1150 SWSL 3S 1W20	59
GREENWOOD, MARK H.	IDS	59 2147	UGWC	18960000	0.02200	N	865 W 315 E4SL 2S 1W34	59
GREENWOOD, MARK H.	I S	59 2604	UGWC	19190000	0.25000	N	500 W 500 E4SL 2S 1W34	59
GUSS, ABE	O	59 328	APPLCERT	19510124	0.12600	N	450 E 396 S4SL 2S 1W27	59
GYGI, WALLACE NEIL	IDS	59 4537	APPLCERT	19770719	0.02200	N	1183 E 204 SWSL 3S 1W11	59
HADLEY, MARIE	ID	59 4390	APPLCERT	19800818	0.01500	N	646 W 771 SESL 3S 1W 9	59
HAL K. LARSEN AND SONS CONSTRUCTION INC.	IDS	59 4323	APPLCERT	19761004	0.01500	S	180 W 967 N4SL 3S 1W32	59
HALL, JACK W.		59 3814	APPLLAPD	19710712	0.01500	N	200 W 766 NESL 4S 2W 4	59
HAM, BILLY W. AND GRACE	IDS	59 4143	APPLCERT	19750521	0.01500	S	230 E 355 N4SL 3S 1W20	59
HAMILTON PROPERTIES L.C., LOWELL W.	I	59 5582	APPLAPP	19980617	0.00000	S	400 W 300 NESL 4S 2W 3	59
HAMILTON PROPERTIES L.C., LOWELL W.	I	59 5582	APPLAPP	19980617	0.00000	S	400 W 1320 NESL 4S 2W 3	59
HAMILTON, LOWELL AND MARY L.	I	59 2720	APPLAPP	19980617	0.00000	S	400 W 1320 NESL 4S 2W 3	59
HAMILTON, LOWELL AND MARY L.	I	59 2720	APPLAPP	19980617	0.00000	S	400 W 300 NESL 4S 2W 3	59
HAMILTON, LOWELL AND MARY L.	I	59 2720	UGWC	19170000	0.07000	S	597 W 1350 NESL 4S 2W 3	59
HAMILTON, RALPH	IDS	59 5204	APPLCERT	19860820	0.01500	S	335 E 105 NWSL 4S 2W 2	59
HANCOCK, FORREST	IDS	59 995	APPLNPR	19511108	0.01500	S	1235 E 1185 N4SL 3S 1W14	59
HANSEN, CHARLES G.	IDS	59 4894	APPLLAPD	19820601	0.01500	S	920 W 1060 NESL 3S 1W27	59
HANSEN, GREG	ID	59 4869	APPLLAPD	19811230	0.01500	S	1150 E 1220 N4SL 3S 1W 3	59
HANSEN, GREGORY L.	ID	59 4942	APPLLAP	19830504	0.01500	N	400 E 600 W4SL 3S 1W 2	59
HANSEN, KEVIN	I	59 5096	APPLCERT	19890525	0.04000	N	65 W 777 SESL 3S 1W 9	59
HANSEN, KEVIN & CAROL	IDS	59 4684	APPLCERT	19781205	0.01500	N	65 W 777 SESL 3S 1W 9	59
HANSEN, PAUL L. AND ROXANNE S.	IDS	59 3885	APPLCERT	19721031	0.01500	N	70 W 875 SESL 3S 2W33	59

HANSEN, PAUL LEROY	IDS	59 4946	APPLLAPD	19830525	0.01500	N	100 W 1100 SESL 3S 2W33	59
HARDMAN, DAVID NORD	ID	59 4005	APPLLAPD	19761116	0.01500	N	329 W 220 S4SL 3S 1W20	59
HARMAN, MAURICE M.	IDS	59 1693	APPLUNAP	19630315	4.00000	S	50 E 10 W4SL 3S 1W22	59
HARMAN, MAURICE M. (ETAL)		59 1626	APPLLAPD	19690831	4.00000	N	60 W 1260 S4SL 3S 1W 9	59
HARPER, FRANCIS M.	IDS	59 4414	APPLCERT	19770215	0.01500	N	1893 E 642 S4SL 3S 1W29	59
HATT, THIEL F.	I	59 5105	APPLLAPD	19850604	0.02200	S	550 W 420 N4SL 3S 1W14	59
HAUN, ARCH L. & EVA F.	S	59 245	APPLNPR	19410529	0.01500	S	432 W 168 N4SL 3S 1W 4	59
HAUN, ARCH L. AND EVA F.		59 2170	UGWCDIS	19200000	0.02600	S	332 W 168 N4SL 3S 1W 4	59
HAYMORE, BRUCE	IDS	59 5464	UGWC	19320000	0.00000	S	166 W 78 E4SL 3S 1W21	59
HERRIMAN IRRIGAITON CO.		59 17	APPLLAPD	19550211	4.59000	N	1711 W 1316 SESL 3S 2W34	59
HERRIMAN PIPELINE & DEVELOPMENT CO. (HELD BY BWR)	I	59 16	APPLCERT	19550211	0.41000	N	1711 W 1316 SESL 3S 2W34	59
HERRIMAN PIPELINE & DEVELOPMENT CO. (HELD BY BWR)	IDS O	59 1212	APPLCERT	19550305	0.98300	N	2020 W 100 SESL 3S 2W34	59
HERRIMAN PIPELINE AND DEVELOPMENT COMPANY		59 5258	APPLAPP	19940217	1.00000	N	2020 W 100 SESL 3S 2W34	59
HERRIMAN PIPELINE AND DEVELOPMENT COMPANY		59 5258	APPLAPP	19940217	1.00000	N	1711 W 1316 SESL 3S 2W34	59
HEUGHS CREEK ASSOCIATES LLC	IDS	59 2416	UGWC	19300000	0.05600	S	324 E 235 N4SL 3S 1W32	59
HILBERT, DEMA & GARY	IDS	59 4964	APPLLAPD	19830810	0.01500	S	120 E 1170 W4SL 3S 1W29	59
HILL, ALLEN F.	IDS	59 4858	APPLLAPD	19811102	0.03000	N	805 E 1239 W4SL 3S 1W14	59
HOGGE, J. NORMAN	IDS	59 3950	APPLCERT	19730508	0.01500	N	493 E 1513 SWSL 3S 1W20	59
HOLBROOK, VENILE	I S	59 4873	APPLCERT	19820219	0.01500	S	1690 W 460 NESL 3S 1W28	59
HOLMAN, BOBBY JOE	IDS	59 5084	APPLLAPD	19850306	0.01500	N	343 W 551 SESL 3S 2W33	59
HOLT, ALMA M.		59 1987	UGWCDIS	1902	0.01100	S	1420 W 170 NESL 3S 1W15	59
HOLT, MARIE		59 2007	UGWCDIS	19100000	0.01100	S	1820 W 200 N4SL 3S 1W15	59
HOOGVELDT, MARTIN M.	IDS	59 5140	APPLLAPD	19850911	0.01500	N	2460 E 60 S4SL 3S 1W29	59
HOPES, ROBERT	IDS	59 3600	APPLCERT	19690611	0.04500	S	880 E 552 NWSL 3S 1W 4	59
HOWELL, KEVAN	IDS	59 4148	APPLCERT	19750616	0.01500	S	332 W 669 N4SL 3S 1W30	59
HUG, JON J.		59 3452	APPLLAPD	19680418	0.01500	S	660 E 165 W4SL 3S 1W29	59
HUNTSMAN, COURTNEY C. AND PATRICIA H.	I	59 3925	APPLCERT	19730514	0.10000	N	636 E 39 S4SL 2S 1W34	59
HYMAS, CHAD		59 5525	APPLAPP	19961210	0.00000	N	764 W 80 SESL 3S 2W33	59
HYMAS, CHAD	ID	59 5525	FIXDAPP	19960314	0.00000	N	764 W 80 SESL 3S 2W33	59
IVERSON, LE GRAND	I	59 4898	APPLLAPD	19820625	0.045	N	1330 E 1040 S4SL 2S 1W28	59
IVIE, JIM D. & WANDA	IDS	59 3826	APPLCERT	19711103	0.01500	N	263 E 1425 S4SL 3S 2W33	59
IVIE, JIM DEE	IDS	59 4925	APPLAPP	19830210	0.01500	N	300 W 900 SESL 3S 2W33	59
IVIE, JIM DEE	IDS	59 4924	APPLAPP	19830210	0.01500	N	263 E 1425 S4SL 3S 2W33	59
IWAMOTO, TAKEO		59 4544	APPLAPP	19990713	0.02200	S	110 W 460 N4SL 3S 1W10	59
IWAMOTO, TAKEO		59 2552	UGWCDIS	19000000	0.02200	S	100 W 186 N4SL 3S 1W10	59
IWAMOTO, TAKEO	ID O	59 4536	APPLCERT	19770719	0.01500	S	110 W 460 N4SL 3S 1W10	59
IWAMOTO, TAKEO	ID O	59 4544	UGWC	19350000	0.02200	S	50 W 125 N4SL 3S 1W10	59
IWAMOTO, TAKEO	I O	59 4544	APPLWD	19950731	0.02200	S	110 W 460 N4SL 3S 1W10	59
J. N. HUTCHINGS & SONS INCORPORATED		59 2631	UGWCDIS	19210600	0.06700	S	480 E 152 N4SL 3S 1W 9	59
JENSEN AND WILKINSON INCORPORATED	I S	59 2607	UGWC	18990000	0.02200	S	5050 W 280 NESL 3S 1W15	59
JENSEN, DONALD D. & JANE R.	I	59 4948	APPLCERT	19830527	0.02000	S	26 W 1124 NESL 3S 1W16	59
JENSEN, MRS. GEORGE M.		59 1993	UGWCDIS	1924	0.022	N	2540 W 120 S4SL 2S 1W28	59
JENSEN, VERNON B. AND FERN L.		59 2246	UGWCDIS	19240000	0.00400	S	1403 W 4740 NESL 3S 1W15	59
JEPPSEN, BRUCE	I	59 4355	DIL	1903	4.00000	N	1755 E 1655 W4SL 3S 1W11	59
JEPPSEN, BRUCE	I	59 4254	DIL	1903	0.40000	N	595 E 460 W4SL 3S 1W11	59
JESSEE, NORMAN	I	59 4476	APPLCERT	19770509	0.01500	S	164 W 312 NESL 3S 1W22	59
JESSEE, NORMAN P.	I	59 4459	APPLCERT	19770418	0.01400	N	204 W 420 SESL 3S 1W17	59
JESSEE, NORMAN P.	IDS	59 3597	APPLCERT	19690527	0.01500	N	204 W 420 SESL 3S 1W17	59
JOHNSON, CHESTER L.	IDS	59 4032	APPLLAPD	19740402	0.01500	N	278 E 786 SWSL 3S 1W20	59
JOHNSON, RANDY	IDS	59 4031	APPLLAPD	19740402	0.01500	N	278 E 786 SWSL 3S 1W20	59
JONES BROTHERS		59 1665	APPLLAPD	19620327	10.00000	N	100 SWSL 3S 2W10	59
JONES, HAL H.	ID	59 5296	APPLAPP	19900717	0.01500	S	350 W 485 NESL 3S 1W16	59
JONES, JOAN E.	IDS	59 4596	APPLLAPD	19850709	0.07800	S	100 E 180 NWSL 3S 1W16	59
JONES, MERLIN H.	DS	59 2842	UGWC	19000000	0.02200	S	180 E 105 W4SL 3S 1W 3	59
JONES, OTTO F.	I S	59 4768	APPLCERT	19800318	0.14000	N	531 E 14 W4SL 3S 1W16	59
JONES, OTTO F.	I S	59 4326	APPLCERT	19761019	0.06000	N	521 E 14 W4SL 3S 1W16	59
JORDAN VALLEY WATER CONSERVANCY DISTRICT		59 1536	APPLAPP	19960612	5.00000	S	840 W 250 E4SL 3S 2W26	59

JORDAN VALLEY WATER CONSERVANCY DISTRICT	I	59 1210	APPLCERT	19550305	3.55000	S 75 W 1768 NESL 3S 1W30	59
JORDAN, DEAN L. III AND ROXANE D.	ID	59 1112	APPLNPR	19530627	0.01500	S 585 W 225 E4SL 2S 1W27	59
JORDAN, DEAN L. III AND ROXANE D.	I	59 1953	UGWC	19030000	0.22300	N 2115 W 220 SESL 2S 1W27	59
JORDAN, DEAN L. III AND ROXANE D.	ID	59 1952	UGWC	19070000	0.03300	S 585 W 225 E4SL 2S 1W27	59
JORGENSEN, DAVID B.		59 3937	APPLLAPD	19730319	0.01500	S 3220 W 3550 NESL 3S 1W20	59
JU, DAVID	IDS	59 4974	APPLLAPD	19831019	0.01500	S 130 E 100 NWSL 4S 2W 2	59
KARTCHNER, EARL	IDS	59 4962	APPLLAP	19830805	0.01500	N 1050 E 1500 SWSL 3S 1W22	59
KARTCHNER, EARL	IDS	59 5133	APPLLAP	19850808	0.01500	N 2500 E 150 S4SL 3S 1W29	59
KEMP, KAY F.		59 3796	UGWC	18960000	0.02200	N 865 W 315 E4SL 2S 1W34	59
KENNECOTT UTAH COPPER CORPORATION	O	59 5209	APPLCERT	19861201	1.04000	S 694 E 1256 NWSL 3S 2W27	59
KENNECOTT UTAH COPPER CORPORATION		59 3	APPLAPP	19950811	3.00000	S 115 W 2634 NESL 3S 2W27	59
KENNECOTT UTAH COPPER CORPORATION		59 3	APPLAPP	19960226	2.00000	S 3700 E 4250 NWSL 3S 2W16	59
KENNECOTT UTAH COPPER CORPORATION	I O	59 1006	APPLPDPT	19520405	1.00000	S 698 E 1142 W4SL 3S 2W29	59
KENNECOTT UTAH COPPER CORPORATION	IDS	59 93	APPLCERT	19380114	0.00400	N 1362 E 650 SWSL 3S 2W32	59
KENNECOTT UTAH COPPER CORPORATION	O	59 1042	APPLCERT	19621213	4.44000	S 150 E 2500 NWSL 3S 2W14	59
KENNECOTT UTAH COPPER CORPORATION	ID	59 1271	APPLNPR	19560620	0.01500	S 371 W 147 N4SL 3S 2W32	59
KENNECOTT UTAH COPPER CORPORATION		59 945	APPLAPP	19960226	2.00000	S 100 E 250 NWSL 3S 2W27	59
KENNECOTT UTAH COPPER CORPORATION		59 3	APPLAPP	19970818	3.00000	S 115 W 2634 NESL 3S 2W27	59
KENNECOTT UTAH COPPER CORPORATION		59 3	APPLUNAP	19960823	3.00000	S 115 W 2634 NESL 3S 2W27	59
KENNECOTT UTAH COPPER CORPORATION		59 3	APPLEXP	19950126	2.00000	S 3700 E 4250 NWSL 3S 2W16	59
KENNECOTT UTAH COPPER CORPORATION	O	59 3991	APPLWDD	19621213	7.00000	S 150 E 2500 NWSL 3S 2W14	59
KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	19890915	0.89000	S 2664 E 683 NWSL 3S 2W17	59
KENNECOTT UTAH COPPER CORPORATION		59 609	APPLCERT	19480217	4.00000	S 698 E 1142 W4SL 3S 2W29	59
KENNECOTT UTAH COPPER CORPORATION		59 2750	UGWCDIS	19320815	0.02200	N 100 E 3334 SWSL 3S 2W 8	59
KENNECOTT UTAH COPPER CORPORATION		59 2065	UGWCCERT	18900000	1.50000	S 698 E 1142 W4SL 3S 2W29	59
KENNECOTT UTAH COPPER CORPORATION		59 2554	UGWCDIS	18960000	0.02200	S 375 E 380 NWSL 3S 2W27	59
KENNECOTT UTAH COPPER CORPORATION	O	59 1653	APPLCERT	19611121	4.00000	S 2347 E 1149 NWSL 3S 2W14	59
KENNECOTT UTAH COPPER CORPORATION	O	59 3991	APPLWDD	19621213	7.00000	N 100 E 100 SWSL 3S 2W13	59
KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	19940119	0.89000	S 2700 E 690 NWSL 3S 2W17	59
KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	19940119	0.89000	S 2664 E 683 NWSL 3S 2W17	59
KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	19950126	2.00000	S 100 E 250 NWSL 3S 2W27	59
KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	19920402	0.89000	S 2700 E 690 NWSL 3S 2W17	59
KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	19920402	0.89000	S 2664 E 638 NWSL 3S 2W17	59
KENNECOTT UTAH COPPER CORPORATION		59 3	APPLAPP	19970220	2.00000	S 3700 E 4250 NWSL 3S 2W16	59
KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	19890915	0.89000	S 2700 E 690 NWSL 3S 2W17	59
KENNECOTT UTAH COPPER CORPORATION		59 3	APPLAPP	19990205	3.00000	S 115 W 2634 NESL 3S 2W27	59
KENNWORTHY, EARL & BETTY	I	59 4644	APPLCERT	19780524	0.20000	N 1260 W 795 SESL 3S 1W 8	59
KERKMAN, FRED W.	DS	59 2817	UGWC	19290000	0.01100	S 150 E 912 NWSL 3S 1W 3	59
KIMBER, IRVIN GERALD	I	59 4559	APPLCERT	19770810	0.01500	S 304 E 751 W4SL 3S 1W14	59
KOCH, ROBERT	ID	59 4744	APPLCERT	19790823	0.01500	N 127 E 1473 SWSL 3S 1W 2	59
KOGIANES, JOHN G.	I S	59 1623	APPLCERT	19610711	0.50000	S 1310 W 680 E4SL 2S 1W34	59
KOGIANES, JOHN G.	ID	59 2430	UGWC	19150000	0.00900	S 490 W 145 E4SL 2S 1W34	59
KOURIS, ROSE G. AND MARY N.	ID	59 2350	UGWC	19030000	0.04500	N 155 W 1830 SESL 2S 1W27	59
KYRIOPOULOS, LOUISE	I	59 4503	APPLCERT	19770614	0.03500	S 1230 W 2065 E4SL 2S 1W33	59
LARSEN, GERALD	IDS	59 4838	APPLLAPD	19810813	0.01500	S 180 W 967 N4SL 3S 1W32	59
LARSEN, RONALD L.	IDS	59 4030	APPLCERT	19740402	0.01500	S 854 W 204 N4SL 3S 1W32	59
LARSEN, ROY L. AND AUDREY L.		59 2799	UGWCDIS	1890	0.01100	S 3027 E 140 N4SL 3S 1W27	59
LARSEN, TERRY AND LINDA LUZITANO	I	59 5546	APPLREJ	19961114	0.00000	S 1055 W 325 N4SL 3S 1W26	59
LARSON, STERLING B.	I S	59 1166	APPLCERT	19540817	1.00000	N 1296 E 44 S4SL 3S 1W11	59
LAWSON, WOODROW AND RUBY	IDS	59 4299	DIL	19340000	0.02700	N 1030 W 615 SESL 3S 1W 4	59
LDS CHURCH, CORPORATION OF THE PRESIDING BISHOP	I	59 1689	APPLUNAP	19630227	4.00000	S 55 W 1269 NESL 3S 1W20	59
LDS CHURCH, GRANT STAKE		59 2146	UGWCDIS	19190000	0.01100	N 185 E 404 W4SL 3S 1W21	59
LDS CHURCH, MILL CREEK STAKE, ATTN: H. D. LOWRY		59 2133	UGWCDIS	19200000	0.02700	S 3063 W 172 N4SL 3S 1W28	59
LEE, KEVIN M.	IDS	59 5390	FIXDAPP	19930412	0.01500	N 345 W 550 SESL 3S 2W33	59
LUCAS, FRED	IDS	57 8567	APPLLAPD	19810210	0.01500	S 950 W 1650 NESL 3S 1W20	57
LUCAS, GUSTAVE	S	59 3042	UGWC	19290000	0.03300	S 2510 W 1570 NESL 3S 1W20	59
MABEY, DANIEL L. AND ANN W.	ID	59 2168	UGWC	19171100	0.01300	S 2656 E 146 N4SL 3S 1W16	59

MACKAY, KEITH P.		59 4260	APPLLAPD	19760722	0.01500	N 870 E 420 S4SL 3S 2W33	59
MADSEN, ORVILLE	I S O	59 5054	APPLLAPD	19840702	0.01500	S 100 W 1000 NESL 3S 1W32	59
MADSEN, WAYNE AND MARION	ID	59 2274	UGWC	19110000	0.056	N 150 E 690 S4SL 2S 1W28	59
MAKRIS, GEORGE	S	59 2263	UGWC	18860000	0.02200	N 810 W 730 SESL 2S 1W27	59
MARSHALL, EARL F.		59 2410	UGWCLAPD	19310000	0.11100	S 1702 W 155 N4SL 3S 1W 4	59
MARTIN, MARK K.	IDS	59 4304	APPLCERT	19760723	0.01500	N 325 W 130 S4SL 3S 1W29	59
MASCARO, BOB	D	59 5068	APPLUNAP	19841016	0.20000	S 820 E 800 NWSL 3S 1W 8	59
MAURER, JACKSON S.	D	59 666	APPLNPR	19480830	0.01500	N 625 W 110 S4SL 3S 1W11	59
MAXFIELD, E. O. & ROSAMOND P.		59 2100	UGWCDIS	18930000	0.02200	S 2798 W 218 N4SL 3S 1W27	59
MAYNARD, THEODORE		59 2877	UGWCDIS	193007	0.00700	S 1879 W 5167 NESL 3S 1W15	59
MCALLISTER, LYLE D.	IDS	59 4941	APPLLAPD	19830330	0.04000	S 750 W 850 N4SL 3S 1W16	59
MCALLISTER, LYLE D.	IDS	59 4941	APPLLAPD	19830330	0.04000	S 200 W 850 N4SL 3S 1W16	59
MCCARTHY, CURTIS L. & CHARICE	IDS	59 3399	APPLCERT	19620918	0.01500	S 100 E 2430 W4SL 3S 1W29	59
MCDONALD, JULIUS M. AND IRENE S.	I S	59 3214	UGWC	19100000	0.01100	N 205 E 438 S4SL 2S 1W27	59
MCDOUGAL, DANIEL W.	IDS	59 2239	UGWC	18960000	0.02200	N 2730 E 800 SWSL 2S 1W26	59
MCDOUGAL, EDMUND L.		59 2398	UGWCDIS	18840000	0.06700	S 1075 E 2179 NWSL 3S 1W 2	59
MCGRATH, JERRY L. & PEGGY Z.	I S	59 5473	UGWC	1934	0.00000	S 1255 W 325 N4SL 3S 1W26	59
MCKEE, CLIFTON A.	IDS	59 2320	UGWC	19160000	0.00100	S 3955 W 130 N4SL 3S 1W16	59
MCMULLIN, CLELL V.	IDS	59 2269	UGWC	19311100	0.06700	N 2620 W 130 S4SL 3S 1W16	59
MCMULLIN, URBAN B. & VERDA H.	I	59 3080	UGWC	19000000	0.03300	S 1968 W 264 NESL 3S 1W15	59
MCQUEEN, NELSON L.	IDS	59 4940	APPLCERT	19830426	0.01500	S 335 W 1255 N4SL 3S 1W28	59
MECHAM, LAVERL (GENERAL PERSONAL REPRESENTATIVE)	I S	59 405	APPLNPR	19440518	0.01500	N 116 E 672 W4SL 3S 1W 2	59
MECHAM, LOUIS F.	IDS	59 5246	APPLLAPD	19871103	0.01500	S 240 E 750 NWSL 4S 2W 3	59
MIELKE, DWIGHT		59 3948	APPLLAPD	19730508	0.01500	N 1315 E 130 S4SL 3S 1W20	59
MITCHELL, ARTHUR O. AND LEVARA	I S	59 5233	APPLCERT	19870803	0.01300	N 1720 W 217 SESL 3S 2W34	59
MITCHELL, MARCUS		59 1869	UGWCDIS	1904	0.00200	S 1589 E 2820 NWSL 3S 1W14	59
MONTOYA, ALEX AND MARY L.		59 526	APPLDIS	19461126	0.01500	N 1025 E 195 S4SL 3S 2W33	59
MOOSMAN, GLEN	I	59 4404	APPLCERT	19770127	0.10000	N 1048 W 143 E4SL 3S 1W 4	59
MOOSMAN, GLEN	D	59 4953	APPLLAP	19900608	0.04500	N 1050 W 2500 E4SL 3S 1W 4	59
MURPHY, GUS	S	59 3746	UGWCLIT	19320000	0.02200	S 166 W 78 E4SL 3S 1W21	59
N. L. K. FAMILY TRUST	IDS	59 5387	UGWC	19000000	0.03300	S 1075 W 150 N4SL 3S 1W29	59
NAYLOR, BETTY G.	I	59 4747	UGWC	19030000	0.10000	N 825 E 500 SWSL 2S 1W35	59
NAYLOR, DEAN		59 2033	UGWCDIS	19111115	0.01500	S 2241 E 146 NWSL 3S 1W14	59
NAYLOR, HENRY W.		59 3997	APPLLAPD	19731030	0.01500	N 1000 W 520 S4SL 2S 1W33	59
NAYLOR, LARRY C.	I S	59 3982	APPLCERT	19730802	0.01500	N 230 W 1190 S4SL 3S 1W20	59
NAYLOR, ROBERT A. AND BERTHA	I	59 2288	UGWC	19020000	0.03300	S 2470 W 245 NESL 3S 1W10	59
NEFF, NELDON J. AND ELAINE	I	59 2290	UGWC	19200000	0.05600	S 65 W 143 N4SL 3S 1W28	59
NELSON, CHARLES R. AND ELLEN E.	I S	59 2972	UGWC	19200000	0.04500	N 944 W 200 E4SL 3S 1W 3	59
NELSON, HENRY		59 2293	UGWCDIS	19030000	0.06700	S 787 E 654 NWSL 3S 1W14	59
NEWSOME, RICHARD C. & RUTH H.	S	59 1940	UGWC	18960000	0.00400	N 1310 E 2412 SWSL 3S 1W11	59
NEWTON, WILLIAM D. AND LAVELL E.		59 2409	UGWCLAPD	19240800	0.01100	N 190 E 1012 SWSL 3S 1W28	59
NIELSEN, HENRY D.		59 3012	UGWCDIS	19100000	0.04500	S 4158 W 2879 NESL 3S 1W15	59
NIELSEN, LARRY M.		59 4451	APPLLAPD	19770324	0.06700	N 810 W 300 SESL 3S 1W 8	59
NIELSEN, T. JOHN (II)	ID	59 4742	APPLCERT	19790801	0.01500	S 1014 W 1937 E4SL 3S 1W21	59
NIELSEN, THOMAS J.	I	59 4741	APPLCERT	19790801	0.01500	S 1014 W 1937 E4SL 3S 1W21	59
NOGALES, RITO AND URVANA	I	59 2264	UGWC	19110000	0.04500	N 115 W 972 SESL 2S 1W27	59
NORTH JORDAN IRRIGATION COMPANY	I S	59 2460	UGWC	19290000	5.00000	N 2070 E 580 SWSL 2S 1W26	59
NORTH JORDAN IRRIGATION COMPANY		59 2453	UGWC	19290000	3.00000	N 810 W 730 SESL 2S 1W27	59
NORTH JORDAN IRRIGATION COMPANY	I S	59 2457	UGWC	19290000	3.50000	N 1580 E 530 SWSL 2S 1W26	59
NUZMAN, LESTER J.	I S	59 4842	APPLCERT	19810824	0.07000	N 404 E 165 SWSL 3S 1W 2	59
OAKESON, GLEN W. & MOANA C.	IDS	59 3871	APPLCERT	19720823	0.01500	N 723 W 214 S4SL 3S 1W29	59
OLSEN, CECIL A.	ID	59 4471	APPLCERT	19770503	0.01500	N 1541 E 489 S4SL 3S 1W29	59
OLSEN, JOHN H.	ID	59 641	APPLNPR	19480614	0.01500	S 1043 E 140 NWSL 3S 1W 2	59
OLSEN, JOHN H.	I	59 3336	DIL	19340000	0.06700	S 1068 E 60 NWSL 3S 1W 2	59
OPP, BARBARA K.		59 4622	APPLLAPD	19780313	0.05600	N 200 E 1040 S4SL 3S 1W17	59
ORME, GILBERT	IDS	59 5000	APPLLAPD	19840507	0.01500	N 1050 E 1500 SWSL 3S 1W22	59
ORTEGA, JOSEPH A. AND ZELMA M.	D	59 2967	UGWC	19250000	0.11100	S 330 E 1422 NWSL 2S 1W35	59

OWEN, LAVAWN R.	I	59 4107	APPLLAPD	19781204	2.00000	N 100 W 1200 SESL 3S 1W 8	59
PANDO, JACOB	I	59 2686	UGWC	19080000	0.02700	N 540 W 160 SESL 2S 1W33	59
PARRY, BLAINE B.		59 1744	APPLLAPD	19650316	0.01500	S 150 W 1420 N4SL 3S 1W29	59
PASCOE, ERWIN L. JR. AND BEATRICE	IDS	59 2683	UGWC	19240701	0.00200	S 1192 E 186 N4SL 3S 1W29	59
PATTERSON, REX	ID	59 3053	UGWC	19040000	0.02200	S 80 W 630 NESL 2S 1W34	59
PEASE, CECIL AND WILMA	IDS	59 4127	APPLCERT	19750325	0.01500	N 1435 E 1190 W4SL 3S 1W14	59
PEASE, JANICE	IDS	59 4912	APPLLAPD	19821007	0.04500	S 1120 E 870 NWSL 3S 1W14	59
PEINE, FRED	IDS	59 5228	APPLUNAP	19870529	0.05000	S 800 E 855 NWSL 3S 1W 4	59
PEINE, FRED	I S	59 3621	APPLLAPD	19700603	0.01500	S 800 E 855 NWSL 3S 1W 4	59
PERSCHON, A. ROBERT	IDS	59 4346	APPLCERT	19770103	0.02200	N 503 E 2361 W4SL 3S 1W10	59
PETERS, FRANK		59 3977	APPLLAPD	19730702	0.01500	N 1785 E 1180 SWSL 3S 1W20	59
PETERSEN, CRAIG	IDS	59 4325	APPLCERT	19761014	0.01500	S 635 E 177 NWSL 3S 1W29	59
PETERSEN, ROY C.	D	59 3263	UGWC	19310000	0.01500	S 1437 W 165 N4SL 3S 1W29	59
PETERSEN, ROY C.		59 2844	UGWCDIS	1927	0.02200	S 1420 W 158 N4SL 3S 1W29	59
PETERSON BROS.	IDS	59 3397	APPLUNAP	19660713	2.00000	S 1300 E 20 NWSL 3S 1W16	59
PETERSON, DONALD L. AND F. MILES		59 654	APPLDIS	19480722	0.01500	S 119 W 168 N4SL 3S 1W16	59
PETERSON, MRS. CLYDE	DS	59 3051	UGWC	19340000	0.04500	S 2536 W 280 NESL 3S 1W20	59
PETERSON, RODNEY K.	IDS	59 2298	UGWC	19140000	0.01100	S 1296 E 107 NWSL 3S 1W29	59
PETERSON, ROY G. AND BEVERLY L.	I S	59 2099	UGWC	18950000	0.00900	S 412 W 55 NESL 3S 1W10	59
PETTEGREW, DONALD E. AND MERLE J. WARDLE	IDS	57 8537	APPLLAPD	19800624	0.01500	N 410 W 1720 E4SL 3S 1W27	57
PHELPS, ORVAL K. & FLORENCE J.	ID	59 581	APPLNPR	19470729	0.01500	N 230 E 90 W4SL 3S 1W15	59
PHELPS, STEVEN D. & VICKI LIN	IDS	59 4055	APPLCERT	19740530	0.01500	S 1235 W 156 N4SL 3S 1W29	59
PHELPS, WILFORD E. & ISABELL	IDS	59 3769	UGWC	19300000	0.02200	S 987 W 150 N4SL 3S 1W29	59
PONT, DONALD E	I	59 5052	APPLCERT	19840622	0.01000	N 1084 E 186 SWSL 3S 1W14	59
POTOMAC CORPORATION	ID O	59 4436	APPLCERT	19770301	0.22000	S 180 W 664 NESL 2S 1W34	59
POWELL, KEITH L. AND MELVA J.	IDS	59 2034	UGWC	19290000	0.00400	S 1155 E 115 N4SL 3S 1W16	59
PRICE, JOHN L.	IDS	59 4813	APPLLAPD	19850520	0.13300	S 1260 E 200 N4SL 3S 1W 4	59
PULLEY, HARVEY	I	59 5311	APPLLAP	19760719	0.05700	N 200 W 1100 E4SL 3S 1W 5	59
PULLEY, HARVEY	IDS	59 4259	APPLCERT	19760719	0.04300	N 251 W 1127 E4SL 3S 1W 5	59
PUZEY, NAD	IDS	59 4786	APPLLAPD	19860812	0.01500	S 700 E 2200 NWSL 3S 1W26	59
QUILTER, JAMES O. & VIRGINIA A.	ID	59 1263	APPLNPR	19560521	0.01500	N 1687 W 200 S4SL 3S 1W28	59
QUILTER, JAMES O. AND VIRGINIA R.	DS	59 2846	UGWC	19160000	0.02700	N 445 W 620 S4SL 2S 1W35	59
RADMALL, GLEN		59 638	APPLDIS	19480604	0.01500	S 49 E 75 NWSL 3S 1W 2	59
RASMUSSEN, BRENT K.	IDS	59 4338	APPLCERT	19761123	0.01500	N 394 W 1980 E4SL 3S 1W27	59
RASMUSSEN, CLYDE & ILA R.	I	59 4286	DIL	19340000	2.50000	S 1068 E 60 NWSL 3S 1W 2	59
RASMUSSEN, CLYDE AND ILA R.	IDS	59 2361	UGWC	19030000	0.00400	S 520 E 1000 NWSL 3S 1W 2	59
RASMUSSEN, KENNETH P. & ELSIE S.	IDS	59 4771	APPLCERT	19801008	0.01500	N 327 W 223 S4SL 3S 1W20	59
RASMUSSEN, TRAVIS & BEA	IDS	59 3817	APPLCERT	19710803	0.01500	N 965 W 202 S4SL 3S 1W20	59
REID, JOHN A AND NOLA M.	ID	59 2292	UGWC	19030000	0.04500	N 1906 E 150 SWSL 3S 1W11	59
REID, JOHN A.	I S	59 4417	APPLCERT	19770216	0.20500	S 1137 E 163 W4SL 3S 1W11	59
RICE, KENNETH F. (JR.)	IDS	59 4079	APPLCERT	19740815	0.01500	N 292 E 760 SWSL 3S 1W20	59
RICE, KENNETH F. (JR.) & DIANA M.	IDS	59 4330	APPLLAPD	19840504	0.01500	N 300 E 720 SWSL 3S 1W20	59
RICHARDS, STUART H.	D	59 2862	UGWC	19090000	0.00600	S 1029 W 208 N4SL 3S 1W 3	59
RICHARDSON, DUANE G.	IDS	59 4753	APPLCERT	19791023	0.01500	S 825 E 155 N4SL 3S 1W 2	59
RICHARDSON, DUANE G. (TRUSTEE, RICHARDSON FAMILY T.)	DS	59 3005	UGWC	19080000	0.00700	S 760 E 140 N4SL 3S 1W 2	59
RICHINS, MARY ANN	IDS	59 3464	UGWC	18960000	0.02200	N 865 W 315 E4SL 2S 1W34	59
RIVERTON (CITY OF)	C	59 1554	APPLAPP	19960412	1.50000	S 320 W 122 NESL 3S 1W31	59
RIVERTON CITY	C	59 1533	APPLAPP	19950103	5.00000	N 113 W 786 NESL 3S 1W32	59
RIVERTON CITY	C	59 1118	APPLUNAP	19620623	2.00000	S 320 W 122 NESL 3S 1W31	59
RIVERTON CITY CORPORATION	C	59 1534	APPLCERT	19590804	5.00000	S 320 W 122 NESL 3S 1W31	59
RIVERTON CITY CORPORATION	C	59 1189	APPLCERT	19540913	2.46000	S 320 W 122 NESL 3S 1W31	59
ROBBINS, GOLDEN W.	I S	59 1770	DIL	18730000	0.50000	N 1620 W 250 S4SL 3S 1W14	59
ROBERTS, FRANK C. AND JACQUELINE	I S	59 3926	APPLCERT	19730514	0.10000	N 636 E 39 S4SL 2S 1W34	59
ROBERTS, G. ELDON		59 1930	UGWCDIS	1906	0.056	S 1280 W 140 N4SL 2S 1W28	59
ROBERTSON, DOUGLAS AND BETH	IDS	59 4091	APPLLAPD	19741007	0.01500	S 1262 W 190 N4SL 3S 1W29	59
ROWE, GLENN N. & MELODY A.	I	59 5001	APPLCERT	19840507	0.01500	S 340 W 1226 NESL 3S 1W16	59
RUSHTON, CLINTON V. & JOAN R.	I	59 4908	APPLCERT	19820902	0.01500	S 205 E 218 W4SL 3S 1W14	59

RUSHTON, DONALD	ID O	59 3417	APPLUNAP	19670112	3.00000	N 800 E 200 SWSL 3S 1W17	59
RUSSELL, CARL		59 1277	APPLDIS	19560717	0.01500	S 715 W 161 N4SL 3S 1W 4	59
RUSSELL, CARL		59 1307	APPLDIS	19570328	0.01500	S 690 W 70 N4SL 3S 1W 4	59
SALT LAKE COUNTY	I	59 5425	APPLAPP	19940302	2.00000	S 1195 W 1280 NESL 3S 1W 4	59
SALT LAKE COUNTY	I	59 5179	APPLAPP	19920415	2.00000	S 970 W 1265 NESL 3S 1W 4	59
SALT LAKE COUNTY	I	59 5179	APPLAPP	19860611	2.00000	S 970 W 1265 NESL 3S 1W 4	59
SALT LAKE COUNTY	O	59 2368	UGWC	18960000	0.02700	N 2 E 750 S4SL 2S 1W33	59
SALT LAKE COUNTY	I	59 5425	APPLAPP	19940302	2.00000	S 970 W 1265 NESL 3S 1W 4	59
SALT LAKE COUNTY C/O BILL DUNN MTN. VIEW GOLF COURSE		59 1972	UGWCDIS	1909	0.00900	N 320 E 1100 S4SL 2S 1W33	59
SALT LAKE COUNTY RECREATION DEPARTMENT		59 3090	UGWCDIS	18900000	0.03300	S 429 W 820 NESL 3S 1W 4	59
SALT LAKE COUNTY, REAL ESTATE DIVISION, FINANCE DEPT.		59 2816	UGWCDIS	1907	0.01100	N 800 E 132 W4SL 3S 1W22	59
SAVAGE, EARL & CHRISTINE	IDS	59 4935	APPLLAPD	19830331	0.01500	S 240 E 420 NWSL 4S 2W 2	59
SCHMIDT TRUST, HENRY F.	I	59 5312	APPLREJ	19890621	0.14900	N 2640 W 1100 S4SL 3S 1W 3	59
SCHMIDT, DARLENE (C/O MABLE JENKINS)	IDS	59 4833	APPLLAPD	19810728	0.03000	S 800 E 960 W4SL 3S 1W 3	59
SCHMIDT, HENRY F.	I	59 4258	APPLAPP	19921217	0.25000	N 2640 W 1100 S4SL 3S 1W 3	59
SCHMIDT, HENRY F.	I	59 4258	APPLAPP	19921217	0.25000	N 870 W 455 S4SL 3S 1W 3	59
SCHMIDT, HENRY F.	I	59 5126	APPLAPP	19850626	0.75000	N 2640 W 1100 S4SL 3S 1W 3	59
SCHMIDT, HENRY F.	I	59 4258	APPLAPP	19921217	0.25000	N 875 W 470 S4SL 3S 1W 3	59
SCHMIDT, HENRY F.	I	59 4258	APPLAPP	19921217	0.25000	N 865 W 455 S4SL 3S 1W 3	59
SCHMIDT, HENRY F.	I	59 4258	APPLAPP	19921217	0.25000	N 875 W 460 S4SL 3S 1W 3	59
SCHMIDT, HENRY F.		59 3811	APPLLAPD	19710625	0.50000	N 1300 W 1000 S4SL 3S 1W 3	59
SCHMIDT, HENRY F.	I	59 4258	APPLAPP	19921217	0.25000	N 865 W 460 S4SL 3S 1W 3	59
SCHMIDT, HENRY F. (TRUST)		59 4258	APPLAPP	19921217	0.25000	N 865 W 455 S4SL 3S 1W 3	59
SCHMIDT, HENRY F. (TRUST)		59 4258	APPLAPP	19921217	0.25000	N 875 W 460 S4SL 3S 1W 3	59
SCHMIDT, HENRY F. (TRUST)		59 4258	APPLAPP	19921217	0.25000	N 865 W 460 S4SL 3S 1W 3	59
SCHMIDT, HENRY F. (TRUST)		59 4258	APPLAPP	19921217	0.25000	N 870 W 455 S4SL 3S 1W 3	59
SCHMIDT, HENRY F. (TRUST)		59 4258	APPLAPP	19921217	0.25000	N 875 W 470 S4SL 3S 1W 3	59
SCHMIDT, JOSEPH J.	I	59 1198	APPLCERT	19541108	5.00000	N 110 E 41 W4SL 3S 1W 9	59
SCHMIDT, JOSEPH J.	I	59 1613	APPLCERT	19610605	1.07000	N 110 E 41 W4SL 3S 1W 9	59
SCHMIDT, PAUL D.	ID	59 2553	UGWC	19040000	0.01800	N 1120 W 156 S4SL 3S 1W 3	59
SCHMIDT, PAUL D.	IDS	59 2136	UGWC	19000000	0.20000	N 1768 W 170 S4SL 3S 1W 3	59
SCHORR, WILLIAM H.	I S	59 2724	UGWC	19291000	0.011	S 75 W 220 E4SL 2S 1W29	59
SCHOUDEL, JAMES E. AND SANDRA	IDS	59 5089	APPLLAPD	19850326	0.01500	N 343 W 551 SESL 3S 2W33	59
SCHOUTEN, LARRY J.	ID	59 4901	APPLCERT	19820728	0.01500	N 765 E 2482 W4SL 3S 1W29	59
SCHOUTEN, SHERRILL J.	IDS	59 3869	APPLCERT	19720811	0.01500	S 340 E 790 NWSL 3S 1W29	59
SCIUTO, STEVEN	IDS	59 4244	APPLCERT	19760622	0.01500	N 1809 E 1021 S4SL 3S 1W29	59
SEAL, EMMA V.	IDS	59 764	APPLNPR	19490922	0.01500	S 1000 E 105 N4SL 3S 1W32	59
SEEGRIST, ROGER	D	59 4788	APPLLAPD	19810122	0.01500	N 920 E 790 W4SL 3S 1W11	59
SHARP, YOUNG		59 2687	UGWCDIS	19290000	0.00000	S 860 E 220 N4SL 3S 1W 3	59
SHULSEN, ERMA T.		59 1592	APPLDIS	19610327	0.10000	N 747 W 220 S4SL 2S 1W34	59
SHULSEN, LARKEN H.	I S	59 2343	UGWC	19080000	0.01100	S 425 E 200 N4SL 2S 1W34	59
SIMMONS, KENNETH M. & ONEITA P.		59 3122	UGWCDIS	19300000	0.01100	S 2543 W 648 NESL 3S 1W20	59
SIMPSON, ROBERT L.	IDS	59 3816	APPLCERT	19710727	0.01500	N 343 W 551 SESL 3S 2W33	59
SMITH, ALVIN R. AND SANDRA H.		59 3902	APPLLAPD	19791101	0.01500	N 2200 E 1400 SWSL 3S 1W20	59
SMITH, CLINTON E. AND ALMEDA H.		59 2713	UGWCDIS	1900	0.500	S 835 W 580 NWSL 2S 1W28	59
SMITH, F. E.	IDS	59 2037	UGWC	19080000	0.02200	N 1600 W 575 S4SL 3S 1W22	59
SMITH, JOHN W.	IDS	59 569	APPLNPR	19470515	0.01500	N 600 E 90 W4SL 3S 1W 2	59
SOFFE, VAUGHN C.	ID	59 2396	UGWC	19080000	0.04500	S 2211 E 2879 NWSL 3S 1W14	59
SORENSON, RUSSELL	IDS	59 4982	APPLCERT	19840206	0.01500	S 1005 E 1860 NWSL 3S 1W26	59
SOUTH JORDAN CITY	C	59 5170	APPLUNAP	19860411	3.00000	N 200 W 2400 SESL 3S 2W23	59
SOUTH JORDAN CITY	C	59 5171	APPLUNAP	19860411	3.00000	N 200 E 2800 SWSL 3S 2W24	59
SOUTH JORDAN CITY	C	59 5169	APPLUNAP	19860411	3.00000	S 200 E 200 NWSL 3S 1W10	59
SOUTH JORDAN, CITY OF	C	59 5152	APPLUNAP	19851210	3.50000	S 400 W 50 E4SL 3S 1W10	59
SOUTH JORDAN, CITY OF	C	59 5152	APPLUNAP	19851210	3.50000	N 1540 W 640 SESL 3S 1W10	59
SOUTH JORDAN, CITY OF	C	59 5152	APPLUNAP	19851210	3.50000	N 1540 E 920 S4SL 3S 1W10	59
SOUTH JORDAN, TOWN OF	I	59 1001	APPLCERT	19540608	0.50000	N 320 E 666 W4SL 3S 1W14	59
SOUTH VALLEY WATER RECLAMATION FACILITY	O	59 5108	APPLCERT	19850614	0.01500	N 100 W 2100 SESL 3S 2W21	59

SOUTH VALLEY WATER RECLAMATION FACILITY			APPLWDD	19840309	0.00000	N 1840 W 166 E4SL 3S 2W21	
SOUTHERN PACIFIC TRANSPORTATION COMPANY		59 2675	UGWCDIS	19090000	0.06700	S 3404 E 422 N4SL 3S 1W 6	59
SOUTHERN PACIFIC TRANSPORTATION COMPANY		59 2676	UGWCDIS	19090000	0.06700	S 3445 E 448 N4SL 3S 1W 6	59
SOUTHWIRE COMPANY	I O	59 4831	APPLLAPD	19810721	1.00000	S 720 W 674 NESL 3S 1W 5	59
SPIERS, LORAINE T. AND GARTH	IDS	59 5122	APPLLAP	19850619	0.01500	S 80 E 855 W4SL 3S 1W29	59
SPOERRI, AUGUST F.	ID	59 5305	APPLLAP	19900821	0.01500	N 810 W 300 SESL 3S 1W 8	59
SPRATLING, JOHN	DS	59 2685	UGWC	19260000	0.02700	S 1628 W 120 NESL 3S 1W 9	59
SPRATLING, JOHN	I	59 1636	APPLCERT	19610822	0.15500	N 181 E 33 S4SL 3S 1W 4	59
SPRATLING, JOHN	I	59 1637	APPLCERT	19610822	0.63400	N 2640 W 33 S4SL 3S 1W 9	59
STALLINGS, DON	IDS	59 4848	APPLCERT	19810902	0.01500	S 175 W 1475 E4SL 3S 1W22	59
STALLINGS, REX	IDS	59 4847	APPLLAPD	19810901	0.01500	S 130 W 1550 E4SL 3S 1W22	59
STATE OF UTAH DEPARTMENT OF TRANSPORTATION		59 2084	UGWCDIS	19300700	0.01100	N 354 W 2624 SESL 3S 1W20	59
STATE OF UTAH DIVISION OF PARKS & RECREATION	I	59 1078	APPLCERT	19530213	2.00000	N 412 E 35 SWSL 3S 1W14	59
STEINFELDT, MARLIN J. AND DORALYN M.	ID	59 2741	UGWC	19110000	0.013	N 950 E 170 S4SL 2S 1W28	59
STRATTON, FRANCES E. AND REED J.	I S	59 3949	APPLCERT	19730514	0.10000	N 636 E 39 S4SL 2S 1W34	59
STROH, KIMBERLY S.	IDS	59 5333	FIXDLAP	19911008	0.01500	S 660 W 1900 E4SL 3S 2W34	59
SULLIVAN, DOUGLAS AND ILEAN	IDS	59 4636	APPLCERT	19780424	0.01500	N 1155 E 1390 SWSL 3S 1W22	59
TATEOKA, MATT	I	59 1176	APPLCERT	19540726	2.62000	N 35 E 35 SWSL 3S 1W 9	59
TATEOKA, MATT	I	59 1620	APPLCERT	19610627	3.49000	N 35 E 35 SWSL 3S 1W 9	59
TAYLOR, FRANK L.	DS	59 2829	UGWC	19030000	0.01100	S 80 E 1345 NWSL 3S 1W 2	59
TAYLOR, FRANK L.	DS	59 2830	UGWC	19030000	0.01100	S 118 E 1728 NWSL 3S 1W 2	59
TAYLOR, JOYCE M.	IDS	59 3879	APPLCERT	19541117	0.43700	S 662 E 44 NWSL 4S 2W 3	59
TESCH, ARDEN		59 2052	UGWCDIS	19210000	0.033	N 910 W 110 SESL 2S 1W29	59
TESCH, WILLIAM H. AND BARBARA J.		59 1800	UGWCDIS	1914	0.013	N 1370 W 130 S4SL 2S 1W28	59
THACKER, O. J.	D	59 1855	UGWC	19090000	0.027	S 2230 W 190 N4SL 2S 1W28	59
THOMETZ, LOEL	ID	59 4845	APPLLAPD	19810824	0.01500	N 600 W 1610 E4SL 3S 1W16	59
THOMPSON, MAX	IDS	59 1723	APPLCERT	19640328	0.05700	S 3308 E 130 N4SL 3S 1W29	59
THOMPSON, SHONNA F.	ID	59 5219	APPLLAPD	19870409	0.01500	N 40 W 1905 E4SL 3S 1W27	59
THORNE, RONALD H.	I	59 1627	APPLCERT	19610717	2.98000	S 810 W 1295 N4SL 3S 1W28	59
TIDWELL, BERT ALLEN	IDS	59 4054	APPLCERT	19740524	0.01500	N 875 E 1089 SWSL 3S 1W20	59
TISCHNER, PAUL R.	IDS	59 4825	APPLLAPD	19810617	0.01500	N 1030 W 2310 E4SL 3S 1W16	59
TODD, MAURINE	IDS	59 3643	UGWC	19710221	0.015	S 2045 W 495 NESL 2S 1W29	59
TOLBERT, CLINTON BERNELL	IDS	59 3842	APPLLAPD	19720419	0.50000	N 335 W 900 SESL 3S 2W12	59
TOLBERT, CLINTON BERNELL AND CONNIE (TRUST)	IDS	59 5316	FIXDAPP	19901203	0.01500	N 335 W 900 SESL 3S 2W12	59
TOLBERT, CLINTON BERNELL AND CONNIE (TRUST)	IDS	59 5315	APPLREJ	19901203	0.50000	N 335 W 900 SESL 3S 2W12	59
TRIMBLE, CUTHBERT J.	I S	59 3262	UGWC	19000000	1.74000	N 355 E 2060 SWSL 3S 1W 2	59
TRIMBLE, CUTHBERT J.	IDS	59 2557	UGWC	19030000	0.08900	N 1745 E 1482 SWSL 3S 1W 2	59
TRIMBLE, CUTHBERT J.	I	59 3786	UGWC	19030000	0.50000	N 1060 E 968 SWSL 3S 1W 2	59
TRIMBLE, CUTHBERT J.	D	59 3784	UGWC	19030000	0.01300	N 1020 E 1760 SWSL 3S 1W 2	59
TRIMBLE, CUTHBERT J.	I	59 3787	UGWC	19030000	1.74000	N 830 E 1365 SWSL 3S 1W 2	59
TRUJILLO FAMILY TRUST	S	59 5394	APPLAPP	19930430	0.01500	S 30 W 520 NESL 3S 1W10	59
TURNER, FRANK P.	IDS	59 5547	FIXDAPP	19961121	0.00000	N 764 W 80 SESL 3S 2W33	59
TURNER, LARRY J.		59 5524	APPLWD	19961121	0.00000	N 764 W 80 SESL 3S 2W33	59
TURNER, LARRY J.	ID	59 4477	APPLCERT	19770510	0.01500	N 764 W 80 SESL 3S 2W33	59
TURNER, LARRY J.	ID	59 5524	FIXDAPP	19960314	0.00000	N 964 W 180 SESL 3S 2W33	59
VANLEUVEN, E. WAYNE & LUCRECIA C.	I	59 5102	APPLAPP	19890619	0.05400	N 65 W 777 SESL 3S 1W 9	59
VANSLEEUWEN, CON	ID	59 5173	APPLLAPD	19860429	0.01500	S 450 W 1700 E4SL 3S 2W34	59
VANSLEEUWEN, CON AND HENNIE	IDS	59 4871	APPLLAPD	19820112	0.01500	S 450 W 1700 E4SL 3S 2W34	59
VANSLEEUWEN, PAUL R. & JOLEN	IDS	59 4863	APPLLAPD	19811117	0.01500	S 450 W 1700 E4SL 3S 2W34	59
VANSLEEUWEN, RONALD & JANET	IDS	59 4877	APPLLAPD	19820330	0.01500	S 450 W 1700 E4SL 3S 2W34	59
WALKER, ARLENE D.		59 2163	UGWCDIS	19280500	0.00900	S 3006 E 158 N4SL 3S 1W28	59
WALKER, E. R.	ID	59 4837	APPLLAPD	19810804	0.01500	N 340 E 1350 W4SL 3S 1W11	59
WALKER, GEORGE J.	I	59 1610	APPLCERT	19610526	1.56000	S 1105 W 710 N4SL 3S 2W35	59
WALKER, JOHN	I S	59 4123	APPLCERT	19750306	0.03200	N 1507 W 233 SESL 2S 1W27	59
WALKER, LYNN	I	59 5244	APPLCERT	19870923	0.01500	N 721 E 419 W4SL 3S 1W 8	59
WARREN, DEAN T.	I S	59 4723	APPLCERT	19790508	0.02100	S 772 W 284 NESL 3S 1W 3	59
WELLS, D. DEAN	IDS	59 3565	APPLCERT	19680715	0.01500	N 265 E 805 S4SL 3S 1W17	59

WELLS, NAOMI G.		59 2542	UGWCDIS	19000000	0.01100	S 2340 E 149 NWSL 3S 1W11	59
WEST JORDAN, CITY OF		59 1299	APPLREJD	19570123	0.00000	W 100 E4SL 3S 1W 7	59
WEST JORDAN, CITY OF	C	59 1572	APPLAPP	19600714	1.00000	S 200 E 1500 NWSL 2S 1W35	59
WEST JORDAN, CITY OF		59 1298	APPLREJD	19570123	2.50000	N 500 E 2050 SWSL 3S 1W 2	59
WEST JORDAN, CITY OF		59 2883	UGWCDIS	1934	0.22000	S 660 E 85 NWSL 2S 1W35	59
WEST JORDAN, CITY OF	I	59 3009	UGWC	19100000	0.01100	S 1275 W 530 NESL 2S 1W34	59
WHELWRIGHT, DAVID A. AND MAVIS G.	I	59 5101	APPLAPP	19850506	0.05400	N 65 W 777 SESL 3S 1W 9	59
WILCOX, LORETTA	IDS	59 5074	APPLCERT	19880809	0.01500	S 1471 W 151 NESL 3S 1W30	59
WILCOX, WALTER C AND NELLIE S.	S	59 2641	UGWC	19040000	0.00700	N 1385 E 150 W4SL 3S 1W 2	59
WILEY, ROBERT G.	ID	59 5229	APPLCERT	19870612	0.01500	N 117 W 286 SESL 3S 1W 9	59
WILKINSON, RICHARD AND ROMONA		59 2131	UGWCDIS	19200000	0.02200	N 255 W 105 E4SL 3S 1W21	59
WILLIAMSON, KENNETH HAROLD	I	59 1716	APPLUNAP	19640213	0.25000	N 300 W 779 E4SL 3S 1W21	59
WITHERSPOON, JAMES R.	DS	59 1180	APPLCERT	19540804	0.01500	N 1188 E 291 S4SL 3S 2W33	59
WITHERSPOON, JAMES R.	IDS	59 5324	APPLAPP	19910416	0.01500	N 1110 E 655 S4SL 3S 2W33	59
WOODS, THOMAS C. AND NELL (JR.)	IDS	59 1011	APPLNPR	19520421	0.01500	S 70 E 10 W4SL 3S 1W21	59
YARBERRY, AFTON L.	I S	59 3619	APPLLAPD	19700513	0.01500	S 1160 W 835 N4SL 3S 1W16	59
YATES, J. MAC AND GLORIA RUTH	I S	59 5059	APPLCERT	19840726	0.06700	N 962 W 584 SESL 3S 1W 9	59
YERGENSEN, R. L.	I	59 4356	DIL	1903	4.00000	N 1755 E 1655 W4SL 3S 1W11	59
YOUNG, PARLEY A.		59 2467	UGWCDIS	19050000	0.13000	N 1017 E 153 W4SL 3S 1W14	59

Sorted by priority date

PRIORITY	OWNER	USES	WRNUM	STATUS	FLOW (CFS)	LOCATION	AREA_CODE
18730000	ROBBINS, GOLDEN W.	I S	59 1770	DIL	0.50000	N 1620 W 250 S4SL 3S 1W14	59
18840000	MCDOUGAL, EDMUND L.		59 2398	UGWCDIS	0.06700	S 1075 E 2179 NWSL 3S 1W 2	59
18860000	MAKRIS, GEORGE	S	59 2263	UGWC	0.02200	N 810 W 730 SESL 2S 1W27	59
1890	LARSEN, ROY L. AND AUDREY L.		59 2799	UGWCDIS	0.01100	S 3027 E 140 N4SL 3S 1W27	59
18900000	SALT LAKE COUNTY RECREATION DEPARTMENT		59 3090	UGWCDIS	0.03300	S 429 W 820 NESL 3S 1W 4	59
18900000	KENNECOTT UTAH COPPER CORPORATION		59 2065	UGWCCERT	1.50000	S 698 E 1142 W4SL 3S 2W29	59
18920000	GARDNER, JOHN R. AND EDWIN F.	D	59 2526	UGWC	0.00900	N 525 E 300 SWSL 2S 1W35	59
18930000	MAXFIELD, E. O. & ROSAMOND P.		59 2100	UGWCDIS	0.02200	S 2798 W 218 N4SL 3S 1W27	59
18940000	AFCO DEVELOPMENT COMPANY		59 2282	UGWCDIS	0.02200	N 1270 W 682 SWSL 3S 1W 7	59
18950000	PETERSON, ROY G. AND BEVERLY L.	I S	59 2099	UGWC	0.00900	S 412 W 55 NESL 3S 1W10	59
18960000	GAILEY, GRACE E.		59 2283	UGWCDIS	0.01100	N 2282 E 1975 SWSL 3S 1W11	59
18960000	GREENWOOD, MARK H.	IDS	59 2147	UGWC	0.02200	N 865 W 315 E4SL 2S 1W34	59
18960000	SALT LAKE COUNTY	O	59 2368	UGWC	0.02700	N 2 E 750 S4SL 2S 1W33	59
18960000	KEMP, KAY F.		59 3796	UGWC	0.02200	N 865 W 315 E4SL 2S 1W34	59
18960000	RICHINS, MARY ANN	IDS	59 3464	UGWC	0.02200	N 865 W 315 E4SL 2S 1W34	59
18960000	KENNECOTT UTAH COPPER CORPORATION		59 2554	UGWCDIS	0.02200	S 375 E 380 NWSL 3S 2W27	59
18960000	NEWSOME, RICHARD C. & RUTH H.	S	59 1940	UGWC	0.00400	N 1310 E 2412 SWSL 3S 1W11	59
18960000	MCDOUGAL, DANIEL W.	IDS	59 2239	UGWC	0.02200	N 2730 E 800 SWSL 2S 1W26	59
18990000	JENSEN AND WILKINSON INCORPORATED	I S	59 2607	UGWC	0.02200	S 5050 W 280 NESL 3S 1W15	59
18990000	GOECKERITZ, RUDOLPH E. & DENISE	I S	59 4027	UGWC	1.16000	N 400 W 650 S4SL 3S 1W 2	59
18990000	BECKSTEAD, EDWARD B.		59 2589	UGWCDIS	0.02200	S 1207 W 166 NESL 3S 1W27	59
18990000	CARTER, JAMES W.		59 2644	UGWCDIS	0.007	S 135 W 2050 N4SL 2S 1W28	59
1900	SMITH, CLINTON E. AND ALMEDA H.		59 2713	UGWCDIS	0.500	S 835 W 580 NWSL 2S 1W28	59
1900	GEDGE, NATHAN R. AND GRACE		59 2952	UGWCDIS	0.06600	S 1525 W 250 NESL 3S 1W10	59
19000000	SCHMIDT, PAUL D.	IDS	59 2136	UGWC	0.20000	N 1768 W 170 S4SL 3S 1W 3	59
19000000	MCMULLIN, URBAN B. & VERDA H.	I	59 3080	UGWC	0.03300	S 1968 W 264 NESL 3S 1W15	59
19000000	FULLMER, GENE L. & DELORES H.	I S	59 4364	UGWC	0.50000	N 1785 E 1578 W4SL 3S 1W11	59
19000000	IWAMOTO, TAKEO		59 2552	UGWCDIS	0.02200	S 100 W 186 N4SL 3S 1W10	59
19000000	WELLS, NAOMI G.		59 2542	UGWCDIS	0.01100	S 2340 E 149 NWSL 3S 1W11	59
19000000	JONES, MERLIN H.	DS	59 2842	UGWC	0.02200	S 180 E 105 W4SL 3S 1W 3	59
19000000	TRIMBLE, CUTHBERT J.	I S	59 3262	UGWC	1.74000	N 355 E 2060 SWSL 3S 1W 2	59
19000000	N. L. K. FAMILY TRUST	IDS	59 5387	UGWC	0.03300	S 1075 W 150 N4SL 3S 1W29	59
19010000	ANDERSON, MAX W. AND MAURINE M.		59 2524	UGWCDIS	0.03300	N 1370 E 174 SWSL 3S 1W11	59
1902	HOLT, ALMA M.		59 1987	UGWCDIS	0.01100	S 1420 W 170 NESL 3S 1W15	59
19020000	NAYLOR, ROBERT A. AND BERTHA	I	59 2288	UGWC	0.03300	S 2470 W 245 NESL 3S 1W10	59
19020000	FORMAN, STANFORD M.		59 2681	UGWCDIS	0.22300	S 1458 W 140 NESL 3S 1W16	59
19020000	DICK, JAMES	I S	59 2815	UGWC	0.02200	N 600 E 145 SWSL 2S 1W35	59
1903	CHAVEZ, TONY A.	I	59 4280	DIL	4.00000	N 1380 E 1665 W4SL 3S 1W11	59
1903	JEPPSEN, BRUCE	I	59 4355	DIL	4.00000	N 1755 E 1655 W4SL 3S 1W11	59
1903	JEPPSEN, BRUCE	I	59 4254	DIL	0.40000	N 595 E 460 W4SL 3S 1W11	59
1903	YERGENSEN, R. L.	I	59 4356	DIL	4.00000	N 1755 E 1655 W4SL 3S 1W11	59
1903	CHAVEZ, TONY A,	I	59 4357	DIL	4.00000	N 1755 E 1655 W4SL 3S 1W11	59
1903	BROWN, LULA		59 1951	UGWCDIS	0.02700	N 1445 W 220 SESL 2S 1W27	59
19030000	TRIMBLE, CUTHBERT J.	I	59 3787	UGWC	1.74000	N 830 E 1365 SWSL 3S 1W 2	59
19030000	GARDNER, JOHN R. AND EDWIN F.	I S	59 2525	UGWC	2.00000	N 1600 E 35 SWSL 2S 1W35	59
19030000	TRIMBLE, CUTHBERT J.	I	59 3786	UGWC	0.50000	N 1060 E 968 SWSL 3S 1W 2	59
19030000	NAYLOR, BETTY G.	I	59 4747	UGWC	0.10000	N 825 E 500 SWSL 2S 1W35	59
19030000	TRIMBLE, CUTHBERT J.	IDS	59 2557	UGWC	0.08900	N 1745 E 1482 SWSL 3S 1W 2	59
19030000	JORDAN, DEAN L. III AND ROXANE D.	I	59 1953	UGWC	0.22300	N 2115 W 220 SESL 2S 1W27	59
19030000	RASMUSSEN, CLYDE AND ILA R.	IDS	59 2361	UGWC	0.00400	S 520 E 1000 NWSL 3S 1W 2	59
19030000	TRIMBLE, CUTHBERT J.	D	59 3784	UGWC	0.01300	N 1020 E 1760 SWSL 3S 1W 2	59
19030000	KOURIS, ROSE G. AND MARY N.	ID	59 2350	UGWC	0.04500	N 155 W 1830 SESL 2S 1W27	59
19030000	BOARD OF EDUCATION (JORDAN SCHOOL DISTRICT)		59 2003	UGWCDIS	0.01100	N 112 W 420 SESL 2S 1W33	59
19030000	FULLMER, GENE L. & DELORES H.	I S	59 4363	UGWC	1.00000	N 1755 E 1655 W4SL 3S 1W11	59

19030000	TAYLOR, FRANK L.	DS	59 2829	UGWC	0.01100	S 80 E 1345 NWSL 3S 1W 2	59
190300C0	TAYLOR, FRANK L.	DS	59 2830	UGWC	0.01100	S 118 E 1728 NWSL 3S 1W 2	59
19030000	NELSON, HENRY		59 2293	UGWCDIS	0.06700	S 787 E 654 NWSL 3S 1W14	59
19030000	REID, JOHN A AND NOLA M.	ID	59 2292	UGWC	0.04500	N 1906 E 150 SWSL 3S 1W11	59
1904	MITCHELL, MARCUS		59 1869	UGWCDIS	0.00200	S 1589 E 2820 NWSL 3S 1W14	59
19040000	PATTERSON, REX	ID	59 3053	UGWC	0.02200	S 80 W 630 NESL 2S 1W34	59
19040000	BIGLER, LOUIS B.		59 2045	UGWCDIS	0.01800	S 340 W 198 NESL 3S 1W 3	59
19040000	BOARD OF EDUCATION (JORDAN SCHOOL DISTRICT)		59 2491	UGWCDIS	0.04500	S 466 W 352 E4SL 3S 1W 3	59
19040000	SCHMIDT, PAUL D.	ID	59 2553	UGWC	0.01800	N 1120 W 156 S4SL 3S 1W 3	59
19040000	WILCOX, WALTER C AND NELLIE S.	S	59 2641	UGWC	0.00700	N 1385 E 150 W4SL 3S 1W 2	59
19050000	YOUNG, PARLEY A.		59 2467	UGWCDIS	0.13000	N 1017 E 153 W4SL 3S 1W14	59
19050000	FINLAYSON, MAX A.		59 2414	UGWCDIS	0.009	N 775 E 805 SWSL 2S 1W28	59
19050000	CASH, LAVON ISAKSON		59 2608	UGWCDIS	0.01100	S 2464 E 1558 NWSL 3S 1W14	59
1906	ROBERTS, G. ELDON		59 1930	UGWCDIS	0.056	S 1280 W 140 N4SL 2S 1W28	59
19060000	DIXIE SIX CORPORATION		59 2281	UGWCDIS	0.04500	N 187 W 1645 S4SL 3S 1W22	59
19060000	GOODRIDGE, JAMES WILLIS	I S	59 3323	UGWC	0.01100	N 580 E 95 SWSL 2S 1W26	59
19060000	BETTS, REID G. AND LUCILLE B.	DS	59 2375	UGWC	0.03300	N 2092 W 200 SESL 3S 1W10	59
19060000	BIGLER, LOUIS B. AND HAZEL A.	I	59 2075	UGWC	0.75000	S 330 W 1320 NESL 3S 1W 3	59
19060000	COOPER, NEWELL J.	DS	59 2351	UGWC	0.00900	N 120 E 141 SWSL 3S 1W 2	59
1907	SALT LAKE COUNTY, REAL ESTATE DIVISION, FINANCE DEPT.		59 2816	UGWCDIS	0.01100	N 800 E 132 W4SL 3S 1W22	59
19070000	JORDAN, DEAN L. III AND ROXANE D.	ID	59 1952	UGWC	0.03300	S 585 W 225 E4SL 2S 1W27	59
19080000	PANDO, JACOB	I	59 2686	UGWC	0.02700	N 540 W 160 SESL 2S 1W33	59
19080000	SHULSEN, LARKEN H.	I S	59 2343	UGWC	0.01100	S 425 E 200 N4SL 2S 1W34	59
19080000	SMITH, F. E.	IDS	59 2037	UGWC	0.02200	N 1600 W 575 S4SL 3S 1W22	59
19080000	SOFFE, VAUGHN C.	ID	59 2396	UGWC	0.04500	S 2211 E 2879 NWSL 3S 1W14	59
19080000	RICHARDSON, DUANE G. (TRUSTEE, RICHARDSON FAMILY T.)	DS	59 3005	UGWC	0.00700	S 760 E 140 N4SL 3S 1W 2	59
1909	BOARD OF EDUCATION (JORDAN SCHOOL DISTRICT)		59 2849	UGWCDIS	0.01800	S 1152 W 77 NESL 3S 1W15	59
1909	SALT LAKE COUNTY C/O BILL DUNN MTN. VIEW GOLF COURSE		59 1972	UGWCDIS	0.00900	N 320 E 1100 S4SL 2S 1W33	59
19090000	RICHARDS, STUART H.	D	59 2862	UGWC	0.00600	S 1029 W 208 N4SL 3S 1W 3	59
19090000	SOUTHERN PACIFIC TRANSPORTATION COMPANY		59 2676	UGWCDIS	0.06700	S 3445 E 448 N4SL 3S 1W 6	59
19090000	SOUTHERN PACIFIC TRANSPORTATION COMPANY		59 2675	UGWCDIS	0.06700	S 3404 E 422 N4SL 3S 1W 6	59
19090000	THACKER, O. J.	D	59 1855	UGWC	0.027	S 2230 W 190 N4SL 2S 1W28	59
19100000	WEST JORDAN, CITY OF	I	59 3009	UGWC	0.01100	S 1275 W 530 NESL 2S 1W34	59
19100000	HOLT, MARIE		59 2007	UGWCDIS	0.01100	S 1820 W 200 N4SL 3S 1W15	59
19100000	MCDONALD, JULIUS M. AND IRENE S.	I S	59 3214	UGWC	0.01100	N 205 E 438 S4SL 2S 1W27	59
19100000	NIELSEN, HENRY D.		59 3012	UGWCDIS	0.04500	S 4158 W 2879 NESL 3S 1W15	59
1911	CAIN, DONEL D. AND VELMA M.		59 1872	UGWCDIS	0.01300	S 5248 W 2823 NESL 3S 1W15	59
19110000	STEINFELDT, MARLIN J. AND DORALYN M.	ID	59 2741	UGWC	0.013	N 950 E 170 S4SL 2S 1W28	59
19110000	MADSEN, WAYNE AND MARION	ID	59 2274	UGWC	0.056	N 150 E 690 S4SL 2S 1W28	59
19110000	NOGALES, RITO AND URVANA	I	59 2264	UGWC	0.04500	N 115 W 972 SESL 2S 1W27	59
19111115	NAYLOR, DEAN		59 2033	UGWCDIS	0.01500	S 2241 E 146 NWSL 3S 1W14	59
191200	CRANE, J. REED AND RAE S.		59 2916	UGWCDIS	0.01100	N 2190 E 175 SWSL 3S 2W35	59
191207	BRECKON, DAVID C.		59 1847	UGWCDIS	0.18900	S 1402 W 2941 NESL 3S 1W15	59
1914	TESCH, WILLIAM H. AND BARBARA J.		59 1800	UGWCDIS	0.013	N 1370 W 130 S4SL 2S 1W28	59
19140000	PETERSON, RODNEY K.	IDS	59 2298	UGWC	0.01100	S 1296 E 107 NWSL 3S 1W29	59
19150000	KOGIANES, JOHN G.	ID	59 2430	UGWC	0.00900	S 490 W 145 E4SL 2S 1W34	59
19160000	QUILTER, JAMES O. AND VIRGINIA R.	DS	59 2846	UGWC	0.02700	N 445 W 620 S4SL 2S 1W35	59
19160000	GARDNER, RALPH W.	DS	59 2371	UGWC	0.02200	N 755 E 1625 SWSL 2S 1W35	59
19160000	MCKEE, CLIFTON A.	IDS	59 2320	UGWC	0.00100	S 3955 W 130 N4SL 3S 1W16	59
19170000	FULLMER, LAWRENCE W. & MARY E.	IDS	59 4298	DIL	0.00400	N 230 W 300 SESL 3S 1W 4	59
19170000	BILLS, CECELIA M.	D	59 2404	UGWC	0.01100	S 2550 W 2445 NESL 3S 1W29	59
19170000	HAMILTON, LOWELL AND MARY L.	I	59 2720	UGWC	0.07000	S 597 W 1350 NESL 4S 2W 3	59
19171100	MABEY, DANIEL L. AND ANN W.	ID	59 2168	UGWC	0.01300	S 2656 E 146 N4SL 3S 1W16	59
19180000	CARDWELL, ROBERT L. (FAMILY TRUST)	IDS	59 2256	UGWC	0.08900	N 1224 W 308 S4SL 3S 1W29	59
19181100	BECKSTEAD, EDWARD B.		59 2322	UGWCDIS	0.00100	S 110 W 670 NESL 3S 1W29	59
19190000	GREENWOOD, MARK H.	I S	59 2604	UGWC	0.25000	N 500 W 500 E4SL 2S 1W34	59
19190000	LDS CHURCH, GRANT STAKE		59 2146	UGWCDIS	0.01100	N 185 E 404 W4SL 3S 1W21	59

19200000	BLOOD, KAY H.	S	59 2183	UGWC	0.03300	N 1940 W 936 SESL 3S 1W20	59
19200000	CONTINENTAL COPPER AND STEEL INDUSTRIES INCORPORATED		59 3089	UGWCDIS	0.03300	S 110 W 50 NESL 3S 1W 5	59
19200000	DANSIE, JESSE H.	IDS	59 3177	UGWC	0.01500	N 1275 W 270 S4SL 3S 2W34	59
19200000	WILKINSON, RICHARD AND ROMONA		59 2131	UGWCDIS	0.02200	N 255 W 105 E4SL 3S 1W21	59
19200000	LDS CHURCH, MILL CREEK STAKE, ATTN: H. D. LOWRY		59 2133	UGWCDIS	0.02700	S 3063 W 172 N4SL 3S 1W28	59
19200000	NELSON, CHARLES R. AND ELLEN E.	I S	59 2972	UGWC	0.04500	N 944 W 200 E4SL 3S 1W 3	59
19200000	HAUN, ARCH L. AND EVA F.		59 2170	UGWCDIS	0.02600	S 332 W 168 N4SL 3S 1W 4	59
19200000	GARDNER, DUNCAN R.	S	59 3076	UGWC	0.03300	N 1005 W 140 SESL 2S 1W34	59
19200000	NEFF, NELDON J. AND ELAINE	I	59 2290	UGWC	0.05600	S 65 W 143 N4SL 3S 1W28	59
19201100	CAHOON, JAY C.		59 2169	UGWCDIS	0.02200	S 1178 W 148 N4SL 3S 1W 4	59
19210000	TESCH, ARDEN		59 2052	UGWCDIS	0.033	N 910 W 110 SESL 2S 1W29	59
19210000	ERICKSON, ERNEST G.		59 2411	UGWCDIS	0.22200	N 302 W 445 E4SL 3S 1W 5	59
19210600	J. N. HUTCHINGS & SONS INCORPORATED		59 2631	UGWCDIS	0.06700	S 480 E 152 N4SL 3S 1W 9	59
19220000	BIGLER, LOUIS B.	I	59 3246	UGWC	1.00000	S 827 W 1237 NESL 3S 1W 3	59
19220600	GARDNER, DUNCAN R.	ID	59 2429	UGWC	0.00800	N 1005 W 141 SESL 2S 1W34	59
1924	JENSEN, MRS. GEORGE M.		59 1993	UGWCDIS	0.022	N 2540 W 120 S4SL 2S 1W28	59
19240000	JENSEN, VERNON B. AND FERN L.		59 2246	UGWCDIS	0.00400	S 1403 W 4740 NESL 3S 1W15	59
19240701	PASCOE, ERWIN L. JR. AND BEATRICE	IDS	59 2683	UGWC	0.00200	S 1192 E 186 N4SL 3S 1W29	59
19240800	NEWTON, WILLIAM D. AND LAVELL E.		59 2409	UGWCLAPD	0.01100	N 190 E 1012 SWSL 3S 1W28	59
19241000	COOPER, WILLIAM A. AND DARLENE	I	59 1838	UGWC	0.01100	N 610 E 80 S4SL 3S 1W16	59
19250000	GLOVER, GEOFFREY	IDS	59 2354	UGWC	0.02200	S 119 W 339 NESL 3S 1W28	59
19250000	ORTEGA, JOSEPH A. AND ZELMA M.	D	59 2967	UGWC	0.11100	S 330 E 1422 NWSL 2S 1W35	59
1926	BUSH, GUSTAVA E.		59 1966	UGWCDIS	0.02200	N 177 W 1547 SESL 3S 1W19	59
19260000	SPRATLING, JOHN	DS	59 2685	UGWC	0.02700	S 1628 W 120 NESL 3S 1W 9	59
1927	PETERSEN, ROY C.		59 2844	UGWCDIS	0.02200	S 1420 W 158 N4SL 3S 1W29	59
19270000	BIGLER, LOUIS B. AND HAZEL A.	I	59 2434	UGWC	2.00000	N 147 W 706 E4SL 3S 1W 3	59
19280500	WALKER, ARLENE D.		59 2163	UGWCDIS	0.00900	S 3006 E 158 N4SL 3S 1W28	59
19290000	NORTH JORDAN IRRIGATION COMPANY		59 2453	UGWC	3.00000	N 810 W 730 SESL 2S 1W27	59
19290000	KERKMAN, FRED W.	DS	59 2817	UGWC	0.01100	S 150 E 912 NWSL 3S 1W 3	59
19290000	SHARP, YOUNG		59 2687	UGWCDIS	0.00000	S 860 E 220 N4SL 3S 1W 3	59
19290000	NORTH JORDAN IRRIGATION COMPANY	I S	59 2460	UGWC	5.00000	N 2070 E 580 SWSL 2S 1W26	59
19290000	POWELL, KEITH L. AND MELVA J.	IDS	59 2034	UGWC	0.00400	S 1155 E 115 N4SL 3S 1W16	59
19290000	LUCAS, GUSTAVE	S	59 3042	UGWC	0.03300	S 2510 W 1570 NESL 3S 1W20	59
19290000	NORTH JORDAN IRRIGATION COMPANY	I S	59 2457	UGWC	3.50000	N 1580 E 530 SWSL 2S 1W26	59
19291000	SCHORR, WILLIAM H.	I S	59 2724	UGWC	0.011	S 75 W 220 E4SL 2S 1W29	59
19300000	HEUGHS CREEK ASSOCIATES LLC	IDS	59 2416	UGWC	0.05600	S 324 E 235 N4SL 3S 1W32	59
19300000	PHELPS, WILFORD E. & ISABELL	IDS	59 3769	UGWC	0.02200	S 987 W 150 N4SL 3S 1W29	59
19300000	SIMMONS, KENNETH M. & ONEITA P.		59 3122	UGWCDIS	0.01100	S 2543 W 648 NESL 3S 1W20	59
193007	MAYNARD, THEODORE		59 2877	UGWCDIS	0.00700	S 1879 W 5167 NESL 3S 1W15	59
19300700	STATE OF UTAH DEPARTMENT OF TRANSPORTATION		59 2084	UGWCDIS	0.01100	N 354 W 2624 SESL 3S 1W20	59
19310000	MARSHALL, EARL F.		59 2410	UGWCLAPD	0.11100	S 1702 W 155 N4SL 3S 1W 4	59
19310000	PETERSEN, ROY C.	D	59 3263	UGWC	0.01500	S 1437 W 165 N4SL 3S 1W29	59
19310600	BROADHEAD, ARVIS E.	IDS	59 2154	UGWC	0.11100	S 3303 W 203 N4SL 3S 1W28	59
19311100	MCMULLIN, CLELL V.	IDS	59 2269	UGWC	0.06700	N 2620 W 130 S4SL 3S 1W16	59
19320000	HAYMORE, BRUCE	IDS	59 5464	UGWC	0.00000	S 166 W 78 E4SL 3S 1W21	59
19320000	MURPHY, GUS	S	59 3746	UGWCLIT	0.02200	S 166 W 78 E4SL 3S 1W21	59
19320815	KENNECOTT UTAH COPPER CORPORATION		59 2750	UGWCDIS	0.02200	N 100 E 3334 SWSL 3S 2W 8	59
19330000	BRINKERHOFF, CLAUD	I	59 1969	UGWC	0.00200	N 1050 E 110 SWSL 2S 1W26	59
19330000	ACCOUNTING AND MANAGEMENT ASSOCIATES		59 2556	UGWCDIS	0.22000	N 50 E 133 W4SL 3S 1W 2	59
19330000	ACCOUNTING AND MANAGEMENT ASSOCIATES		59 2555	UGWCDIS	0.22000	N 52 E 65 W4SL 3S 1W 2	59
19330200	BUTTERFIELD, ELDON AND SHIRLEY	S	59 2318	UGWC	0.00000	S 141 W 920 NESL 3S 1W30	59
19330800	BOSSHARDT, JOHN	I S	59 1965	UGWC	0.01100	S 93 E 127 N4SL 3S 1W21	59
1934	BECKSTEAD, DALE	I S	59 5473	UGWC	0.00000	S 1255 W 325 N4SL 3S 1W26	59
1934	MCGRATH, JERRY L. & PEGGY Z.	I S	59 5473	UGWC	0.00000	S 1255 W 325 N4SL 3S 1W26	59
1934	WEST JORDAN, CITY OF		59 2883	UGWCDIS	0.22000	S 660 E 85 NWSL 2S 1W35	59
19340000	OLSEN, JOHN H.	I	59 3336	DIL	0.06700	S 1068 E 60 NWSL 3S 1W 2	59
19340000	COOK, JOSEPH E.	IDS	59 3797	UGWC	0.01500	N 160 W 400 S4SL 2S 1W35	59

19340000	GARDNER, RALPH	I	59 4285	DIL	2.50000	S 1068 E 60 NWSL 3S 1W 2	59
19340000	GARDNER, EDWIN F. & JOHN R.	I S	59 3909	UGWC	2.50000	S 1068 E 60 NWSL 3S 1W 2	59
19340000	RASMUSSEN, CLYDE & ILA R.	I	59 4286	DIL	2.50000	S 1068 E 60 NWSL 3S 1W 2	59
19340000	PETERSON, MRS. CLYDE	DS	59 3051	UGWC	0.04500	S 2536 W 280 NESL 3S 1W20	59
19340000	LAWSON, WOODROW AND RUBY	IDS	59 4299	DIL	0.02700	N 1030 W 615 SESL 3S 1W 4	59
19350000	IWAMOTO, TAKEO	ID O	59 4544	UGWC	0.02200	S 50 W 125 N4SL 3S 1W10	59
19361112	BRECKON, DAVID C.		59 84	UGWC	0.03400	S 1401 W 290 N4SL 3S 1W15	59
19380114	KENNECOTT UTAH COPPER CORPORATION	IDS	59 93	APPLCERT	0.00400	N 1362 E 650 SWSL 3S 2W32	59
19410529	HAUN, ARCH L. & EVA F.	S	59 245	APPLNPR	0.01500	S 432 W 168 N4SL 3S 1W 4	59
19431029	GARDNER, HOWARD D.	ID	59 388	APPLNPR	0.01500	S 290 W 145 E4SL 2S 1W34	59
19440515	CAVENDER, THELMA	D	59 404	APPLNPR	0.01500	N 3068 E 118 SWSL 2S 1W26	59
19440518	MECHAM, LAVERL (GENERAL PERSONAL REPRESENTATIVE)	I S	59 405	APPLNPR	0.01500	N 116 E 672 W4SL 3S 1W 2	59
19440927	CHAVEZ, JOSE		59 420	APPLDIS	0.01500	S 400 E 1280 NWSL 2S 1W35	59
19461126	MONTOYA, ALEX AND MARY L.		59 526	APPLDIS	0.01500	N 1025 E 195 S4SL 3S 2W33	59
19470424	CHARON, JUNE	I S	59 564	APPLNPR	0.01500	S 101 E 899 W4SL 3S 1W21	59
19470515	SMITH, JOHN W.	IDS	59 569	APPLNPR	0.01500	N 600 E 90 W4SL 3S 1W 2	59
19470729	PHELPS, ORVAL K. & FLORENCE J.	ID	59 581	APPLNPR	0.01500	N 230 E 90 W4SL 3S 1W15	59
19471007	ATWOOD, JAMES M.	I S	59 598	APPLNPR	0.01500	N 200 W 1975 E4SL 3S 1W 5	59
19480217	KENNECOTT UTAH COPPER CORPORATION		59 609	APPLCERT	4.00000	S 698 E 1142 W4SL 3S 2W29	59
19480604	RADMALL, GLEN		59 638	APPLDIS	0.01500	S 49 E 75 NWSL 3S 1W 2	59
19480614	OLSEN, JOHN H.	ID	59 641	APPLNPR	0.01500	S 1043 E 140 NWSL 3S 1W 2	59
19480722	PETERSON, DONALD L. AND F. MILES		59 654	APPLDIS	0.01500	S 119 W 168 N4SL 3S 1W16	59
19480830	MAURER, JACKSON S.	D	59 666	APPLNPR	0.01500	N 625 W 110 S4SL 3S 1W11	59
19490922	SEAL, EMMA V.	IDS	59 764	APPLNPR	0.01500	S 1000 E 105 N4SL 3S 1W32	59
19510124	GUSS, ABE	O	59 328	APPLCERT	0.12600	N 450 E 396 S4SL 2S 1W27	59
19510912	BUSHNELL, LEROY C.		59 980	APPLDIS	0.01500	N 1230 W 895 E4SL 3S 1W16	59
19511108	HANCOCK, FORREST	IDS	59 995	APPLNPR	0.01500	S 1235 E 1185 N4SL 3S 1W14	59
19520405	KENNECOTT UTAH COPPER CORPORATION	I O	59 1006	APPLPDPT	1.00000	S 698 E 1142 W4SL 3S 2W29	59
19520408	BIGLER, LOUIS B.	ID O	59 1007	APPLNPR	0.01500	S 592 W 163 NESL 3S 1W 3	59
19520421	WOODS, THOMAS C. AND NELL (JR.)	IDS	59 1011	APPLNPR	0.01500	S 70 E 10 W4SL 3S 1W21	59
19530213	STATE OF UTAH DIVISION OF PARKS & RECREATION	I	59 1078	APPLCERT	2.00000	N 412 E 35 SWSL 3S 1W14	59
19530313	GIFFORD, JON TROY	IDS O	59 1091	APPLCERT	0.08900	S 455 W 212 NESL 3S 1W 3	59
19530627	JORDAN, DEAN L. III AND ROXANE D.	ID	59 1112	APPLNPR	0.01500	S 585 W 225 E4SL 2S 1W27	59
19530709	BUHLER, JOSEPH K.	O	59 1116	APPLCERT	0.03200	N 110 E 1630 SWSL 3S 1W 8	59
19540608	SOUTH JORDAN, TOWN OF	I	59 1001	APPLCERT	0.50000	N 320 E 666 W4SL 3S 1W14	59
19540726	TATEOKA, MATT	I	59 1176	APPLCERT	2.62000	N 35 E 35 SWSL 3S 1W 9	59
19540804	WITHERSPOON, JAMES R.	DS	59 1180	APPLCERT	0.01500	N 1188 E 291 S4SL 3S 2W33	59
19540817	LARSON, STERLING B.	I S	59 1166	APPLCERT	1.00000	N 1296 E 44 S4SL 3S 1W11	59
19540911	BUTTERFIELD, JAMES S.	I	59 1188	APPLCERT	1.18000	N 50 E 40 SWSL 3S 2W26	59
19540913	RIVERTON CITY CORPORATION	C	59 1189	APPLCERT	2.46000	S 320 W 122 NESL 3S 1W31	59
19541108	SCHMIDT, JOSEPH J.	I	59 1198	APPLCERT	5.00000	N 110 E 41 W4SL 3S 1W 9	59
19541117	DANSIE, JESSE	I	59 1249	APPLLAP	3.79300	N 2300 E 1500 SWSL 3S 2W33	59
19541117	DANSIE, JESSE	I	59 1249	APPLLAP	3.79300	S 1500 E 1400 NWSL 3S 2W34	59
19541117	DANSIE, JESSE	I	59 1249	APPLLAP	3.79300	S 1500 W 1450 NESL 3S 2W34	59
19541117	DANSIE, JESSE	I	59 1249	APPLLAP	3.79300	N 1000 E 2300 SWSL 3S 2W34	59
19541117	DANSIE, JESSE	I	59 1249	APPLLAP	3.79300	S 1250 E4SL 3S 2W33	59
19541117	DANSIE, JESSE RODNEY	I S	59 1200	APPLCERT	1.19000	S 740 E 1330 W4SL 3S 2W33	59
19541117	TAYLOR, JOYCE M.	IDS	59 3879	APPLCERT	0.43700	S 662 E 44 NWSL 4S 2W 3	59
19541117	DANSIE, JESSE	I	59 1249	APPLLAP	3.79300	S 2600 W 1450 NESL 3S 2W34	59
19541117	DANSIE, JESSE	I	59 1249	APPLLAP	3.79300	S 950 E 1050 E4SL 3S 2W33	59
19541117	DANSIE, JESSE	I	59 1249	APPLLAP	3.79300	S 50 E4SL 3S 2W33	59
19541117	DANSIE, JESSE	I	59 1249	APPLLAP	3.79300	N 1500 E 2000 SWSL 3S 2W33	59
19541117	DANSIE, JESSE	I	59 1249	APPLLAP	3.79300	S 950 E4SL 3S 2W33	59
19541117	DANSIE, JESSE	I	59 1249	APPLLAP	3.79300	N 1900 E 2400 SWSL 3S 2W34	59
19550211	HERRIMAN PIPELINE & DEVELOPMENT CO. (HELD BY BWR)	I	59 16	APPLCERT	0.41000	N 1711 W 1316 SESL 3S 2W34	59
19550211	HERRIMAN IRRIGAITON CO.		59 17	APPLLAPD	4.59000	N 1711 W 1316 SESL 3S 2W34	59
19550305	JORDAN VALLEY WATER CONSERVANCY DISTRICT	I	59 1210	APPLCERT	3.55000	S 75 W 1768 NESL 3S 1W30	59

19550305	HERRIMAN PIPELINE & DEVELOPMENT CO. (HELD BY BWR)	IDS O	59 1212	APPLCERT	0.98300	N 2020 W 100 SESL 3S 2W34	59
19560521	QUILTER, JAMES O. & VIRGINIA A.	ID	59 1263	APPLNPR	0.01500	N 1687 W 200 S4SL 3S 1W28	59
19560620	KENNECOTT UTAH COPPER CORPORATION	ID	59 1271	APPLNPR	0.01500	S 371 W 147 N4SL 3S 2W32	59
19560709	BROWN, DARREL H.	S	59 1275	APPLNPR	0.01500	S 431 E 29 NWSL 3S 1W32	59
19560717	RUSSELL, CARL		59 1277	APPLDIS	0.01500	S 715 W 161 N4SL 3S 1W 4	59
19561008	BOWLES, ROBERT I.	I	59 4751	APPLCERT	1.16000	S 2531 E 1083 NWSL 3S 2W35	59
19561008	BOWLES, ROBERT I.	I	59 4751	APPLCERT	1.16000	S 353 E 666 NWSL 3S 2W35	59
19570123	WEST JORDAN, CITY OF		59 1299	APPLREJD	0.00000	W 100 E4SL 3S 1W 7	59
19570123	WEST JORDAN, CITY OF		59 1298	APPLREJD	2.50000	N 500 E 2050 SWSL 3S 1W 2	59
19570131	BOOTH, WILLIAM H.	ID	59 1302	APPLNPR	0.01500	N 635 E 145 SWSL 3S 1W 5	59
19570328	RUSSELL, CARL		59 1307	APPLDIS	0.01500	S 690 W 70 N4SL 3S 1W 4	59
19580122	DIMOND, STANLEY G.	I S	59 1352	APPLCERT	2.00000	N 1276 E 168 S4SL 3S 1W 5	59
19590123	CRUMP, STANLEY R. AND ARLENE J.	IDS	59 1406	APPLNPR	0.01500	S 1560 E 90 N4SL 3S 1W27	59
19590804	RIVERTON CITY CORPORATION	C	59 1534	APPLCERT	5.00000	S 320 W 122 NESL 3S 1W31	59
19591105	GLENMOOR GOLF COURSE INC	I	59 4189	APPLCERT	1.39000	S 678 E 316 W4SL 3S 1W 7	59
19591105	GLENMOOR GOLF COURSE INC.	I	59 1521	APPLCERT	1.11000	S 10 E 254 W4SL 3S 1W 7	59
19591105	GLENMOOR GOLF COURSE INC.	I	59 1521	APPLCERT	1.11000	S 2222 E 257 NWSL 3S 1W 7	59
19600428	BIGLER, LOUIS B.		59 1559	APPLDIS	1.00000	S 1320 W 1470 NESL 3S 1W 3	59
19600714	WEST JORDAN, CITY OF	C	59 1572	APPLAPP	1.00000	S 200 E 1500 NWSL 2S 1W35	59
19610327	SHULSEN, ERMA T.		59 1592	APPLDIS	0.10000	N 747 W 220 S4SL 2S 1W34	59
19610411	BOWLES, ARVID W. AND JOYCE G.	I	59 5359	APPLCERT	0.00000	S 1218 W 1417 N4SL 3S 2W35	59
19610511	BODELL, NOREEN S.	I S	59 1605	APPLCERT	1.80000	S 1213 E 350 N4SL 3S 2W35	59
19610521	AKITA, FRANK K.	I	59 1606	APPLCERT	2.71000	N 1240 W 1305 SESL 3S 1W20	59
19610526	WALKER, GEORGE J.	I	59 1610	APPLCERT	1.56000	S 1105 W 710 N4SL 3S 2W35	59
19610529	ALLISON, CHARLES L. (JR.)		59 1611	APPLLAPD	2.00000	S 2616 E 1607 NWSL 3S 1W 5	59
19610605	FERAGEN, LEONARD H.	DS	59 1612	APPLCERT	0.01500	N 2202 E 193 S4SL 3S 1W29	59
19610605	SCHMIDT, JOSEPH J.	I	59 1613	APPLCERT	1.07000	N 110 E 41 W4SL 3S 1W 9	59
19610627	TATEOKA, MATT	I	59 1620	APPLCERT	3.49000	N 35 E 35 SWSL 3S 1W 9	59
19610711	KOGIANES, JOHN G.	I S	59 1623	APPLCERT	0.50000	S 1310 W 680 E4SL 2S 1W34	59
19610717	THORNE, RONALD H.	I	59 1627	APPLCERT	2.98000	S 810 W 1295 N4SL 3S 1W28	59
19610822	SPRATLING, JOHN	I	59 1636	APPLCERT	0.15500	N 181 E 33 S4SL 3S 1W 4	59
19610822	SPRATLING, JOHN	I	59 1637	APPLCERT	0.63400	N 2640 W 33 S4SL 3S 1W 9	59
19610830	BRADY, L. PEIRCE	I	59 1640	APPLUNAP	2.00000	N 200 E 10 S4SL 3S 1W29	59
19610908	ALVERSON, VERNELL		59 1643	APPLLAPD	0.10000	S 38 W 1447 E4SL 3S 1W 4	59
19611121	KENNECOTT UTAH COPPER CORPORATION	O	59 1653	APPLCERT	4.00000	S 2347 E 1149 NWSL 3S 2W14	59
19620305	DUTSON, BERNARD W.	IDS	59 1661	APPLCERT	0.01500	S 635 E 145 W4SL 3S 1W29	59
19620321	BRIGHT, CHARLES W.	IDS	59 1664	APPLCERT	0.00400	S 3410 W 202 N4SL 3S 1W29	59
19620327	JONES BROTHERS		59 1665	APPLLAPD	10.00000	N 100 SWSL 3S 2W10	59
19620426	DIMOND, STANLEY G.	I S	59 1671	APPLCERT	1.00000	N 1276 E 168 S4SL 3S 1W 5	59
19620619	GILBERT, DONALD R. & SUSAN J.	IDS	59 1031	APPLCERT	0.00200	S 3136 W 256 N4SL 3S 1W29	59
19620623	RIVERTON CITY	C	59 1118	APPLUNAP	2.00000	S 320 W 122 NESL 3S 1W31	59
19620918	MCCARTHY, CURTIS L. & CHARICE	IDS	59 3399	APPLCERT	0.01500	S 100 E 2430 W4SL 3S 1W29	59
19621213	KENNECOTT UTAH COPPER CORPORATION	O	59 3991	APPLWDD	7.00000	S 150 E 2500 NWSL 3S 2W14	59
19621213	KENNECOTT UTAH COPPER CORPORATION	O	59 1042	APPLCERT	4.44000	S 150 E 2500 NWSL 3S 2W14	59
19621213	KENNECOTT UTAH COPPER CORPORATION	O	59 3991	APPLWDD	7.00000	N 100 E 100 SWSL 3S 2W13	59
19630130	ALLISON, CHARLES, L. (JR.)		59 1683	APPLLAPD	0.01500	S 2616 E 1657 NWSL 3S 1W 5	59
19630227	LDS CHURCH, CORPORATION OF THE PRESIDING BISHOP	I	59 1689	APPLUNAP	4.00000	S 55 W 1269 NESL 3S 1W20	59
19630301	BYTHEWAY, QUINTIN H.		59 1690	APPLLAPD	0.01500	S 166 E 2499 W4SL 2S 1W34	59
19630315	HARMAN, MAURICE M.	IDS	59 1693	APPLUNAP	4.00000	S 50 E 10 W4SL 3S 1W22	59
19630322	DEE'S INCORPORATED	I S	59 1694	APPLCERT	1.00000	S 530 W 2665 E4SL 3S 1W 5	59
19640213	WILLIAMSON, KENNETH HAROLD	I	59 1716	APPLUNAP	0.25000	N 300 W 779 E4SL 3S 1W21	59
19640228	DUTSON, BERNHARD W.		59 1719	APPLLAPD	0.01500	S 630 E 160 W4SL 3S 1W29	59
19640328	THOMPSON, MAX	IDS	59 1723	APPLCERT	0.05700	S 3308 E 130 N4SL 3S 1W29	59
19640805	CONDIE, VERNON ELDEAN		59 1731	APPLLAPD	0.01500	N 1425 E 1177 W4SL 3S 1W14	59
19641228	CONDIE, VERNON ELDEAN		59 1739	APPLLAPD	0.25000	N 1425 E 1177 W4SL 3S 1W14	59
19650316	PARRY, BLAINE B.		59 1744	APPLLAPD	0.01500	S 150 W 1420 N4SL 3S 1W29	59
19660211	BUTTERFIELD, WAYNE W.	IDS	59 3272	APPLUNAP	1.50000	N 50 E 850 SWSL 3S 2W35	59

19660713	PETERSON BROS.	IDS	59 3397	APPLUNAP	2.00000	S 1300 E 20 NWSL 3S 1W16	59
19660916	BUTTERFIELD, WAYNE W.	I	59 3404	APPLUNAP	0.50000	N 50 E 850 SWSL 3S 2W35	59
19670112	RUSHTON, DONALD	ID O	59 3417	APPLUNAP	3.00000	N 800 E 200 SWSL 3S 1W17	59
19680418	HUG, JON J.		59 3452	APPLLAPD	0.01500	S 660 E 165 W4SL 3S 1W29	59
19680715	WELLS, D DEAN	IDS	59 3565	APPLCERT	0.01500	N 265 E 805 S4SL 3S 1W17	59
19680930	BOWLES, ROBERT I.	I	59 1156	APPLCERT	0.61000	N 448 E 1397 W4SL 3S 2W35	59
19690229	GARDNER, DAVID I & GAYLE P.	ID	59 1551	APPLCERT	0.01500	S 921 W 226 N4SL 3S 1W 5	59
19690527	JESSEE, NORMAN P.	IDS	59 3597	APPLCERT	0.01500	N 204 W 420 SESL 3S 1W17	59
19690611	HOPES, ROBERT	IDS	59 3600	APPLCERT	0.04500	S 880 E 552 NWSL 3S 1W 4	59
19690831	HARMAN, MAURICE M. (ETAL)		59 1626	APPLLAPD	4.00000	N 60 W 1260 S4SL 3S 1W 9	59
19691121	FREEMAN, ALONZO		59 1614	APPLLAPD	3.00000	N 75 E 75 SWSL 3S 2W24	59
19700102	BURTON, MILLAN G.	I S	59 3608	APPLCERT	0.030	N 330 E 155 W4SL 2S 1W28	59
19700513	YARBERRY, AFTON L.	I S	59 3619	APPLLAPD	0.01500	S 1160 W 835 N4SL 3S 1W16	59
19700603	PEINE, FRED	I S	59 3621	APPLLAPD	0.01500	S 800 E 855 NWSL 3S 1W 4	59
19710221	TODD, MAURINE	IDS	59 3643	UGWC	0.015	S 2045 W 495 NESL 2S 1W29	59
19710226	GASSER, ROBERT	I S	59 3648	APPLCERT	0.01500	N 279 W 1690 E4SL 3S 1W10	59
19710503	BUNKER, RUSSELL M. AND NANETTE D.	IDS	59 3825	APPLLAP	0.01500	N 418 W 1650 SESL 3S 2W33	59
19710625	SCHMIDT, HENRY F.		59 3811	APPLLAPD	0.50000	N 1300 W 1000 S4SL 3S 1W 3	59
19710712	HALL, JACK W.		59 3814	APPLLAPD	0.01500	N 200 W 766 NESL 4S 2W 4	59
19710712	ERICKSEN, KEITH A	IDS	59 3813	APPLCERT	0.01500	N 105 W 537 NESL 4S 2W 4	59
19710727	SIMPSON, ROBERT L.	IDS	59 3816	APPLCERT	0.01500	N 343 W 551 SESL 3S 2W33	59
19710803	RASMUSSEN, TRAVIS & BEA	IDS	59 3817	APPLCERT	0.01500	N 965 W 202 S4SL 3S 1W20	59
19711103	IVIE, JIM D. & WANDA	IDS	59 3826	APPLCERT	0.01500	N 263 E 1425 S4SL 3S 2W33	59
19720412	ANDREASON, WILLIAM K.	ID O	59 3839	APPLLAPD	0.01500	N 100 W 100 SESL 3S 2W 8	59
19720419	TOLBERT, CLINTON BERNELL	IDS	59 3842	APPLLAPD	0.50000	N 335 W 900 SESL 3S 2W12	59
19720424	FIFE, RICHARD A. AND NORMA D. (JR.)		59 3844	APPLLAPD	0.06700	S 125 E 685 NWSL 3S 1W16	59
19720425	BRINKERHOFF, MORRIS H. AND BRENDA A.	IDS	59 3845	APPLCERT	0.01500	N 201 W 542 S4SL 3S 1W20	59
19720811	SCHOUTEN, SHERRILL J.	IDS	59 3869	APPLCERT	0.01500	S 340 E 790 NWSL 3S 1W29	59
19720823	OAKESON, GLEN W. & MOANA C.	IDS	59 3871	APPLCERT	0.01500	N 723 W 214 S4SL 3S 1W29	59
19721017	DANSIE, JESSE H.		59 1249	APPLAPP	6.37300	N 2300 E 1500 SWSL 3S 2W33	59
19721017	DANSIE, JESSE H.	ID	59 4619	APPLLAP	2.58000	S 1500 W 1450 NESL 3S 2W34	59
19721017	DANSIE, JESSE H.		59 1249	APPLAPP	6.37300	S 950 E 1050 E4SL 3S 2W33	59
19721017	DANSIE, JESSE H.	ID	59 4619	APPLLAP	2.58000	N 1900 E 2400 SWSL 3S 2W34	59
19721017	DANSIE, JESSE H.		59 1249	APPLAPP	6.37300	S 1500 E 1400 NWSL 3S 2W34	59
19721017	DANSIE, JESSE H.		59 1249	APPLAPP	6.37300	S 50 E4SL 3S 2W33	59
19721017	DANSIE, JESSE H.	ID	59 4619	APPLLAP	2.58000	S 950 E4SL 3S 2W33	59
19721017	DANSIE, JESSE H.	ID	59 4619	APPLLAP	2.58000	N 2300 E 1500 SWSL 3S 2W33	59
19721017	DANSIE, JESSE H.	ID	59 4619	APPLLAP	2.58000	N 1500 E 2000 SWSL 3S 2W33	59
19721017	DANSIE, JESSE H.	ID	59 4619	APPLLAP	2.58000	N 1000 E 2300 SWSL 3S 2W34	59
19721017	DANSIE, JESSE H.		59 1249	APPLAPP	6.37300	S 1250 E4SL 3S 2W33	59
19721017	DANSIE, JESSE H.		59 1249	APPLAPP	6.37300	N 1500 E 2000 SWSL 3S 2W33	59
19721017	DANSIE, JESSE H.		59 1249	APPLAPP	6.37300	S 1500 W 1450 NESL 3S 2W34	59
19721017	DANSIE, JESSE H.		59 1249	APPLAPP	6.37300	S 2600 W 1450 NESL 3S 2W34	59
19721017	DANSIE, JESSE H.	ID	59 4619	APPLLAP	2.58000	S 50 E4SL 3S 2W33	59
19721017	DANSIE, JESSE H.		59 1249	APPLAPP	6.37300	N 1900 E 2400 SWSL 3S 2W34	59
19721017	DANSIE, JESSE H.		59 1249	APPLAPP	6.37300	S 950 E4SL 3S 2W33	59
19721017	DANSIE, JESSE H.	ID	59 4619	APPLLAP	2.58000	S 1500 E 1400 NWSL 3S 2W34	59
19721017	DANSIE, JESSE H.	ID	59 4619	APPLLAP	2.58000	S 950 E 1050 E4SL 3S 2W33	59
19721017	DANSIE, JESSE H.	ID	59 4619	APPLLAP	2.58000	S 2600 W 1450 NESL 3S 2W34	59
19721017	DANSIE, JESSE H.		59 1249	APPLAPP	6.37300	N 1000 E 2300 SWSL 3S 2W34	59
19721017	DANSIE, JESSE H.	ID	59 4619	APPLLAP	2.58000	S 1250 E4SL 3S 2W33	59
19721031	HANSEN, PAUL L. AND ROXANNE S.	IDS	59 3885	APPLCERT	0.01500	N 70 W 875 SESL 3S 2W33	59
19730319	JORGENSEN, DAVID B.		59 3937	APPLLAPD	0.01500	S 3220 W 3550 NESL 3S 1W20	59
19730404	CHIVERS, MELANIE	IDS	59 3940	APPLCERT	0.01500	N 1096 E 27 S4SL 3S 2W34	59
19730418	CANDALOT, GENE L.	ID	59 3941	APPLCERT	0.01500	S 173 W 1406 N4SL 3S 1W29	59
19730508	HOGGE, J. NORMAN	IDS	59 3950	APPLCERT	0.01500	N 493 E 1513 SWSL 3S 1W20	59
19730508	MIELKE, DWIGHT		59 3948	APPLLAPD	0.01500	N 1315 E 130 S4SL 3S 1W20	59

19730514	HUNTSMAN, COURTNEY C. AND PATRICIA H.	I	59 3925	APPLCERT	0.10000	N 636 E 39 S4SL 2S 1W34	59
19730514	ROBERTS, FRANK C. AND JACQUELINE	I S	59 3926	APPLCERT	0.10000	N 636 E 39 S4SL 2S 1W34	59
19730514	STRATTON, FRANCES E. AND REED J.	I S	59 3949	APPLCERT	0.10000	N 636 E 39 S4SL 2S 1W34	59
19730530	COOK, GRANT O. (DR.)		59 3954	APPLLAPD	0.01500	S 3220 W 3550 NESL 3S 1W20	59
19730702	PETERS, FRANK		59 3977	APPLLAPD	0.01500	N 1785 E 1180 SWSL 3S 1W20	59
19730802	NAYLOR, LARRY C.	I S	59 3982	APPLCERT	0.01500	N 230 W 1190 S4SL 3S 1W20	59
19731030	NAYLOR, HENRY W.		59 3997	APPLLAPD	0.01500	N 1000 W 520 S4SL 2S 1W33	59
19740402	LARSEN, RONALD L.	IDS	59 4030	APPLCERT	0.01500	S 854 W 204 N4SL 3S 1W32	59
19740402	JOHNSON, CHESTER L.	IDS	59 4032	APPLLAPD	0.01500	N 278 E 786 SWSL 3S 1W20	59
19740402	JOHNSON, RANDY	IDS	59 4031	APPLLAPD	0.01500	N 278 E 786 SWSL 3S 1W20	59
19740418	GLENMOOR GOLF COURSE INC.	I	59 4483	APPLCERT	0.83000	S 678 E 316 W4SL 3S 1W 7	59
19740418	AFCO DEVELOPMENT CORPORATION	D	59 4035	APPLLAPD	5.17000	S 1450 N4SL 3S 1W 7	59
19740418	AFCO DEVELOPMENT CORPORATION	D	59 4035	APPLLAPD	5.17000	E 2500 W4SL 3S 1W 7	59
19740501	BLAND, BRIAN AND SHIRLEE	IDS	59 4041	APPLCERT	0.01500	S 247 W 785 N4SL 3S 1W32	59
19740524	TIDWELL, BERT ALLEN	IDS	59 4054	APPLCERT	0.01500	N 875 E 1089 SWSL 3S 1W20	59
19740530	PHELPS, STEVEN D. & VICKI LIN	IDS	59 4055	APPLCERT	0.01500	S 1235 W 156 N4SL 3S 1W29	59
19740627	ABEYTA, CANDIDA F. AND LOUISA	IDS	59 4063	APPLLAPD	0.04500	S 100 E 967 NWSL 3S 1W 4	59
19740708	ERNEST, ROBERT AND BARBARA	IDS	59 4069	APPLLAPD	0.01500	N 720 W 350 SESL 3S 2W34	59
19740718	DANSIE, ARTHUR H.	IDS	59 4073	APPLCERT	0.01500	N 1096 E 27 S4SL 3S 2W34	59
19740723	BRINGHURST, J. OWEN AND KAREN	IDS	59 4076	APPLCERT	0.01500	N 1127 W 264 S4SL 3S 1W20	59
19740815	RICE, KENNETH F. (JR.)	IDS	59 4079	APPLCERT	0.01500	N 292 E 760 SWSL 3S 1W20	59
19741007	ROBERTSON, DOUGLAS AND BETH	IDS	59 4091	APPLLAPD	0.01500	S 1262 W 190 N4SL 3S 1W29	59
19741029	ANDREGG, ANNA	IDS	59 4097	APPLLAPD	0.04500	S 700 E 1580 NWSL 3S 1W16	59
19741107	DAUSE, BILL	D	59 4100	APPLLAPD	0.01500	S 100 E 525 NWSL 4S 2W 2	59
19750130	BASTIAN, E. P.	IDS	59 4118	APPLCERT	0.01500	S 3286 W 2213 NESL 3S 2W32	59
19750306	WALKER, JOHN	I S	59 4123	APPLCERT	0.03200	N 1507 W 233 SESL 2S 1W27	59
19750325	PEASE, CECIL AND WILMA	IDS	59 4127	APPLCERT	0.01500	N 1435 E 1190 W4SL 3S 1W14	59
19750521	HAM, BILLY W. AND GRACE	IDS	59 4143	APPLCERT	0.01500	S 230 E 355 N4SL 3S 1W20	59
19750609	BATEMAN, DEON R.	IDS	59 4147	APPLCERT	0.01500	S 332 W 699 N4SL 3S 1W30	59
19750616	HOWELL, KEVAN	IDS	59 4148	APPLCERT	0.01500	S 332 W 669 N4SL 3S 1W30	59
19750924	BENNETT, BRENT	IDS	59 4192	APPLCERT	0.01500	N 438 W 145 S4SL 3S 1W29	59
19760408	FLETCHER, JOSEPH L. AND CAROLYN F.	IDS	59 4226	APPLCERT	0.01500	N 507 W 180 S4SL 3S 1W29	59
19760415	EGBERT, KEITH	IDS	59 4229	APPLCERT	0.01500	S 155 E 795 N4SL 3S 1W32	59
19760622	SCIUTO, STEVEN	IDS	59 4244	APPLCERT	0.01500	N 1809 E 1021 S4SL 3S 1W29	59
19760716	ALLEN, JAMES T.& KATHY E.	IDS	59 4255	APPLCERT	0.01500	S 125 W 163 NESL 3S 1W31	59
19760719	PULLEY, HARVEY	IDS	59 4259	APPLCERT	0.04300	N 251 W 1127 E4SL 3S 1W 5	59
19760719	PULLEY, HARVEY	I	59 5311	APPLLAP	0.05700	N 200 W 1100 E4SL 3S 1W 5	59
19760722	MACKAY, KEITH P.		59 4260	APPLLAPD	0.01500	N 870 E 420 S4SL 3S 2W33	59
19760723	MARTIN, MARK K.	IDS	59 4304	APPLCERT	0.01500	N 325 W 130 S4SL 3S 1W29	59
19760819	DAINES, VAUGHN R.	IDS	59 4312	APPLCERT	0.01500	N 903 E 1609 S4SL 3S 1W29	59
19760920	BENTON, JAMES O.	IDS	59 4321	APPLCERT	0.01500	S 180 E 1292 N4SL 3S 1W32	59
19761004	HAL K. LARSEN AND SONS CONSTRUCTION INC.	IDS	59 4323	APPLCERT	0.01500	S 180 W 967 N4SL 3S 1W32	59
19761014	PETERSEN, CRAIG	IDS	59 4325	APPLCERT	0.01500	S 635 E 177 NWSL 3S 1W29	59
19761019	JONES, OTTO F.	I S	59 4326	APPLCERT	0.06000	N 521 E 14 W4SL 3S 1W16	59
19761115	AMES, STEPHEN L.	IDS	59 4333	APPLCERT	0.02500	N 706 E 1413 W4SL 3S 1W16	59
19761116	HARDMAN, DAVID NORD	ID	59 4005	APPLLAPD	0.01500	N 329 W 220 S4SL 3S 1W20	59
19761123	RASMUSSEN, BRENT K.	IDS	59 4338	APPLCERT	0.01500	N 394 W 1980 E4SL 3S 1W27	59
19770103	PERSCHON, A. ROBERT	IDS	59 4346	APPLCERT	0.02200	N 503 E 2361 W4SL 3S 1W10	59
19770127	MOOSMAN, GLEN	I	59 4404	APPLCERT	0.10000	N 1048 W 143 E4SL 3S 1W 4	59
19770215	HARPER, FRANCIS M.	IDS	59 4414	APPLCERT	0.01500	N 1893 E 642 S4SL 3S 1W29	59
19770216	REID, JOHN A.	I S	59 4417	APPLCERT	0.20500	S 1137 E 163 W4SL 3S 1W11	59
19770216	ANDERSON, MAX W.	I S	59 4418	APPLCERT	0.23300	S 1137 E 163 W4SL 3S 1W11	59
19770222	ELLEFSEN, CLARENCE W. (FAMILY TRUST)	I	59 4433	APPLCERT	0.03000	N 288 E 47 SWSL 3S 1W11	59
19770301	POTOMAC CORPORATION	ID O	59 4436	APPLCERT	0.22000	S 180 W 664 NESL 2S 1W34	59
19770304	BATEMAN, GLENN W.	ID	59 4438	APPLCERT	0.01500	N 1020 E 429 W4SL 3S 1W16	59
19770324	NIELSEN, LARRY M.		59 4451	APPLLAPD	0.06700	N 810 W 300 SESL 3S 1W 8	59
19770418	JESSEE, NORMAN P.	I	59 4459	APPLCERT	0.01400	N 204 W 420 SESL 3S 1W17	59

19770422	FAILOR, KENNETH L.	IDS	59 4462	APPLCERT	0.01500	N	161 E 1030 S4SL 3S 1W29	59
19770503	OLSEN, CECIL A.	ID	59 4471	APPLCERT	0.01500	N	1541 E 489 S4SL 3S 1W29	59
19770504	BARLOW, LYMAN J.	I S	59 4472	APPLCERT	0.01500	N	1501 E 49 S4SL 3S 1W29	59
19770509	JESSEE, NORMAN	I	59 4476	APPLCERT	0.01500	S	164 W 312 NESL 3S 1W22	59
19770510	TURNER, LARRY J.	ID	59 4477	APPLCERT	0.01500	N	764 W 80 SESL 3S 2W33	59
19770601	BECKSTEAD, STERLING M.	ID	59 4495	APPLCERT	0.09000	N	1048 E 179 SWSL 3S 1W14	59
19770614	KYRIOPOULOS, LOUISE	I	59 4503	APPLCERT	0.03500	S	1230 W 2065 E4SL 2S 1W33	59
19770707	ALLDREDGE, CLIFFORD L.	I S	59 4525	APPLCERT	0.04500	N	2613 E 2910 SWSL 3S 1W14	59
19770719	GYGI, WALLACE NEIL	IDS	59 4537	APPLCERT	0.02200	N	1183 E 204 SWSL 3S 1W11	59
19770719	IWAMOTO, TAKEO	ID O	59 4536	APPLCERT	0.01500	S	110 W 460 N4SL 3S 1W10	59
19770719	FARNSWORTH, RONALD DALE	ID	59 4538	APPLCERT	0.01500	S	615 E 1235 N4SL 3S 1W15	59
19770810	KIMBER, IRVIN GERALD	I	59 4559	APPLCERT	0.01500	S	304 E 751 W4SL 3S 1W14	59
19770930	DANSIE, A. BRENT AND ALYCE ANN	IDS O	59 5571	APPLAPP	0.00000	N	900 E 100 S4SL 3S 2W34	59
19770930	DANSIE, A. BRENT AND ALYCE ANN	IDS O	59 5571	APPLAPP	0.00000	N	1096 E 27 S4SL 3S 2W34	59
19771003	BUTTERFIELD, ELDON		59 3895	APPLLAPD	0.01500	S	90 W 980 NESL 3S 1W30	59
19780128	GRAHAM, SHIRLENE	IDS	59 3986	APPLAPP	0.01500	N	1500 E 1150 SWSL 3S 1W20	59
19780306	DANSIE, JESSE H.	ID	59 4619	APPLWD	2.58000	S	1250 E4SL 3S 2W33	59
19780306	DANSIE, JESSE H.	ID	59 4619	APPLWD	2.58000	N	1000 E 2300 SWSL 3S 2W34	59
19780306	DANSIE, JESSE H.	ID	59 4619	APPLWD	2.58000	N	2300 E 1500 SWSL 3S 2W33	59
19780306	DANSIE, JESSE H.	ID	59 4619	APPLWD	2.58000	S	1500 W 1450 NESL 3S 2W34	59
19780306	DANSIE, JESSE H.	ID	59 4619	APPLWD	2.58000	N	1900 E 2400 SWSL 3S 2W34	59
19780306	DANSIE, JESSE H.	ID	59 4619	APPLWD	2.58000	S	950 E 1050 E4SL 3S 2W33	59
19780306	DANSIE, JESSE H.	ID	59 4619	APPLWD	2.58000	N	1500 E 2000 SWSL 3S 2W33	59
19780306	DANSIE, JESSE H.	ID	59 4619	APPLWD	2.58000	S	2600 W 1450 NESL 3S 2W34	59
19780306	DANSIE, JESSE H.	ID	59 4619	APPLWD	2.58000	S	950 E4SL 3S 2W33	59
19780306	DANSIE, JESSE H.	ID	59 4619	APPLWD	2.58000	S	1500 E 1400 NWSL 3S 2W34	59
19780306	DANSIE, JESSE H.	ID	59 4619	APPLWD	2.58000	S	50 E4SL 3S 2W33	59
19780313	OPP, BARBARA K.		59 4622	APPLLAPD	0.05600	N	200 E 1040 S4SL 3S 1W17	59
19780322	DEASON, HENRY H AND MAYE W	IDS	59 4624	APPLCERT	0.01500	S	1910 W 600 N4SL 3S 1W 5	59
19780424	SULLIVAN, DOUGLAS AND ILEAN	IDS	59 4636	APPLCERT	0.01500	N	1155 E 1390 SWSL 3S 1W22	59
19780523	ALT, RAYMOND (JR.)	IDS	59 4643	APPLLAPD	0.01500	N	200 E 920 SWSL 3S 1W20	59
19780524	KENNWORTHY, EARL & BETTY	I	59 4644	APPLCERT	0.20000	N	1260 W 795 SESL 3S 1W 8	59
19780919	DICK, JAMES	I	59 4674	APPLCERT	0.22300	N	606 E 560 SWSL 2S 1W35	59
19781204	OWEN, LAVAWN R.	I	59 4107	APPLLAPD	2.00000	N	100 W 1200 SESL 3S 1W 8	59
19781205	HANSEN, KEVIN & CAROL	IDS	59 4684	APPLCERT	0.01500	N	65 W 777 SESL 3S 1W 9	59
19790423	DUTSON, LYMAN W.	IDS	59 4717	APPLCERT	0.01500	S	9 E 53 W4SL 3S 1W29	59
19790508	WARREN, DEAN T.	I S	59 4723	APPLCERT	0.02100	S	772 W 284 NESL 3S 1W 3	59
19790615	DAVIS, F. VAL	I	59 4729	APPLCERT	0.01500	S	270 E 133 W4SL 3S 1W14	59
19790801	NIELSEN, THOMAS J.	I	59 4741	APPLCERT	0.01500	S	1014 W 1937 E4SL 3S 1W21	59
19790801	NIELSEN, T. JOHN (II)	ID	59 4742	APPLCERT	0.01500	S	1014 W 1937 E4SL 3S 1W21	59
19790823	KOCH, ROBERT	ID	59 4744	APPLCERT	0.01500	N	127 E 1473 SWSL 3S 1W 2	59
19790921	BARLOW, JESSE M.	IDS	59 4749	APPLCERT	0.01500	N	1184 E 2086 W4SL 3S 1W 4	59
19791023	RICHARDSON, DUANE G.	IDS	59 4753	APPLCERT	0.01500	S	825 E 155 N4SL 3S 1W 2	59
19791101	SMITH, ALVIN R. AND SANDRA H.		59 3902	APPLLAPD	0.01500	N	2200 E 1400 SWSL 3S 1W20	59
19791116	BOWLES, WILLIAM C. AND KHYVA J.	IDS	59 4309	APPLCERT	0.01400	N	185 E 1100 SWSL 3S 1W20	59
19800314	FRAUGHTON, EDWARD J.	I	59 5529	APPLAPP	0.00000	S	1100 E 150 NWSL 3S 1W14	59
19800314	FRAUGHTON, EDWARD J.	IDS	59 4250	APPLCERT	0.16300	N	1600 E 170 W4SL 3S 1W14	59
19800318	JONES, OTTO F.	I S	59 4768	APPLCERT	0.14000	N	531 E 14 W4SL 3S 1W16	59
19800624	PETTEGREW, DONALD E. AND MERLE J. WARDLE	IDS	57 8537	APPLLAPD	0.01500	N	410 W 1720 E4SL 3S 1W27	57
19800801	BUTTERFIELD, CRAIG E.	IDS	59 4386	APPLCERT	0.01500	S	75 W 237 E4SL 3S 1W30	59
19800818	HADLEY, MARIE	ID	59 4390	APPLCERT	0.01500	N	646 W 771 SESL 3S 1W 9	59
19801004	CHRISTOFFERSON, JOHN B. AND CHERI	IDS	59 4776	APPLLAPD	0.01500	N	230 E 390 S4SL 3S 2W34	59
19801008	RASMUSSEN, KENNETH P. & ELSIE S.	IDS	59 4771	APPLCERT	0.01500	N	327 W 223 S4SL 3S 1W20	59
19801203	BLAND BROTHERS INCORPORATED	ID	59 4783	APPLCERT	0.06500	S	160 W 638 N4SL 3S 1W 3	59
19810122	SEEGRIST, ROGER	D	59 4788	APPLLAPD	0.01500	N	920 E 790 W4SL 3S 1W11	59
19810210	LUCAS, FRED	IDS	57 8567	APPLLAPD	0.01500	S	950 W 1650 NESL 3S 1W20	57
19810220	BEERS, KENNETH D.	ID O	59 4805	APPLCERT	0.06700	N	66 E 592 SWSL 2S 1W26	59

19810302	ANDERSON, NORMAN K.	I	59 4801	APPLLAPD	0.01500	S 335 W 2145 E4SL 3S 1W16	59
19810318	DANSIE, TOM	IDS	59 4807	APPLLAPD	0.01500	N 350 W 1850 SESL 3S 2W34	59
19810617	TISCHNER, PAUL R.	IDS	59 4825	APPLLAPD	0.01500	N 1030 W 2310 E4SL 3S 1W16	59
19810714	BUTCHER, WANEMA C.	IDS	59 4830	APPLLAPD	0.01500	S 45 W 490 E4SL 3S 1W16	59
19810721	SOUTHWIRE COMPANY	I O	59 4831	APPLLAPD	1.00000	S 720 W 674 NESL 3S 1W 5	59
19810728	SCHMIDT, DARLENE (C/O MABLE JENKINS)	IDS	59 4833	APPLLAPD	0.03000	S 800 E 960 W4SL 3S 1W 3	59
19810804	WALKER, E. R.	ID	59 4837	APPLLAPD	0.01500	N 340 E 1350 W4SL 3S 1W11	59
19810813	LARSEN, GERALD	IDS	59 4838	APPLLAPD	0.01500	S 180 W 967 N4SL 3S 1W32	59
19810824	THOMETZ, LOEL	ID	59 4845	APPLLAPD	0.01500	N 600 W 1610 E4SL 3S 1W16	59
19810824	NUZMAN, LESTER J.	I S	59 4842	APPLCERT	0.07000	N 404 E 165 SWSL 3S 1W 2	59
19810901	STALLINGS, REX	IDS	59 4847	APPLLAPD	0.01500	S 130 W 1550 E4SL 3S 1W22	59
19810902	STALLINGS, DON	IDS	59 4848	APPLCERT	0.01500	S 175 W 1475 E4SL 3S 1W22	59
19811102	HILL, ALLEN F.	IDS	59 4858	APPLLAPD	0.03000	N 805 E 1239 W4SL 3S 1W14	59
19811117	VANSLEEUWEN, PAUL R. & JOLEN	IDS	59 4863	APPLLAPD	0.01500	S 450 W 1700 E4SL 3S 2W34	59
19811230	HANSEN, GREG	ID	59 4869	APPLLAPD	0.01500	S 1150 E 1220 N4SL 3S 1W 3	59
19820112	VANSLEEUWEN, CON AND HENNIE	IDS	59 4871	APPLLAPD	0.01500	S 450 W 1700 E4SL 3S 2W34	59
19820219	HOLBROOK, VENILE	I S	59 4873	APPLCERT	0.01500	S 1690 W 460 NESL 3S 1W28	59
19820330	VANSLEEUWEN, RONALD & JANET	IDS	59 4877	APPLLAPD	0.01500	S 450 W 1700 E4SL 3S 2W34	59
19820601	HANSEN, CHARLES G.	IDS	59 4894	APPLLAPD	0.01500	S 920 W 1060 NESL 3S 1W27	59
19820728	SCHOUTEN, LARRY J.	ID	59 4901	APPLCERT	0.01500	N 765 E 2482 W4SL 3S 1W29	59
19820902	RUSHTON, CLINTON V. & JOAN R.	I	59 4908	APPLCERT	0.01500	S 205 E 218 W4SL 3S 1W14	59
19821007	PEASE, JANICE	IDS	59 4912	APPLLAPD	0.04500	S 1120 E 870 NWSL 3S 1W14	59
19821109	DEGRAW, DAVID L.	I	59 4917	APPLLAP	0.04500	S 235 E 460 W4SL 3S 1W14	59
19830210	IVIE, JIM DEE	IDS	59 4924	APPLAPP	0.01500	N 263 E 1425 S4SL 3S 2W33	59
19830210	IVIE, JIM DEE	IDS	59 4925	APPLAPP	0.01500	N 300 W 900 SESL 3S 2W33	59
19830228	DANSIE, KENT ALMA	IDS	59 4928	APPLLAP	0.01500	N 300 W 1950 SESL 3S 2W34	59
19830330	MCALLISTER, LYLE D.	IDS	59 4941	APPLLAPD	0.04000	S 750 W 850 N4SL 3S 1W16	59
19830330	MCALLISTER, LYLE D.	IDS	59 4941	APPLLAPD	0.04000	S 200 W 850 N4SL 3S 1W16	59
19830331	SAVAGE, EARL & CHRISTINE	IDS	59 4935	APPLLAPD	0.01500	S 240 E 420 NWSL 4S 2W 2	59
19830426	MCQUEEN, NELSON L.	IDS	59 4940	APPLCERT	0.01500	S 335 W 1255 N4SL 3S 1W28	59
19830504	HANSEN, GREGORY L.	ID	59 4942	APPLLAP	0.01500	N 400 E 600 W4SL 3S 1W 2	59
19830525	HANSEN, PAUL LEROY	IDS	59 4946	APPLLAPD	0.01500	N 100 W 1100 SESL 3S 2W33	59
19830526	BALVIN, SUSAN D.	IDS	59 4947	APPLLAPD	0.05000	N 1300 E 1200 SWSL 3S 1W 5	59
19830527	JENSEN, DONALD D. & JANE R.	I	59 4948	APPLCERT	0.02000	S 26 W 1124 NESL 3S 1W16	59
19830802	BOWMAN III, HAROLD I.	O	59 4957	APPLLAPD	0.05000	S 1420 E 810 N4SL 3S 1W27	59
19830805	KARTCHNER, EARL	IDS	59 4962	APPLLAP	0.01500	N 1050 E 1500 SWSL 3S 1W22	59
19830810	HILBERT, DEMA & GARY	IDS	59 4964	APPLLAPD	0.01500	S 120 E 1170 W4SL 3S 1W29	59
19830927	CALLISTER REAL ESTATE AND INVESTMENT CORPORATION	IDS	59 4970	APPLLAPD	0.01500	N 184 E 1100 SWSL 3S 1W20	59
19830927	CALLISTER REAL ESTATE AND INVESTMENT CORPORATION	IDS	59 4971	TEMPEXP	0.01500	N 184 E 1100 SWSL 3S 1W20	59
19831019	JU, DAVID	IDS	59 4974	APPLLAPD	0.01500	S 130 E 100 NWSL 4S 2W 2	59
19840206	SORENSON, RUSSELL	IDS	59 4982	APPLCERT	0.01500	S 1005 E 1860 NWSL 3S 1W26	59
19840309	SOUTH VALLEY WATER RECLAMATION FACILITY			APPLWDD	0.00000	N 1840 W 166 E4SL 3S 2W21	
19840504	RICE, KENNETH F. (JR.) & DIANA M.	IDS	59 4330	APPLLAPD	0.01500	N 300 E 720 SWSL 3S 1W20	59
19840507	ROWE, GLENN N. & MELODY A.	I	59 5001	APPLCERT	0.01500	S 340 W 1226 NESL 3S 1W16	59
19840507	ORME, GILBERT	IDS	59 5000	APPLLAPD	0.01500	N 1050 E 1500 SWSL 3S 1W22	59
19840606	BAKER, JOHN R.	IDS	59 5047	APPLLAPD	0.01500	S 200 W 1090 N4SL 3S 1W28	59
19840622	PONT, DONALD E	I	59 5052	APPLCERT	0.01000	N 1084 E 186 SWSL 3S 1W14	59
19840702	MADSEN, ORVILLE	I S O	59 5054	APPLLAPD	0.01500	S 100 W 1000 NESL 3S 1W32	59
19840726	YATES, J. MAC AND GLORIA RUTH	I S	59 5059	APPLCERT	0.06700	N 962 W 584 SESL 3S 1W 9	59
19841016	MASCARO, BOB	D	59 5068	APPLUNAP	0.20000	S 820 E 800 NWSL 3S 1W 8	59
19841114	GILES, LEE A. AND KATHY	IDS	59 5070	APPLLAPD	0.01500	S 250 E 2440 W4SL 3S 1W29	59
19850306	GORDON, DAL & REATHA	IDS	59 5085	APPLCERT	0.01500	N 345 W 550 SESL 3S 2W33	59
19850306	HOLMAN, BOBBY JOE	IDS	59 5084	APPLLAPD	0.01500	N 343 W 551 SESL 3S 2W33	59
19850326	SCHOUDEL, JAMES E. AND SANDRA	IDS	59 5089	APPLLAPD	0.01500	N 343 W 551 SESL 3S 2W33	59
19850506	WHELWRIGHT, DAVID A. AND MAVIS G.	I	59 5101	APPLAPP	0.05400	N 65 W 777 SESL 3S 1W 9	59
19850520	PRICE, JOHN L.	IDS	59 4813	APPLLAPD	0.13300	S 1260 E 200 N4SL 3S 1W 4	59
19850604	HATT, THIEL F.	I	59 5105	APPLLAPD	0.02200	S 550 W 420 N4SL 3S 1W14	59

19850614	SOUTH VALLEY WATER RECLAMATION FACILITY	O	59 5108	APPLCERT	0.01500	N	100 W 2100 SESL 3S 2W21	59
19850619	SPIERS, LORAINE T. AND GARTH	IDS	59 5122	APPLLAP	0.01500	S	80 E 855 W4SL 3S 1W29	59
19850619	EKINS, RONALD W.		59 4963	APPLAPP	0.01500	S	80 E 590 W4SL 3S 1W29	59
19850626	SCHMIDT, HENRY F.	I	59 5126	APPLAPP	0.75000	N	2640 W 1100 S4SL 3S 1W 3	59
19850705	CLARK, NEAL	I	59 5130	APPLLAPD	0.02500	N	1850 E 150 SWSL 3S 1W14	59
19850709	JONES, JOAN E.	IDS	59 4596	APPLLAPD	0.07800	S	100 E 180 NWSL 3S 1W16	59
19850808	KARTCHNER, EARL	IDS	59 5133	APPLLAP	0.01500	N	2500 E 150 S4SL 3S 1W29	59
19850821	BELCHAK TRUSTEES, THOMAS A. & CHRISTINE J.	IDS	59 5138	APPLAPP	0.10000	N	550 E 800 SWSL 3S 1W 7	59
19850911	HOOGVELDT, MARTIN M.	IDS	59 5140	APPLLAPD	0.01500	N	2460 E 60 S4SL 3S 1W29	59
19851210	SOUTH JORDAN, CITY OF	C	59 5152	APPLUNAP	3.50000	N	1540 W 640 SESL 3S 1W10	59
19851210	SOUTH JORDAN, CITY OF	C	59 5152	APPLUNAP	3.50000	S	400 W 50 E4SL 3S 1W10	59
19851210	SOUTH JORDAN, CITY OF	C	59 5152	APPLUNAP	3.50000	N	1540 E 920 S4SL 3S 1W10	59
19860411	SOUTH JORDAN CITY	C	59 5171	APPLUNAP	3.00000	N	200 E 2800 SWSL 3S 2W24	59
19860411	SOUTH JORDAN CITY	C	59 5169	APPLUNAP	3.00000	S	200 E 200 NWSL 3S 1W10	59
19860411	SOUTH JORDAN CITY	C	59 5170	APPLUNAP	3.00000	N	200 W 2400 SESL 3S 2W23	59
19860429	VANSLEEUWEN, CON	ID	59 5173	APPLLAPD	0.01500	S	450 W 1700 E4SL 3S 2W34	59
19860611	SALT LAKE COUNTY	I	59 5179	APPLAPP	2.00000	S	970 W 1265 NESL 3S 1W 4	59
19860701	DOXEY, SCOTT T.	IDS	59 5185	APPLCERT	0.01500	S	1300 W 730 N4SL 3S 1W 8	59
19860703	GAILEY, SHARON	ID	59 4903	APPLLAPD	0.01500	S	350 W 485 NESL 3S 1W16	59
19860812	PUZEY, NAD	IDS	59 4786	APPLLAPD	0.01500	S	700 E 2200 NWSL 3S 1W26	59
19860820	HAMILTON, RALPH	IDS	59 5204	APPLCERT	0.01500	S	335 E 105 NWSL 4S 2W 2	59
19860917	ANDERSON, DAVIS N.	IDS	59 5206	APPLCERT	0.01500	N	625 W 175 S4SL 3S 1W29	59
19861201	KENNECOTT UTAH COPPER CORPORATION	O	59 5209	APPLCERT	1.04000	S	694 E 1256 NWSL 3S 2W27	59
19870116	BURRUP, RONALD L.	ID	59 5215	APPLCERT	0.05000	S	389 W 1049 NESL 3S 1W16	59
19870325	ALLEN, R. THAD	I	59 5217	APPLLAP	0.01500	N	610 E 965 W4SL 3S 1W11	59
19870409	THOMPSON, SHONNA F.	ID	59 5219	APPLLAPD	0.01500	N	40 W 1905 E4SL 3S 1W27	59
19870529	PEINE, FRED	IDS	59 5228	APPLUNAP	0.05000	S	800 E 855 NWSL 3S 1W 4	59
19870612	WILEY, ROBERT G.	ID	59 5229	APPLCERT	0.01500	N	117 W 286 SESL 3S 1W 9	59
19870803	MITCHELL, ARTHUR O. AND LEVARA	I S	59 5233	APPLCERT	0.01300	N	1720 W 217 SESL 3S 2W34	59
19870903	BOOTH BRENT T. & KAREN N.	I S	59 5240	APPLCERT	0.01500	N	1972 W 1219 SESL 3S 1W29	59
19870923	WALKER, LYNN	I	59 5244	APPLCERT	0.01500	N	721 E 419 W4SL 3S 1W 8	59
19871103	MECHAM, LOUIS F.	IDS	59 5246	APPLLAPD	0.01500	S	240 E 750 NWSL 4S 2W 3	59
19880122	BELCHAK, THOMAS A.	IDS	59 5251	APPLAPP	0.01500	N	550 E 950 SWSL 3S 1W 7	59
19880304	BOWLES, ROBERT I.	I	59 4751	APPLAPP	1.16000	S	300 E 710 NWSL 3S 2W35	59
19880513	EGBERT, SUSAN	I	59 13	APPLWD	0.00000	N	521 E 14 W4SL 3S 1W16	59
19880809	WILCOX, LORETTA	IDS	59 5074	APPLCERT	0.01500	S	1471 W 151 NESL 3S 1W30	59
19890525	HANSEN, KEVIN	I	59 5096	APPLCERT	0.04000	N	65 W 777 SESL 3S 1W 9	59
19890619	VANLEUVEN, E. WAYNE & LUCRECIA C.	I	59 5102	APPLAPP	0.05400	N	65 W 777 SESL 3S 1W 9	59
19890621	SCHMIDT TRUST, HENRY F.	I	59 5312	APPLREJ	0.14900	N	2640 W 1100 S4SL 3S 1W 3	59
19890622	BUTTERFIELD, CINDY B.	IDS	59 5091	APPLAPP	0.01500	S	200 W 60 N4SL 3S 1W30	59
19890915	KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	0.89000	S	2664 E 683 NWSL 3S 2W17	59
19890915	KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	0.89000	S	2700 E 690 NWSL 3S 2W17	59
19900608	MOOSMAN, GLEN	D	59 4953	APPLLAP	0.04500	N	1050 W 2500 E4SL 3S 1W 4	59
19900621	EKINS, RONALD W.	IDS	59 4963	APPLLAPD	0.01500	S	80 E 590 W4SL 3S 1W29	59
19900717	JONES, HAL H.	ID	59 5296	APPLAPP	0.01500	S	350 W 485 NESL 3S 1W16	59
19900821	SPOERRI, AUGUST F.	ID	59 5305	APPLLAP	0.01500	N	810 W 300 SESL 3S 1W 8	59
19901109	FOOTHILL WATER COMPANY		59 1608	APPLEXP	0.50000	S	758 E 1350 W4SL 3S 2W33	59
19901203	TOLBERT, CLINTON BERNELL AND CONNIE (TRUST)	IDS	59 5315	APPLREJ	0.50000	N	335 W 900 SESL 3S 2W12	59
19901203	TOLBERT, CLINTON BERNELL AND CONNIE (TRUST)	IDS	59 5316	FIXDAPP	0.01500	N	335 W 900 SESL 3S 2W12	59
19910416	WITHERSPOON, JAMES R.	IDS	59 5324	APPLAPP	0.01500	N	1110 E 655 S4SL 3S 2W33	59
19910501	BRADLEY, JAN	I	59 5248	APPLAPP	0.01500	N	450 W 450 E4SL 3S 1W28	59
19911008	STROH, KIMBERLY S.	IDS	59 5333	FIXDLAP	0.01500	S	660 W 1900 E4SL 3S 2W34	59
19911217	FOOTHILL WATER COMPANY		59 1608	APPLEXP	0.50000	S	758 E 1350 W4SL 3S 2W33	59
19920205	BELCHAK, THOMAS A. AND CHRISTINE J.		59 5138	APPLAPP	0.10000	N	550 E 800 SWSL 3S 1W 7	59
19920402	KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	0.89000	S	2664 E 638 NWSL 3S 2W17	59
19920402	KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	0.89000	S	2700 E 690 NWSL 3S 2W17	59
19920415	SALT LAKE COUNTY	I	59 5179	APPLAPP	2.00000	S	970 W 1265 NESL 3S 1W 4	59

19920825	GORDON, SCOTT	IDS	59 5364	FIXDLAP	0.00000	N 30 W 400 SESL 3S 2W33	59
19920914	FOOTHILLS WATER COMPANY	IDS	59 3879	APPLEXP	0.00000	S 740 E 1330 W4SL 3S 2W33	59
19921015	FITZGERALD, DENNIS	IDS	59 5374	FIXDAPP	0.01500	N 345 W 550 SESL 3S 2W33	59
19921217	SCHMIDT, HENRY F.	I	59 4258	APPLAPP	0.25000	N 875 W 460 S4SL 3S 1W 3	59
19921217	SCHMIDT, HENRY F. (TRUST)		59 4258	APPLAPP	0.25000	N 865 W 455 S4SL 3S 1W 3	59
19921217	SCHMIDT, HENRY F. (TRUST)		59 4258	APPLAPP	0.25000	N 875 W 460 S4SL 3S 1W 3	59
19921217	SCHMIDT, HENRY F. (TRUST)		59 4258	APPLAPP	0.25000	N 875 W 470 S4SL 3S 1W 3	59
19921217	SCHMIDT, HENRY F. (TRUST)		59 4258	APPLAPP	0.25000	N 870 W 455 S4SL 3S 1W 3	59
19921217	SCHMIDT, HENRY F.	I	59 4258	APPLAPP	0.25000	N 870 W 455 S4SL 3S 1W 3	59
19921217	SCHMIDT, HENRY F.	I	59 4258	APPLAPP	0.25000	N 2640 W 1100 S4SL 3S 1W 3	59
19921217	SCHMIDT, HENRY F.	I	59 4258	APPLAPP	0.25000	N 875 W 470 S4SL 3S 1W 3	59
19921217	SCHMIDT, HENRY F. (TRUST)		59 4258	APPLAPP	0.25000	N 865 W 460 S4SL 3S 1W 3	59
19921217	SCHMIDT, HENRY F.	I	59 4258	APPLAPP	0.25000	N 865 W 455 S4SL 3S 1W 3	59
19921217	SCHMIDT, HENRY F.	I	59 4258	APPLAPP	0.25000	N 865 W 460 S4SL 3S 1W 3	59
19930104	DANSIE, RICHARD PAUL	IDS	59 5383	FIXDAPP	0.00000	N 1300 W 100 S4SL 3S 2W34	59
19930412	LEE, KEVIN M.	IDS	59 5390	FIXDAPP	0.01500	N 345 W 550 SESL 3S 2W33	59
19930430	TRUJILLO FAMILY TRUST	S	59 5394	APPLAPP	0.01500	S 30 W 520 NESL 3S 1W10	59
19940119	KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	0.89000	S 2700 E 690 NWSL 3S 2W17	59
19940119	KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	0.89000	S 2664 E 683 NWSL 3S 2W17	59
19940217	HERRIMAN PIPELINE AND DEVELOPMENT COMPANY		59 5258	APPLAPP	1.00000	N 1711 W 1316 SESL 3S 2W34	59
19940217	HERRIMAN PIPELINE AND DEVELOPMENT COMPANY		59 5258	APPLAPP	1.00000	N 2020 W 100 SESL 3S 2W34	59
19940302	SALT LAKE COUNTY	I	59 5425	APPLAPP	2.00000	S 1195 W 1280 NESL 3S 1W 4	59
19940302	SALT LAKE COUNTY	I	59 5425	APPLAPP	2.00000	S 970 W 1265 NESL 3S 1W 4	59
19940511	DE LIA, JULIAN E.	IDS	59 5440	FIXDLAP	0.01500	N 418 W 1650 SESL 3S 2W33	59
19950103	RIVERTON CITY	C	59 1533	APPLAPP	5.00000	N 113 W 786 NESL 3S 1W32	59
19950126	KENNECOTT UTAH COPPER CORPORATION		59 945	APPLEXP	2.00000	S 100 E 250 NWSL 3S 2W27	59
19950126	KENNECOTT UTAH COPPER CORPORATION		59 3	APPLEXP	2.00000	S 3700 E 4250 NWSL 3S 2W16	59
19950731	IWAMOTO, TAKEO	I O	59 4544	APPLWD	0.02200	S 110 W 460 N4SL 3S 1W10	59
19950811	KENNECOTT UTAH COPPER CORPORATION		59 3	APPLAPP	3.00000	S 115 W 2634 NESL 3S 2W27	59
19960226	KENNECOTT UTAH COPPER CORPORATION		59 945	APPLAPP	2.00000	S 100 E 250 NWSL 3S 2W27	59
19960226	KENNECOTT UTAH COPPER CORPORATION		59 3	APPLAPP	2.00000	S 3700 E 4250 NWSL 3S 2W16	59
19960314	HYMAS, CHAD	ID	59 5525	FIXDAPP	0.00000	N 764 W 80 SESL 3S 2W33	59
19960314	TURNER, LARRY J.	ID	59 5524	FIXDAPP	0.00000	N 964 W 180 SESL 3S 2W33	59
19960412	RIVERTON (CITY OF)	C	59 1554	APPLAPP	1.50000	S 320 W 122 NESL 3S 1W31	59
19960612	JORDAN VALLEY WATER CONSERVANCY DISTRICT		59 1536	APPLAPP	5.00000	S 840 W 250 E4SL 3S 2W26	59
19960823	KENNECOTT UTAH COPPER CORPORATION		59 3	APPLUNAP	3.00000	S 115 W 2634 NESL 3S 2W27	59
19961114	LARSEN, TERRY AND LINDA LUZITANO	I	59 5546	APPLREJ	0.00000	S 1055 W 325 N4SL 3S 1W26	59
19961121	TURNER, FRANK P.	IDS	59 5547	FIXDAPP	0.00000	N 764 W 80 SESL 3S 2W33	59
19961121	TURNER, LARRY J.		59 5524	APPLWD	0.00000	N 764 W 80 SESL 3S 2W33	59
19961210	HYMAS, CHAD		59 5525	APPLAPP	0.00000	N 764 W 80 SESL 3S 2W33	59
19970220	KENNECOTT UTAH COPPER CORPORATION		59 3	APPLAPP	2.00000	S 3700 E 4250 NWSL 3S 2W16	59
19970501	DANSIE, A. BRENT	IDS	59 5565	TEMPAPP	0.00000	N 1096 E 27 S4SL 3S 2W34	59
19970616	GORDON, DAL & REATHA		59 5085	APPLAPP	0.00000	N 255 W 160 SESL 3S 2W33	59
19970818	KENNECOTT UTAH COPPER CORPORATION		59 3	APPLAPP	3.00000	S 115 W 2634 NESL 3S 2W27	59
19980121	DANSIE, A. BRENT AND ALYCE ANN	IDS O	59 5571	APPLAPP	0.00000	N 1096 E 27 S4SL 3S 2W34	59
19980121	DANSIE, A. BRENT AND ALYCE ANN	IDS O	59 5571	APPLAPP	0.00000	N 900 E 100 S4SL 3S 2W34	59
19980424	CARTER, MYRNA B. (FAMILY TRUST AGREEMENT)		59 5581	APPLAPP	0.00000	N 1330 W 1050 S4SL 3S 2W35	59
19980424	CARTER, MYRNA B. (FAMILY TRUST AGREEMENT)		59 5581	APPLAPP	0.00000	N 1450 W 1230 S4SL 3S 2W35	59
19980617	HAMILTON, LOWELL AND MARY L.	I	59 2720	APPLAPP	0.00000	S 400 W 300 NESL 4S 2W 3	59
19980617	HAMILTON PROPERTIES L.C., LOWELL W.	I	59 5582	APPLAPP	0.00000	S 400 W 1320 NESL 4S 2W 3	59
19980617	HAMILTON PROPERTIES L.C., LOWELL W.	I	59 5582	APPLAPP	0.00000	S 400 W 300 NESL 4S 2W 3	59
19980617	HAMILTON, LOWELL AND MARY L.	I	59 2720	APPLAPP	0.00000	S 400 W 1320 NESL 4S 2W 3	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	S 2210 W 1372 NESL 3S 2W34	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	N 1412 W 7 SESL 3S 2W33	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	N 1485 W 244 S4SL 3S 2W34	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	S 1428 W 1425 NESL 3S 2W34	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	S 52 E 5 W4SL 3S 2W34	59

19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	S 1159 E 2344 W4SL 3S 2W33	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	N 279 W 1167 S4SL 3S 2W34	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	S 837 W 48 N4SL 4S 2W 3	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	N 2059 W 492 S4SL 3S 2W34	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	S 593 E 1362 W4SL 3S 2W33	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	S 2818 W 1395 NESL 3S 2W34	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	N 99 W 327 S4SL 3S 2W34	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	S 1347 W 2614 NESL 3S 2W34	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	S 1363 E 1358 NWSL 3S 2W34	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	N 1239 E 872 SWSL 3S 2W34	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	S 758 E 1350 W4SL 3S 2W33	59
19980728	DANSIE, JESSE RODNEY	DS	59 1200	APPLUNAP	1.62700	S 662 E 44 NWSL 4S 2W 3	59
19990205	KENNECOTT UTAH COPPER CORPORATION		59 3	APPLAPP	3.00000	S 115 W 2634 NESL 3S 2W27	59
19990422	BRIGHTON AND NORTH POINT IRRIGATION COMPANY	C	59 5607	APPLUNAP	0.00000	S 770 E 1490 NWSL 3S 1W26	59
19990713	IWAMOTO, TAKEO		59 4544	APPLAPP	0.02200	S 110 W 460 N4SL 3S 1W10	59
	BARKER, CLYDE		59 1117	APPLDIS	0.01500	N 1224 E 90 S4SL 2S 1W34	59
	ATWOOD, JAMES		59 1282	APPLDIS	0.01500	S 2435 E 10 N4SL 3S 1W 5	59
19710603	BAUER, MERRILL R.	I S	59 3810	APPLCERT	0.100	S 1330 E 260 NWSL 2S 1W28	59
19820625	IVERSON, LE GRAND	I	59 4898	APPLLAPD	0.045	N 1330 E 1040 S4SL 2S 1W28	59

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 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 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 review this proposal for aquifer and water-user protection in the southwestern Jordan Valley. Kennecott believes this strategy will prevent additional migration of existing contamination, protect current and potential groundwater users, and facilitate remediation of groundwater in the area. If you agree, Kennecott would like to participate with you in presenting this proposal to the public.

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

APPENDIX F

From: "Lewandowski, Jeff" <LewandowskiJA@cdm.com>
To: "Richard Bay (E-mail)" <RICHARDB@jvwcd.org>
Date: 4/18/00 1:36AM
Subject: Cost Tables for the Concentrate Pipeline to CVWRF

Richard,

Attached is a spreadsheet which includes the two data tables from the Appendix and information for Table 7-2 in the text. The 10 percent contingency calculations are on the "Cost Breakdown - 10% (3)" tab, and the 40 percent contingency calculations are on the "Cost Breakdown - 40% (3)" tab.
<<Cost Summary and Present Worth Calculation03.xls>>

Changes are highlighted in yellow. The following changes were made from the table presented in the November 1999 report:

1) Zone A - No changes in annual or capital costs. The total present value calculation was modified to provide a 13.80 P/A factor for 7% at 50 years, rather than the 13.08 factor. This was done for all calculated present values from the annual costs.

2) Zone B - Base Capital Cost for pipelines is increased for half the cost of the longer pipeline to Central Valley Plant. Pumping costs are reduced since concentrate will not need to be pumped. Pipeline maintenance is increased from increase in pipeline costs.

3) Shallow Wells - Base Capital Cost for pipelines is increased for half the cost of the longer pipeline to Central Valley Plant.

4) Conceptual Project Enhancement - Increased shallow well pumping cost to match spreadsheet values - increased to $278,000 annually.

5) The permeate pumping costs were not changed from the original design. These will be dependent upon how the flow is split between the Jordan Aqueduct and the JVWCD system. The most appropriate assumption seemed to be to use the original flow split - Shallow Well to JA and Deep Well to JVWCD.

I will fax copies of the information to you, just in case you cannot open the spreadsheet file. I will be in after 8:30 AM if you have any questions. I will plan to create a one page memo describing the change in concentrate disposal as I had discussed with Mark A.

Jeff Lewandowski, D. Eng., P.E.
Camp Dresser & McKee
Walnut Creek, CA 94598

CC: "Brown, Douglas" <BrownDR@cdm.com>

The attached summary sheet has manual input figures for all cost in the capital cost spreadsheet and the O&M Replacement spreadsheets.

The rest of the figures are calculations based on the information in the three spreadsheets.

Present worth factors and annualized cost factors are included in the formulas.

Conceptual Design Recommended Project Cost Breakdown (10% Contingency)

		Annual Cost	Base Capital Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	Trust Fund Costs	NRD Costs		
Zone A										
Capital	Treatment Plant	N/A	$4,738,063	$1,753,083	$1,947,344	$8,438,490	$8,438,490	N/A		
	Pipelines	N/A	$1,499,000	$149,900	$494,670	$2,143,570	$2,143,570	N/A		
	Wells	N/A	$0	$0	$0	$0	$0	N/A	$10,582,060	
O&M	Treatment Plant	$365,376	N/A	N/A	N/A	$5,042,189	$5,042,189	N/A		
	Pumping	$442,000	N/A	N/A	N/A	$6,099,600	$6,099,600	N/A	$11,141,789	
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$883,318	$883,318	N/A		$0
	Wells	N/A	N/A	N/A	N/A	$11,052	$11,052	N/A		
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$30,373	$30,373	N/A	$924,743	
Subtotal		*$807,376*	*$6,237,063*	*$1,902,983*	*$2,442,014*	*$22,648,592*	*$22,648,592*	*$0*	*$22,648,592*	
Zone B										
Capital	Treatment Plant	N/A	$4,457,063	$1,649,113	$1,831,853	$7,938,029	$7,938,029	N/A		
	Pipelines	N/A	$3,380,000	$338,000	$1,115,400	$4,833,400	$4,833,400	N/A		
	Wells	N/A	$2,160,000	$216,000	$712,800	$3,088,800	$3,088,800	N/A	$15,860,229	
O&M	Treatment Plant	$317,420	N/A	N/A	N/A	$4,151,854	$4,151,854	N/A		
	Pumping	$393,000	N/A	N/A	N/A	$5,140,440	$5,140,440	N/A	$9,292,294	
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$801,334	$801,334	N/A		
	Wells	N/A	N/A	N/A	N/A	$44,208	$44,208	N/A		
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$68,486	$68,486	N/A	$914,028	
Subtotal		*$710,420*	*$9,997,063*	*$2,203,113*	*$3,660,053*	*$26,066,551*	*$26,066,551*	*$0*	*$26,066,551*	
Shallow Wells										
Capital	Treatment Plant	N/A	$2,920,538	$1,080,599	$1,200,341	$5,201,478	N/A	$5,201,478		
	Pipelines	N/A	$1,334,000	$133,400	$440,220	$1,907,620	N/A	$1,907,620		
	Wells	N/A	$150,000	$15,000	$49,500	$214,500	N/A	$214,500	$7,323,598	
O&M	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	Pumping	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0	
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0	
Subtotal		*$0*	*$4,404,538*	*$1,228,999*	*$1,690,061*	*$7,323,598*	*$0*	*$7,323,598*	*$7,323,598*	
Total		**$1,517,796**	**$20,638,664**	**$5,335,096**	**$7,792,128**	**$56,038,740**	**$48,715,142**	**$7,323,598**	**$56,038,740**	

1. 10% Design Contingency, 27% Contractors OH&P for Treatment Plant, 10% Design Contingency only for Pipelines and Wells.
2. 13% Predesign and Final design, 7% construction services, 5% on site services, 5% change order allowance

Conceptual Design Project Enhancement Cost Breakdown (10% Contingency)

		Annual Cost	Base Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	JVWCD Costs	
Zone A								
Capital	Treatment Plant	N/A	$175,000	$64,750	$71,925	$311,675	$311,675	
	Pipelines	N/A	$0	$0	$0	$0	$0	
	Wells	N/A	$0	$0	$0	$0	$0	$311,675
O&M	Treatment Plant	$25,120	N/A	N/A	N/A	$328,570	$328,570	
	Pumping	$10,200	N/A	N/A	N/A	$133,416	$133,416	$461,986
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	60,943.49	$60,943	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$0	$0	$60,943
Subtotal		*$35,320*	*$175,000*	*$64,750*	*$71,925*	*$834,604*	*$834,604*	*$834,604*
Zone B								
Capital	Treatment Plant	N/A	$1,363,467	$504,483	$560,385	$2,428,335	$2,428,335	
	Pipelines	N/A	$344,000	$34,400	$113,520	$491,920	$491,920	
	Wells	N/A		$0	$0	$0	$0	$2,920,255
O&M	Treatment Plant	$53,665	N/A	N/A	N/A	$701,938	$701,938	
	Pumping	$66,900	N/A	N/A	N/A	$875,052	$875,052	$1,576,990
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$234,234	$234,234	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$6,970	$6,970	$241,204
Subtotal		*$120,565*	*$1,707,467*	*$538,883*	*$673,905*	*$4,738,449*	*$4,738,449*	*$4,738,449*
Shallow Wells								
Capital	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	
	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	$0
O&M	Treatment Plant	$15,985	N/A	N/A	N/A	$209,084	$209,084	
	Pumping	$245,900	N/A	N/A	N/A	$3,216,372	$3,216,372	$3,425,456
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$630,366	$630,366	
	Wells	N/A	N/A	N/A	N/A	$22,104	$22,104	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$27,030	$27,030	$679,500
Subtotal		*$261,885*	*$0*	*$0*	*$0*	*$4,104,955*	*$4,104,955*	*$4,104,955*
Total		**$417,770**	**$1,882,467**	**$603,633**	**$745,830**	**$9,678,008**	**$9,678,008**	**$9,678,008**
								$65,716,748

Conceptual Design Recommended Project Cost Breakdown (10% Contingency)

		Annual Cost	Base Capital Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	Trust Fund Costs	NRD Costs		
Zone A										
Capital	Treatment Plant	N/A	$4,738,063	$1,753,083	$1,947,344	$8,438,490	$8,438,490	N/A		
	Pipelines	N/A	$1,499,000	$149,900	$494,670	$2,143,570	$2,143,570	N/A		
	Wells	N/A	$0	$0	$0	$0	$0	N/A	$10,582,060	
O&M	Treatment Plant	$365,376	N/A	N/A	N/A	$4,779,118	$4,779,118	N/A		
	Pumping	$442,000	N/A	N/A	N/A	$5,781,360	$5,781,360	N/A	$10,560,478	
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$883,318	$883,318	N/A		$0
	Wells	N/A	N/A	N/A	N/A	$11,052	$11,052	N/A		
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$30,373	$30,373	N/A	$924,743	
Subtotal		*$807,376*	*$6,237,063*	*$1,902,983*	*$2,442,014*	*$22,067,281*	*$22,067,281*	*$0*	*$22,067,281*	
Zone B										
Capital	Treatment Plant	N/A	$5,224,530	$1,933,076	$2,147,282	$9,304,888	$9,304,888	N/A		
	Pipelines	N/A	$3,380,000	$338,000	$1,115,400	$4,833,400	$4,833,400	N/A		
	Wells	N/A	$2,160,000	$216,000	$712,800	$3,088,800	$3,088,800	N/A	$17,227,088	
O&M	Treatment Plant	$317,420	N/A	N/A	N/A	$4,151,854	$4,151,854	N/A		
	Pumping	$393,000	N/A	N/A	N/A	$5,140,440	$5,140,440	N/A	$9,292,294	
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$865,797	$865,797	N/A		
	Wells	N/A	N/A	N/A	N/A	$44,208	$44,208	N/A		
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$68,486	$68,486	N/A	$978,490	
Subtotal		*$710,420*	*$10,764,530*	*$2,487,076*	*$3,975,482*	*$27,497,872*	*$27,497,872*	*$0*	*$27,497,872*	
Shallow Wells										
Capital	Treatment Plant	N/A	$2,920,538	$1,080,599	$1,200,341	$5,201,478	N/A	$5,201,478		
	Pipelines	N/A	$1,334,000	$133,400	$440,220	$1,907,620	N/A	$1,907,620		
	Wells	N/A	$150,000	$15,000	$49,500	$214,500	N/A	$214,500	$7,323,598	
O&M	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	Pumping	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0	
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0	
Subtotal		*$0*	*$4,404,538*	*$1,228,999*	*$1,690,061*	*$7,323,598*	*$0*	*$7,323,598*	*$7,323,598*	
Total		$1,517,796	$21,406,131	$5,619,058	$8,107,557	$56,888,751	$49,565,152	$7,323,598	$56,888,751	

1. 10% Design Contingency, 27% Contractors OH&P for Treatment Plant, 10% Design Contingency only for Pipelines and Wells.
2. 13% Predesign and Final design, 7% construction services, 5% on site services, 5% change order allowance

Conceptual Design Project Enhancement Cost Breakdown (10% Contingency)

		Annual Cost	Base Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	JVWCD Costs	
Zone A								
Capital	Treatment Plant	N/A	$175,000	$64,750	$71,925	$311,675	$311,675	
	Pipelines	N/A	$0	$0	$0	$0	$0	
	Wells	N/A	$0	$0	$0	$0	$0	$311,675
O&M	Treatment Plant	$25,120	N/A	N/A	N/A	$328,570	$328,570	
	Pumping	$10,200	N/A	N/A	N/A	$133,416	$133,416	$461,986
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$60,943	$60,943	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$0	$0	$60,943
Subtotal		*$35,320*	*$175,000*	*$64,750*	*$71,925*	*$834,604*	*$834,604*	*$834,604*
Zone B								
Capital	Treatment Plant	N/A	$596,000	$220,520	$244,956	$1,061,476	$1,061,476	
	Pipelines	N/A	$344,000	$34,400	$113,520	$491,920	$491,920	
	Wells	N/A		$0	$0	$0	$0	$1,553,396
O&M	Treatment Plant	$53,665	N/A	N/A	N/A	$701,938	$701,938	
	Pumping	$66,900	N/A	N/A	N/A	$875,052	$875,052	$1,576,990
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$177,026	$177,026	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$6,970	$6,970	$183,996
Subtotal		*$120,565*	*$940,000*	*$254,920*	*$358,476*	*$3,314,383*	*$3,314,383*	*$3,314,383*
Shallow Wells								
Capital	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	
	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	$0
O&M	Treatment Plant	$15,985	N/A	N/A	N/A	$209,084	$209,084	
	Pumping	$245,900	N/A	N/A	N/A	$3,216,372	$3,216,372	$3,425,456
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$630,366	$630,366	
	Wells	N/A	N/A	N/A	N/A	$22,104	$22,104	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$27,030	$27,030	$679,500
Subtotal		*$261,885*	*$0*	*$0*	*$0*	*$4,104,955*	*$4,104,955*	*$4,104,955*
Total		$417,770	$1,115,000	$319,670	$430,401	$8,253,942	$8,253,942	$8,253,942
								$65,142,693

Table 7-2

	Capital Costs	Annual O&M	Present O&M	Replacement	Total
Zone A	$10,580,000	$810,000	$10,560,000	$920,000	$22,060,000
JVWCD Zone A	**$310,000**	**$40,000**	**$460,000**	**$60,000**	**$830,000**
Zone B	$17,230,000	$710,000	$9,290,000	$980,000	$27,500,000
Shallow Wells	$7,320,000	N/A	N/A	N/A	$7,320,000
JVWCD SW	**N/A**	**$260,000**	**$3,430,000**	**$680,000**	**$4,110,000**
JVWCD Zone B	**$1,550,000**	**$120,000**	**$1,580,000**	**$180,000**	**$3,310,000**
TRUST FUND	$35,130,000	$1,520,000	$19,850,000	$1,900,000	$56,880,000
JVWCD	**$1,860,000**	**$420,000**	**$5,470,000**	**$920,000**	**$8,250,000**
					$65,130,000

Conceptual Design Recommended Project Cost Breakdown (10% Contingency)

		Annual Cost	Base Capital Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	Trust Fund Costs	NRD Costs		
Zone A										
Capital	Treatment Plant	N/A	$4,738,063	$1,753,083	$1,947,344	$8,438,490	$8,438,490	N/A		
	Pipelines	N/A	$1,499,000	$149,900	$494,670	$2,143,570	$2,143,570	N/A		
	Wells	N/A	$0	$0	$0	$0	$0	N/A	$10,582,060	
O&M	Treatment Plant	$365,376	N/A	N/A	N/A	$5,042,189	$5,042,189	N/A		
	Pumping	$442,000	N/A	N/A	N/A	$6,099,600	$6,099,600	N/A	$11,141,789	
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$883,318	$883,318	N/A		$0
	Wells	N/A	N/A	N/A	N/A	$11,052	$11,052	N/A		
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$30,373	$30,373	N/A	$924,743	
Subtotal		*$807,376*	*$6,237,063*	*$1,902,983*	*$2,442,014*	*$22,648,592*	*$22,648,592*	*$0*	*$22,648,592*	
Zone B										
Capital	Treatment Plant	N/A	$4,457,063	$1,649,113	$1,831,853	$7,938,029	$7,938,029	N/A		
	Pipelines	N/A	$4,072,400	$407,240	$1,343,892	$5,823,532	$5,823,532	N/A		
	Wells	N/A	$2,160,000	$216,000	$712,800	$3,088,800	$3,088,800	N/A	$16,850,361	
O&M	Treatment Plant	$317,420	N/A	N/A	N/A	$4,380,396	$4,380,396	N/A		
	Pumping	$310,000	N/A	N/A	N/A	$4,278,000	$4,278,000	N/A	$8,658,396	
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$801,334	$801,334	N/A		
	Wells	N/A	N/A	N/A	N/A	$44,208	$44,208	N/A		
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$82,515	$82,515	N/A	$928,057	
Subtotal		*$627,420*	*$10,689,463*	*$2,272,353*	*$3,888,545*	*$26,436,815*	*$26,436,815*	*$0*	*$26,436,815*	
Shallow Wells										
Capital	Treatment Plant	N/A	$2,920,538	$1,080,599	$1,200,341	$5,201,478	N/A	$5,201,478		
	Pipelines	N/A	$2,518,400	$251,840	$831,072	$3,601,312	N/A	$3,601,312		
	Wells	N/A	$150,000	$15,000	$49,500	$214,500	N/A	$214,500	$9,017,290	
O&M	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	Pumping	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0	
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0	
Subtotal		*$0*	*$5,588,938*	*$1,347,439*	*$2,080,913*	*$9,017,290*	*$0*	*$9,017,290*	*$9,017,290*	
Total		**$1,434,796**	**$22,515,464**	**$5,522,776**	**$8,411,472**	**$58,102,696**	**$49,085,406**	**$9,017,290**	**$58,102,696**	

1. 10% Design Contingency, 27% Contractors OH&P for Treatment Plant, 10% Design Contingency only for Pipelines and Wells.
2. 13% Predesign and Final design, 7% construction services, 5% on site services, 5% change order allowance

Conceptual Design Project Enhancement Cost Breakdown (10% Contingency)

		Annual Cost	Base Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	JVWCD Costs	
Zone A								
Capital	Treatment Plant	N/A	$175,000	$64,750	$71,925	$311,675	$311,675	
	Pipelines	N/A	$0	$0	$0	$0	$0	
	Wells	N/A	$0	$0	$0	$0	$0	$311,675
O&M	Treatment Plant	$25,120	N/A	N/A	N/A	$346,656	$346,656	
	Pumping	$10,200	N/A	N/A	N/A	$140,760	$140,760	$487,416
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$60,943	$60,943	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$0	$0	$60,943
Subtotal		*$35,320*	*$175,000*	*$64,750*	*$71,925*	*$860,034*	*$860,034*	*$860,034*
Zone B								
Capital	Treatment Plant	N/A	$1,363,467	$504,483	$560,385	$2,428,335	$2,428,335	
	Pipelines	N/A	$344,000	$34,400	$113,520	$491,920	$491,920	
	Wells	N/A		$0	$0	$0	$0	$2,920,255
O&M	Treatment Plant	$53,665	N/A	N/A	N/A	$740,577	$740,577	
	Pumping	$66,900	N/A	N/A	N/A	$923,220	$923,220	$1,663,797
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$234,234	$234,234	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$6,970	$6,970	$241,204
Subtotal		*$120,565*	*$1,707,467*	*$538,883*	*$673,905*	*$4,825,256*	*$4,825,256*	*$4,825,256*
Shallow Wells								
Capital	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	
	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	$0
O&M	Treatment Plant	$15,985	N/A	N/A	N/A	$220,593	$220,593	
	Pumping	$278,000	N/A	N/A	N/A	$3,836,400	$3,836,400	$4,056,993
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$630,366	$630,366	
	Wells	N/A	N/A	N/A	N/A	$22,104	$22,104	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$27,030	$27,030	$679,500
Subtotal		*$293,985*	*$0*	*$0*	*$0*	*$4,736,493*	*$4,736,493*	*$4,736,493*
Total		**$449,870**	**$1,882,467**	**$603,633**	**$745,830**	**$10,421,783**	**$10,421,783**	**$10,421,783**
								$68,524,480

Table 7-2

	Capital Costs	Annual O&M	Present O&M	Replacement	Total
Zone A	$10,580,000	$810,000	$11,100,000	$920,000	$22,600,000
JVWCD Zone A	**$310,000**	**$40,000**	**$490,000**	**$60,000**	**$860,000**
Zone B	$16,850,000	$630,000	$8,660,000	$930,000	$26,440,000
Shallow Wells	$9,020,000	N/A	N/A	N/A	$9,020,000
JVWCD SW	**N/A**	**$290,000**	**$4,060,000**	**$680,000**	**$4,740,000**
JVWCD Zone B	**$2,920,000**	**$120,000**	**$1,660,000**	**$240,000**	**$4,820,000**
TRUST FUND	$36,450,000	$1,440,000	$19,760,000	$1,850,000	$58,060,000
JVWCD	**$3,230,000**	**$450,000**	**$6,210,000**	**$960,000**	**$10,420,000**
					$68,480,000

Conceptual Design Recommended Project Cost Breakdown (40% Contingency)

		Annual Cost	Base Capital Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	Trust Fund Costs	NRD Costs	
Zone A									
Capital	Treatment Plant	N/A	$4,738,063	$3,174,502	$2,373,770	$10,286,335	$10,286,335	N/A	
	Pipelines	N/A	$1,499,000	$599,600	$629,580	$2,728,180	$2,728,180	N/A	
	Wells	N/A	$0	$0	$0	$0	$0	N/A	$13,014,515
O&M	Treatment Plant	$365,376	N/A	N/A	N/A	$5,042,189	$5,042,189	N/A	
	Pumping	$442,000	N/A	N/A	N/A	$6,099,600	$6,099,600	N/A	$11,141,789
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$1,076,745	$1,076,745	N/A	
	Wells	N/A	N/A	N/A	N/A	$11,052	$11,052	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$38,656	$38,656	N/A	$1,126,453
Subtotal		*$807,376*	*$6,237,063*	*$3,774,102*	*$3,003,350*	*$25,282,757*	*$25,282,757*	*$0*	*$25,282,757*
Zone B									
Capital	Treatment Plant	N/A	$4,457,063	$2,986,232	$2,232,989	$9,676,284	$9,676,284	N/A	
	Pipelines	N/A	$4,072,400	$1,628,960	$1,710,408	$7,411,768	$7,411,768	N/A	
	Wells	N/A	$2,160,000	$864,000	$907,200	$3,931,200	$3,931,200	N/A	$21,019,252
O&M	Treatment Plant	$317,420	N/A	N/A	N/A	$4,380,396	$4,380,396	N/A	
	Pumping	$310,000	N/A	N/A	N/A	$4,278,000	$4,278,000	N/A	$8,658,396
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$976,809	$976,809	N/A	
	Wells	N/A	N/A	N/A	N/A	$44,208	$44,208	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$105,019	$105,019	N/A	$1,126,036
Subtotal		*$627,420*	*$10,689,463*	*$5,479,192*	*$4,850,597*	*$30,803,684*	*$30,803,684*	*$0*	*$30,803,684*
Shallow Wells									
Capital	Treatment Plant	N/A	$2,920,538	$1,956,760	$1,463,190	$6,340,488	N/A	$6,340,488	
	Pipelines	N/A	$2,518,400	$1,007,360	$1,057,728	$4,583,488	N/A	$4,583,488	
	Wells	N/A	$150,000	$60,000	$63,000	$273,000	N/A	$273,000	$11,196,976
O&M	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	Pumping	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
Subtotal		*$0*	*$5,588,938*	*$3,024,120*	*$2,583,918*	*$11,196,976*	*$0*	*$11,196,976*	*$11,196,976*
Total		$1,434,796	$22,515,464	$12,277,415	$10,437,864	$67,283,417	$56,086,441	$11,196,976	$67,283,417

1. 40% Design Contingency, 27% Contractors OH&P for Treatment Plant, 40% Design Contingency only for Pipelines and Wells.
2. 13% Predesign and Final design, 7% construction services, 5% on site services, 5% change order allowance

Conceptual Design Project Enhancement Cost Breakdown

		Annual Cost	Base Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	JVWCD Costs	
Zone A								
Capital	Treatment Plant	N/A	$175,000	$117,250	$87,675	$379,925	$379,925	
	Pipelines	N/A	$0	$0	$0	$0	$0	
	Wells	N/A	$0	$0	$0	$0	$0	$379,925
O&M	Treatment Plant	$25,120	N/A	N/A	N/A	$346,656	$346,656	
	Pumping	$10,200	N/A	N/A	N/A	$140,760	$140,760	$487,416
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$74,289	$74,289	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$0	$0	$74,289
Subtotal		*$35,320*	*$175,000*	*$117,250*	*$87,675*	*$941,630*	*$941,630*	*$941,630*
Zone B								
Capital	Treatment Plant	N/A	$1,363,467	$913,523	$683,097	$2,960,087	$2,960,087	
	Pipelines	N/A	$344,000	$137,600	$144,480	$626,080	$626,080	
	Wells	N/A	$0	$0	$0	$0	$0	$3,586,167
O&M	Treatment Plant	$53,665	N/A	N/A	N/A	$740,577	$740,577	
	Pumping	$66,900	N/A	N/A	N/A	$923,220	$923,220	$1,663,797
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$285,525	$285,525	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$8,871	$8,871	$294,396
Subtotal		*$120,565*	*$1,707,467*	*$1,051,123*	*$827,577*	*$5,544,360*	*$5,544,360*	*$5,544,360*
Shallow Wells								
Capital	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	
	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	$0
O&M	Treatment Plant	$15,985	N/A	N/A	N/A	$220,593	$220,593	
	Pumping	$278,000	N/A	N/A	N/A	$3,836,400	$3,836,400	$4,056,993
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$777,247	$777,247	
	Wells	N/A	N/A	N/A	N/A	$22,104	$22,104	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$34,401	$34,401	$833,752
Subtotal		*$293,985*	*$0*	*$0*	*$0*	*$4,890,745*	*$4,890,745*	*$4,890,745*
Total		$449,870	$1,882,467	$1,168,373	$915,252	$11,376,734	$11,376,734	$11,376,734
								$78,660,151

Table 7-2

	Capital Costs	Annual O&M	Present O&M	Replacement	Total
Zone A	$13,010,000	$810,000	$11,140,000	$1,130,000	$25,280,000
JVWCD Zone A	**$380,000**	**$40,000**	**$490,000**	**$70,000**	**$940,000**
Zone B	$21,020,000	$630,000	$8,660,000	$1,130,000	$30,810,000
Shallow Wells	$11,200,000	N/A	N/A	N/A	$11,200,000
JVWCD SW	**N/A**	**$290,000**	**$4,060,000**	**$830,000**	**$4,890,000**
JVWCD Zone B	**$3,590,000**	**$120,000**	**$1,660,000**	**$290,000**	**$5,540,000**
TRUST FUND	$45,230,000	$1,440,000	$19,800,000	$2,260,000	$67,290,000
JVWCD	**$3,970,000**	**$450,000**	**$6,210,000**	**$1,190,000**	**$11,370,000**

$78,660,000

Conceptual Design Recommended Project Cost Breakdown (40% Contingency)

		Annual Cost	Base Capital Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	Trust Fund Costs	NRD Costs	
Zone A									
Capital	Treatment Plant	N/A	$4,738,063	$3,174,502	$2,373,770	$10,286,335	$10,286,335	N/A	
	Pipelines	N/A	$1,499,000	$599,600	$629,580	$2,728,180	$2,728,180	N/A	
	Wells	N/A	$0	$0	$0	$0	$0	N/A	$13,014,515
O&M	Treatment Plant	$365,376	N/A	N/A	N/A	$4,779,118	$4,779,118	N/A	
	Pumping	$442,000	N/A	N/A	N/A	$5,781,360	$5,781,360	N/A	$10,560,478
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$1,076,745	$1,076,745	N/A	
	Wells	N/A	N/A	N/A	N/A	$11,052	$11,052	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$38,656	$38,656	N/A	$1,126,453
Subtotal		*$807,376*	*$6,237,063*	*$3,774,102*	*$3,003,350*	*$24,701,446*	*$24,701,446*	*$0*	*$24,701,446*
Zone B									
Capital	Treatment Plant	N/A	$5,224,530	$3,500,435	$2,617,490	$11,342,455	$11,342,455	N/A	
	Pipelines	N/A	$3,380,000	$1,352,000	$1,419,600	$6,151,600	$6,151,600	N/A	
	Wells	N/A	$2,160,000	$864,000	$907,200	$3,931,200	$3,931,200	N/A	$21,425,255
O&M	Treatment Plant	$317,420	N/A	N/A	N/A	$4,151,854	$4,151,854	N/A	
	Pumping	$393,000	N/A	N/A	N/A	$5,140,440	$5,140,440	N/A	$9,292,294
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$1,055,387	$1,055,387	N/A	
	Wells	N/A	N/A	N/A	N/A	$44,208	$44,208	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$87,163	$87,163	N/A	$1,186,759
Subtotal		*$710,420*	*$10,764,530*	*$5,716,435*	*$4,944,290*	*$31,904,307*	*$31,904,307*	*$0*	*$31,904,307*
Shallow Wells									
Capital	Treatment Plant	N/A	$2,920,538	$1,956,760	$1,463,190	$6,340,488	N/A	$6,340,488	
	Pipelines	N/A	$1,334,000	$533,600	$560,280	$2,427,880	N/A	$2,427,880	
	Wells	N/A	$150,000	$60,000	$63,000	$273,000	N/A	$273,000	$9,041,368
O&M	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	Pumping	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
Subtotal		*$0*	*$4,404,538*	*$2,550,360*	*$2,086,470*	*$9,041,368*	*$0*	*$9,041,368*	*$9,041,368*
Total		$1,517,796	$21,406,131	$12,040,898	$10,034,109	$65,647,121	$56,605,753	$9,041,368	$65,647,121

1. 40% Design Contingency, 27% Contractors OH&P for Treatment Plant, 40% Design Contingency only for Pipelines and Wells.
2. 13% Predesign and Final design, 7% construction services, 5% on site services, 5% change order allowance

Conceptual Design Project Enhancement Cost Breakdown

		Annual Cost	Base Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	JVWCD Costs	
Zone A								
Capital	Treatment Plant	N/A	$175,000	$117,250	$87,675	$379,925	$379,925	
	Pipelines	N/A	$0	$0	$0	$0	$0	
	Wells	N/A	$0	$0	$0	$0	$0	$379,925
O&M	Treatment Plant	$25,120	N/A	N/A	N/A	$328,570	$328,570	
	Pumping	$10,200	N/A	N/A	N/A	$133,416	$133,416	$461,986
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$74,289	$74,289	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$0	$0	$74,289
Subtotal		*$35,320*	*$175,000*	*$117,250*	*$87,675*	*$916,199*	*$916,199*	*$916,199*
Zone B								
Capital	Treatment Plant	N/A	$596,000	$399,320	$298,596	$1,293,916	$1,293,916	
	Pipelines	N/A	$344,000	$137,600	$144,480	$626,080	$626,080	
	Wells	N/A	$0	$0	$0	$0	$0	$1,919,996
O&M	Treatment Plant	$53,665	N/A	N/A	N/A	$701,938	$701,938	
	Pumping	$66,900	N/A	N/A	N/A	$875,052	$875,052	$1,576,990
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$215,791	$215,791	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$8,871	$8,871	$224,662
Subtotal		*$120,565*	*$940,000*	*$536,920*	*$443,076*	*$3,721,648*	*$3,721,648*	*$3,721,648*
Shallow Wells								
Capital	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	
	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	$0
O&M	Treatment Plant	$15,985	N/A	N/A	N/A	$209,084	$209,084	
	Pumping	$245,900	N/A	N/A	N/A	$3,216,372	$3,216,372	$3,425,456
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$768,402	$768,402	
	Wells	N/A	N/A	N/A	N/A	$22,104	$22,104	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$34,401	$34,401	$824,908
Subtotal		*$261,885*	*$0*	*$0*	*$0*	*$4,250,363*	*$4,250,363*	*$4,250,363*
Total		$417,770	$1,115,000	$654,170	$530,751	$8,888,211	$8,888,211	$8,888,211
								$74,535,332

Table 7-2

	Capital Costs	Annual O&M	Present O&M	Replacement	Total
Zone A	$13,010,000	$810,000	$10,560,000	$1,130,000	$24,700,000
JVWCD Zone A	**$380,000**	**$40,000**	**$460,000**	**$70,000**	**$910,000**
Zone B	$21,430,000	$710,000	$9,290,000	$1,190,000	$31,910,000
Shallow Wells	$9,040,000	N/A	N/A	N/A	$9,040,000
JVWCD SW	**N/A**	**$260,000**	**$3,430,000**	**$820,000**	**$4,250,000**
JVWCD Zone B	$1,920,000	$120,000	$1,580,000	$220,000	$3,720,000
TRUST FUND	$43,480,000	$1,520,000	$19,850,000	$2,320,000	$65,650,000
JVWCD	**$2,300,000**	**$420,000**	**$5,470,000**	**$1,110,000**	**$8,880,000**

$74,530,000

Conceptual Design Recommended Project Cost Breakdown (40% Contingency)

		Annual Cost	Base Capital Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	Trust Fund Costs	NRD Costs	
Zone A									
Capital	Treatment Plant	N/A	$4,738,063	$3,174,502	$2,373,770	$10,286,335	$10,286,335	N/A	
	Pipelines	N/A	$1,499,000	$599,600	$629,580	$2,728,180	$2,728,180	N/A	
	Wells	N/A	$0	$0	$0	$0	$0	N/A	$13,014,515
O&M	Treatment Plant	$365,376	N/A	N/A	N/A	$4,779,118	$4,779,118	N/A	
	Pumping	$442,000	N/A	N/A	N/A	$5,781,360	$5,781,360	N/A	$10,560,478
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$1,076,745	$1,076,745	N/A	
	Wells	N/A	N/A	N/A	N/A	$11,052	$11,052	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$38,656	$38,656	N/A	$1,126,453
Subtotal		*$807,376*	*$6,237,063*	*$3,774,102*	*$3,003,350*	*$24,701,446*	*$24,701,446*	*$0*	*$24,701,446*
Zone B									
Capital	Treatment Plant	N/A	$4,457,063	$2,986,232	$2,232,989	$9,676,284	$9,676,284	N/A	
	Pipelines	N/A	$3,380,000	$1,352,000	$1,419,600	$6,151,600	$6,151,600	N/A	
	Wells	N/A	$2,160,000	$864,000	$907,200	$3,931,200	$3,931,200	N/A	$19,759,084
O&M	Treatment Plant	$317,420	N/A	N/A	N/A	$4,151,854	$4,151,854	N/A	
	Pumping	$393,000	N/A	N/A	N/A	$5,140,440	$5,140,440	N/A	$9,292,294
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$976,809	$976,809	N/A	
	Wells	N/A	N/A	N/A	N/A	$44,208	$44,208	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$87,163	$87,163	N/A	$1,108,181
Subtotal		*$710,420*	*$9,997,063*	*$5,202,232*	*$4,559,789*	*$30,159,558*	*$30,159,558*	*$0*	*$30,159,558*
Shallow Wells									
Capital	Treatment Plant	N/A	$2,920,538	$1,956,760	$1,463,190	$6,340,488	N/A	$6,340,488	
	Pipelines	N/A	$1,334,000	$533,600	$560,280	$2,427,880	N/A	$2,427,880	
	Wells	N/A	$150,000	$60,000	$63,000	$273,000	N/A	$273,000	$9,041,368
O&M	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	Pumping	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
Subtotal		*$0*	*$4,404,538*	*$2,550,360*	*$2,086,470*	*$9,041,368*	*$0*	*$9,041,368*	*$9,041,368*
Total		$1,517,796	$20,638,664	$11,526,695	$9,649,608	$63,902,372	$54,861,004	$9,041,368	$63,902,372

1. 40% Design Contingency, 27% Contractors OH&P for Treatment Plant, 40% Design Contingency only for Pipelines and Wells.
2. 13% Predesign and Final design, 7% construction services, 5% on site services, 5% change order allowance

Conceptual Design Project Enhancement Cost Breakdown

		Annual Cost	Base Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	JVWCD Costs	
Zone A								
Capital	Treatment Plant	N/A	$175,000	$117,250	$87,675	$379,925	$379,925	
	Pipelines	N/A	$0	$0	$0	$0	$0	
	Wells	N/A	$0	$0	$0	$0	$0	$379,925
O&M	Treatment Plant	$25,120	N/A	N/A	N/A	$328,570	$328,570	
	Pumping	$10,200	N/A	N/A	N/A	$133,416	$133,416	$461,986
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$74,289	$74,289	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$0	$0	$74,289
Subtotal		*$35,320*	*$175,000*	*$117,250*	*$87,675*	*$916,199*	*$916,199*	*$916,199*
Zone B								
Capital	Treatment Plant	N/A	$1,363,467	$913,523	$683,097	$2,960,087	$2,960,087	
	Pipelines	N/A	$344,000	$137,600	$144,480	$626,080	$626,080	
	Wells	N/A	$0	$0	$0	$0	$0	$3,586,167
O&M	Treatment Plant	$53,665	N/A	N/A	N/A	$701,938	$701,938	
	Pumping	$66,900	N/A	N/A	N/A	$875,052	$875,052	$1,576,990
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$285,525	$285,525	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$8,871	$8,871	$294,396
Subtotal		*$120,565*	*$1,707,467*	*$1,051,123*	*$827,577*	*$5,457,553*	*$5,457,553*	*$5,457,553*
Shallow Wells								
Capital	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	
	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	$0
O&M	Treatment Plant	$15,985	N/A	N/A	N/A	$209,084	$209,084	
	Pumping	$245,900	N/A	N/A	N/A	$3,216,372	$3,216,372	$3,425,456
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$768,402	$768,402	
	Wells	N/A	N/A	N/A	N/A	$22,104	$22,104	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$34,401	$34,401	$824,908
Subtotal		*$261,885*	*$0*	*$0*	*$0*	*$4,250,363*	*$4,250,363*	*$4,250,363*
Total		$417,770	$1,882,467	$1,168,373	$915,252	$10,624,116	$10,624,116	$10,624,116
								$74,526,488

Description of Cost Item	Capital Cost		
	Zone A	Zone B	JVWCD Enhancement
Well Facility Costs			
Zone A Wells	$0		
Zone B Wells		$3,088,800	
Shallow Wells			$214,500
Pipeline Capital Costs			
Zone A RO Facility at 250 mg/l	$2,143,570		$0
Zone B RO Facility at 250 mg/l with Shallow Wells		$4,833,400	$2,399,540
Future Pipe Cost for Zone A Concentrate	$4,867,720		
Future Pipe Cost for Zone B Concentrate		$2,676,960	
Treatment Facilities Capital Costs			
Zone A RO Facility at 250 mg/l	$8,438,489		$311,675
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$7,938,028	$7,629,813
Summary of Year 0 Capital Costs			
Zone A RO Facility at 250 mg/l	$10,582,059		$311,675
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$15,860,228	$10,243,853
Summary of Future Capital Costs			
Future Pipe Cost for Zone A Concentrate	$4,867,720		
Future Pipe Cost for Zone B Concentrate		$2,676,960	

Zone A Capital Cost
in Year 0 =

Zone B Capital Cost
in Year 0 =

JVWCD Capital Cost for Enhance
Zone A =
Zone B =

Annual Cost through 2029	Annual Costs After 2029	25 Year Replacement Costs
Zone A = $807,376	Zone A = $807,376	Zone A = $5,020,318
Zone B = $710,420	Zone B = $710,420	Zone B = $4,962,149
JVWCD = $417,770	JVWCD = $417,770	JVWCD = $5,329,243

Present Worth Calculation	Zone A	Zone B	Zone A Enhancement	Zone B Enhancement
Capital Costs	$10,582,059	$15,860,228	$311,675	$10,243,853
PW of Annualized Cost through 2029 at 7% interest, 30 yrs 12.409	$10,018,729	$8,815,602	$438,286	$4,745,822
PW of Annualized Cost from 2030 to 2049 at P/A 50-30 13.08-12.409	$541,749	$476,692	$23,700	$256,624
25 year Replacement cost brought to PW P/F 25 year 7% 0.1842	$924,742.58	$914,028	$60,943.49	$920,703.07
50 year Replacement Cost: Assume Value = $0	$0	$0	$0	$0
Total Present Worth Value	**$22,067,280**	**$26,066,549**	**$834,604**	**$16,167,002**

Replacement Costs After 2029
Zone A = $5,306,758
Zone B = $5,054,549
JVWCD = $5,400,083

Annualized Cost Over 50 Years	Zone A	Zone B	Zone A Enhancement	Zone B Enhancement
Present Worth Cost	$22,067,280	$26,066,549	$834,604	$16,167,002
Annualized Cost Factor 50 years, 7% A/P = 0.07246	**$1,598,995**	**$1,888,782**	**$60,475**	**$1,171,461**

Future O&M and capital costs are not inflated. Net effect is to minimize present worth of these costs. Potential shortfall in Trust Fund.

O&M and Replacement Costs	Annual Cost		25-Year Replacement Cost			50-Yea
	Zone A	Zone B	JVWCD Enhancement	Zone A	Zone B	Enhancement
Well Facility Replacement Costs						
Zone A Wells				$60,000		
Zone B Wells					$240,000	
Shallow Wells						$120,000
Pumping Costs						
Zone A RO Facility at 250 mg/l	$442,000		$10,200			
Zone B RO Facility at 250 mg/l with Shallow Wells		$393,000	$312,800			
Pipeline Maintenance Costs						
Zone A RO Facility at 250 mg/l				$164,890		$0
Zone B RO Facility at 250 mg/l with Shallow Wells					$371,800	$184,580
Treatment Plant O&M Costs						
Zone A RO Facility at 250 mg/l	$365,376		$25,120			
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$317,420	$69,650			
Treatment Plant Replacement Costs						
Zone A RO Facility at 250 mg/l				$4,795,428		$330,855
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells					$4,350,349	$4,693,808
Total Annual O&M and Replacement Costs						
Zone A RO Facility at 250 mg/l	$807,376		$35,320	$5,020,318		$330,855
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$710,420	$382,450		$4,962,149	$4,998,388

O&M and Replacement Cost for Great Salt Lake Concentrate Pipeline and Pumping	Annual Cost		25-Year Replacement Cost			50-Yea
	Zone A	Zone B	JVWCD Enhancement	Zone A	Zone B	Enhancement
Future Pipeline Maintenance Costs						
Future Pipe Cost for Zone A Concentrate				$374,440		
Future Pipe Cost for Zone B Concentrate					$205,920	
Future Pumping Costs						
Future Pumping Cost for Zone A Concentrate to GSL after 2029	**$24,000**		**$2,900**			
Future Pumping Cost for Zone B Concentrate to GSL after 2029		**$83,000**	**$26,300**			
Future Pipeline Maintenance Costs which are no long applicable						
Future Pipe Cost for Zone A Concentrate				$88,000		
Future Pipe Cost for Zone B Concentrate					$113,520	$70,840
Future Pumping Costs which are no long applicable						
Future Pumping Cost for Zone A Concentrate no long used after 2029	$24,000		$2,900			
Future Pumping Cost for Zone B Concentrate which are no long used after 2029		$83,000	$26,300			

Description of Cost Item	Capital Cost			
	Zone A	Zone B	JVWCD Enhancement	Shallow Well
Well Facility Replacement Costs				
Zone A Wells	$0			
Zone B Wells		$3,931,200		
Shallow Wells			$273,000	
Pipeline Capital Costs				
Zone A RO Facility at 250 mg/l	$2,728,180		$0	
Zone B RO Facility at 250 mg/l with Shallow Wells		$6,151,600	$3,053,960	
Future Pipe Cost for Zone A Concentrate	$6,195,280			
Future Pipe Cost for Zone B Concentrate		$3,407,040		
Treatment Facilities Capital Costs				
Zone A RO Facility at 250 mg/l	$10,286,334		$379,925	
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$9,676,283	$9,300,575	
Summary of Year 0 Capital Costs				
Zone A RO Facility at 250 mg/l	$13,014,514		$379,925	
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$19,759,083	$12,627,535	
Summary of Future Capital Costs				
Future Pipe Cost for Zone A Concentrate	$6,195,280			
Future Pipe Cost for Zone B Concentrate		$3,407,040		

Zone A Capital Cost
in Year 0 =

Zone B Capital Cost
in Year 0 =

JVWCD Capital Cost for Enhance
Zone A =
Zone B =

Annual Cost through 2029	Annual Costs After 2029	25 Year Replacement Costs
Zone A = $807,376	Zone A = $807,376	Zone A = $6,115,382
Zone B = $710,420	Zone B = $710,420	Zone B = $6,016,181
JVWCD = $417,770	JVWCD = $417,770	JVWCD = $6,479,875

Present Worth Calculation	Zone A	Zone B	Zone A Enhancement	Zone B Enhancement
Capital Costs	$13,014,514	$19,759,083	$379,925	$12,627,535
PW of Annualized Cost through 2029 at 7% interest, 30 yrs 12.409	$10,018,729	$8,815,602	$438,286	$4,745,822
PW of Annualized Cost from 2030 to 2049 at P/A 50-30 13.08-12.409	$541,749	$476,692	$23,700	$256,624
25 year Replacement cost brought to PW P/F 25 year 7% 0.1842	$1,126,453.36	$1,108,181	$74,288.78	$1,119,304.19
50 year Replacement Cost: Assume Value = $0	$0	$0	$0	$0
Total Present Worth Value	**$24,701,445**	**$30,159,557**	**$916,199**	**$18,749,285**

Replacement Costs After 2029
Zone A = $6,534,626
Zone B = $6,151,421
JVWCD = $6,583,559

Annualized Cost Over 50 Years	Zone A	Zone B	Zone A Enhancement	Zone B Enhancement
Present Worth Cost	$24,701,445	$30,159,557	$916,199	$18,749,285
Annualized Cost Factor 50 years, 7% A/P = 0.07246	**$1,789,867**	**$2,185,362**	**$66,388**	**$1,358,573**

Future O&M and capital costs are not inflated. Net effect is to minimize present worth of these costs. Potential shortfall in Trust Fund.

O&M and Replacement Costs	Annual Cost		25-Year Replacement Cost			50-Year
	Zone A	Zone B	JVWCD Enhancement	Zone A	Zone B	Enhancement
Well Facility Replacement Costs						
Zone A Wells				$60,000		
Zone B Wells					$240,000	
Shallow Wells						$120,000
Pumping Costs						
Zone A RO Facility at 250 mg/l	$442,000		$10,200			
Zone B RO Facility at 250 mg/l with Shallow Wells		$393,000	$312,800			
Pipeline Maintenance Costs						
Zone A RO Facility at 250 mg/l				$209,860		$0
Zone B RO Facility at 250 mg/l with Shallow Wells					$473,200	$234,920
Treatment Plant O&M Costs						
Zone A RO Facility at 250 mg/l	$365,376		$25,120			
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$317,420	$69,650			
Treatment Plant Replacement Costs						
Zone A RO Facility at 250 mg/l				$5,845,522		$403,305
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells					$5,302,981	$5,721,650
Total Annual O&M and Replacement Costs						
Zone A RO Facility at 250 mg/l	$807,376		$35,320	$6,115,382		$403,305
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$710,420	$382,450		$6,016,181	$6,076,570

O&M and Replacement Cost for Great Salt Lake Concentrate Pipeline and Pumping	Annual Cost		25-Year Replacement Cost			50-Year
	Zone A	Zone B	JVWCD Enhancement	Zone A	Zone B	Enhancement
Future Pipeline Maintenance Costs						
Future Pipe Cost for Zone A Concentrate				$548,044		
Future Pipe Cost for Zone B Concentrate					$301,392	
Future Pumping Costs						
Future Pumping Cost for Zone A Concentrate to GSL after 2029	**$24,000**		**$2,900**			
Future Pumping Cost for Zone B Concentrate to GSL after 2029		**$83,000**	**$26,300**			
Future Pipeline Maintenance Costs which are no long applicable						
Future Pipe Cost for Zone A Concentrate				$128,800		
Future Pipe Cost for Zone B Concentrate					$166,152	$103,684
Future Pumping Costs which are no long applicable						
Future Pumping Cost for Zone A Concentrate no long used after 2029	$24,000		$2,900			
Future Pumping Cost for Zone B Concentrate which are no long used after 2029		$83,000	$26,300			

Description of Cost Item	Capital Cost			
	Zone A	Zone B	JVWCD Enhancement	Shallow Well
Well Facility Costs				
Zone A Wells	$0			
Zone B Wells		$3,088,800		
Shallow Wells			$214,500	$214,500
Pipeline Capital Costs				
Zone A RO Facility at 250 mg/l	$2,143,570		$0	
Zone B RO Facility at 250 mg/l with Shallow Wells		$4,833,400	$2,399,540	$1,934,790
Future Pipe Cost for Zone A Concentrate	$4,867,720			
Future Pipe Cost for Zone B Concentrate		$2,676,960		
Treatment Facilities Capital Costs				
Zone A RO Facility at 250 mg/l	$8,438,489		$311,675	
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$7,938,028	$7,629,813	$5,201,477
Summary of Year 0 Capital Costs				
Zone A RO Facility at 250 mg/l	$10,582,059		$311,675	
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$15,860,228	$10,243,853	$7,350,767
Summary of Future Capital Costs				
Future Pipe Cost for Zone A Concentrate	$4,867,720			
Future Pipe Cost for Zone B Concentrate		$2,676,960		

Zone A Capital Cost
In Year 0 =

Zone B Capital Cost
In Year 0 =

JVWCD Capital Cost for Enhanc
Zone A =
Zone B =
SW =

Annual Cost through 2029	Annual Costs After 2029	25 Year Replacement Costs
Zone A = $807,376	Zone A = $807,376	Zone A = $5,020,318
Zone B = $734,420	Zone B = $734,420	Zone B = $4,962,149
JVWCD = $393,770	JVWCD = $393,770	JVWCD = $5,329,243

Present Worth Calculation	Zone A	Zone B	Zone A Enhancement	Zone B Enhancement
Capital Costs	$10,582,059	$15,860,228	$311,675	$10,243,853
PW of Annualized Cost through 2029 at 7% interest, 30 yrs 12.409	$10,018,729	$9,113,418	$438,286	$4,745,822
PW of Annualized Cost from 2030 to 2049 at P/A 50-30 13.08-12.409	$541,749	$492,796	$23,700	$256,624
25 year Replacement cost brought to PW P/F 25 year 7% 0.1842	$925,245	$914,028	$60,943.49	$920,703.07
50 year Replacement Cost: Assume Value = $0	$0	$0	$0	$0
Total Present Worth Value	**$22,067,782**	**$26,380,469**	**$834,604**	**$16,167,002**

Replacement Costs After 2029
Zone A = $5,306,758
Zone B = $5,054,549
JVWCD = $5,400,083

Annualized Cost Over 50 Years	Zone A	Zone B	Zone A Enhancement	Zone B Enhancement
Present Worth Cost	$22,067,782	$26,380,469	$834,604	$16,167,002
Annualized Cost Factor 50 years, 7% A/P = 0.07246	**$1,599,031**	**$1,911,529**	**$60,475**	**$1,171,461**

Future O&M and capital costs are not inflated. Net effect is to minimize present worth of these costs. Potential shortfall in Trust Fund.

O&M and Replacement Costs	Annual Cost		25-Year Replacement Cost			50-Ye
	Zone A	Zone B	JVWCD Enhancement	Zone A	Zone B	Enhancement
Well Facility Replacement Costs						
Zone A Wells				$60,000		
Zone B Wells					$240,000	
Shallow Wells						$120,000
Pumping Costs						
Zone A RO Facility at 250 mg/l	$442,000		$10,200			
Zone B RO Facility at 250 mg/l with Shallow Wells		$393,000	$312,800			
Pipeline Maintenance Costs						
Zone A RO Facility at 250 mg/l				$164,890		$0
Zone B RO Facility at 250 mg/l with Shallow Wells					$371,800	$184,580
Treatment Plant O&M Costs						
Zone A RO Facility at 250 mg/l	$365,376		$25,120			
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$317,420	$69,650			
Treatment Plant Replacement Costs						
Zone A RO Facility at 250 mg/l				$4,795,428		$330,855
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells					$4,350,349	$4,693,808
Total Annual O&M and Replacement Costs						
Zone A RO Facility at 250 mg/l	$807,376		$35,320	$5,020,318		$330,855
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$710,420	$382,450		$4,962,149	$4,998,388

O&M and Replacement Cost for Great Salt Lake Concentrate Pipeline and Pumping	Annual Cost		25-Year Replacement Cost			50-Ye
	Zone A	Zone B	JVWCD Enhancement	Zone A	Zone B	Enhancement
Future Pipeline Maintenance Costs						
Future Pipe Cost for Zone A Concentrate				$374,440		
Future Pipe Cost for Zone B Concentrate					$205,920	
Future Pumping Costs						
Future Pumping Cost for Zone A Concentrate to GSL after 2029	**$24,000**		**$2,900**			
Future Pumping Cost for Zone B Concentrate to GSL after 2029		**$83,000**	**$26,300**			
Future Pipeline Maintenance Costs which are no long applicable						
Future Pipe Cost for Zone A Concentrate				$88,000		
Future Pipe Cost for Zone B Concentrate					$113,520	$70,840
Future Pumping Costs which are no long applicable						
Future Pumping Cost for Zone A Concentrate no long used after 2029	$24,000		$2,900			
Future Pumping Cost for Zone B Concentrate which are no long used after 2029		$83,000	$26,300			

Zone B Shallow Well Enhancement Summary

Capital Costs

Well Facilities	$214,500
Pipeline	$1,934,790
Treatment Facilities	$5,201,477
Total	*$7,350,767*

O&M and Replacement Costs

	Annual	*25 Year*	*50 year*
Well Facility Replacement		$120,000	$80,000
Pumping	$278,000		
Pipeline Maintenance		$148,830	
Treatment O&M	$31,971		
Treatment Plant Replacement		$3,422,183	$501,055
Total	*$309,971*	*$3,691,013*	*$581,055*

Present Worth Calculation	Shallow Wells
Capital Costs	$7,350,767
PW of Annualized Cost through 2029 at 7% interest, 30 yrs 12.409	$3,846,430.14
PW of Annualized Cost from 2030 to 2049 at P/A 50-30 13.08-12.409	$207,990.54
25 year Replacement cost brought to PW P/F 25 year 7% 0.1842	$680,253.70
50 year Replacement Cost: Assume Value = $0	$0
Total Present Worth Value	**$12,085,441**

Description of Cost Item	Capital Cost			
	Zone A	Zone B	JVWCD Enhancement	
Well Facility Replacement Costs				
Zone A Wells	$0			
Zone B Wells		$3,931,200		
Shallow Wells			$273,000	$273,000
Pipeline Capital Costs				
Zone A RO Facility at 250 mg/l	$2,728,180		$0	
Zone B RO Facility at 250 mg/l with Shallow Wells		$6,151,600	$3,053,960	$2,462,460
Future Pipe Cost for Zone A Concentrate	$6,195,280			
Future Pipe Cost for Zone B Concentrate		$3,407,040		
Treatment Facilities Capital Costs				
Zone A RO Facility at 250 mg/l	$10,286,334		$379,925	
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$9,676,283	$9,300,575	$6,340,487
Summary of Year 0 Capital Costs				
Zone A RO Facility at 250 mg/l	$13,014,514		$379,925	
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$19,759,083	$12,627,535	$9,075,947
Summary of Future Capital Costs				
Future Pipe Cost for Zone A Concentrate	$6,195,280			
Future Pipe Cost for Zone B Concentrate		$3,407,040		

Zone A Capital Cost in Year 0 =

Zone B Capital Cost in Year 0 =

JVWCD Capital Cost for Enhance
Zone A =
Zone B =

SW =

Annual Cost through 2029	Annual Costs After 2029	25 Year Replacement Costs
Zone A = $807,376	Zone A = $807,376	Zone A = $6,115,382
Zone B = $710,420	Zone B = $710,420	Zone B = $6,016,181
JVWCD = $417,770	JVWCD = $417,770	JVWCD = $6,479,875

Present Worth Calculation	Zone A	Zone B	Zone A Enhancement	Zone B Enhancement
Capital Costs	$13,014,514	$19,759,083	$379,925	$12,627,535
PW of Annualized Cost through 2029 at 7% interest, 30 yrs 12.409	$10,018,729	$8,815,602	$438,286	$4,745,822
PW of Annualized Cost from 2030 to 2049 at P/A 50-30 13.08-12.409	$541,749	$476,692	$23,700	$256,624
25 year Replacement cost brought to PW P/F 25 year 7% 0.1842	$1,127,065	$1,108,181	$74,288.78	$1,119,304.19
50 year Replacement Cost: Assume Value = $0	$0	$0	$0	$0
Total Present Worth Value	**$24,702,057**	**$30,159,557**	**$916,199**	**$18,749,285**

Replacement Costs After 2029
Zone A = $6,534,626
Zone B = $6,151,421
JVWCD = $6,583,559

Annualized Cost Over 50 Years	Zone A	Zone B	Zone A Enhancement	Zone B Enhancement
Present Worth Cost	$24,702,057	$30,159,557	$916,199	$18,749,285
Annualized Cost Factor 50 years, 7% A/P = 0.07246	**$1,789,911**	**$2,185,362**	**$66,388**	**$1,358,573**

Future O&M and capital costs are not inflated. Net effect is to minimize present worth of these costs. Potential shortfall in Trust Fund.

O&M and Replacement Costs	Annual Cost		25-Year Replacement Cost			50-Yea
	Zone A	Zone B	JVWCD Enhancement	Zone A	Zone B	Enhancement
Well Facility Replacement Costs						
Zone A Wells				$60,000		
Zone B Wells					$240,000	
Shallow Wells						$120,000
Pumping Costs						
Zone A RO Facility at 250 mg/l	$442,000		$10,200			
Zone B RO Facility at 250 mg/l with Shallow Wells		$393,000	$312,800			
Pipeline Maintenance Costs						
Zone A RO Facility at 250 mg/l				$209,860		$0
Zone B RO Facility at 250 mg/l with Shallow Wells					$473,200	$234,920
Treatment Plant O&M Costs						
Zone A RO Facility at 250 mg/l	$365,376		$25,120			
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$317,420	$69,650			
Treatment Plant Replacement Costs						
Zone A RO Facility at 250 mg/l				$5,845,522		$403,305
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells					$5,302,981	$5,721,650
Total Annual O&M and Replacement Costs						
Zone A RO Facility at 250 mg/l	$807,376		$35,320	$6,115,382		$403,305
Zone B RO Facility at 250 mg/l with Upgrade & Shallow Wells		$710,420	$382,450		$6,016,181	$6,076,570

O&M and Replacement Cost for Great Salt Lake Concentrate Pipeline and Pumping	Annual Cost		25-Year Replacement Cost			50-Yea
	Zone A	Zone B	JVWCD Enhancement	Zone A	Zone B	Enhancement
Future Pipeline Maintenance Costs						
Future Pipe Cost for Zone A Concentrate				$548,044		
Future Pipe Cost for Zone B Concentrate					$301,392	
Future Pumping Costs						
Future Pumping Cost for Zone A Concentrate to GSL after 2029	**$24,000**		**$2,900**			
Future Pumping Cost for Zone B Concentrate to GSL after 2029		**$83,000**	**$26,300**			
Future Pipeline Maintenance Costs which are no long applicable						
Future Pipe Cost for Zone A Concentrate				$128,800		
Future Pipe Cost for Zone B Concentrate					$166,152	$103,684
Future Pumping Costs which are no long applicable						
Future Pumping Cost for Zone A Concentrate no long used after 2029	$24,000		$2,900			
Future Pumping Cost for Zone B Concentrate which are no long used after 2029		$83,000	$26,300			

Zone B Shallow Well Enhancement Summary

Capital Costs

Well Facilities	$273,000
Pipeline	$2,462,460
Treatment Facilities	$6,340,487
Total	*$9,075,947*

O&M and Replacement Costs

	Annual	*25 Year*	*50 year*
Well Facility Replacement		$120,000	$80,000
Pumping	$278,000		
Pipeline Maintenance		$189,420	
Treatment O&M	$31,971		
Treatment Plant Replacement		$4,171,566	$610,775
Total	*$309,971*	*$4,480,986*	*$690,775*

Present Worth Calculation	Shallow Wells
Capital Costs	$9,075,947
PW of Annualized Cost through 2029 at 7% interest, 30 yrs 12.409	$3,846,430.14
PW of Annualized Cost from 2030 to 2049 at P/A 50-30 13.08-12.409	$207,990.54
25 year Replacement cost brought to PW P/F 25 year 7% 0.1842	$825,845.72
50 year Replacement Cost: Assume Value = $0	$0
Total Present Worth Value	**$13,956,213**

The attached summary sheet has manual input figures for all cost in the capital cost spreadsheet and the O&M Replacement spreadsheets.

The rest of the figures are calculations based on the information in the three spreadsheets.

Present worth factors and annualized cost factors are included in the formulas.

Conceptual Design Recommended Project Cost Breakdown (10% Contingency)

		Annual Cost	Base Capital Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	Trust Fund Costs	NRD Costs		
Zone A										
Capital	Treatment Plant	N/A	$4,738,063	$1,753,083	$1,947,344	$8,438,490	$8,438,490	N/A		
	Pipelines	N/A	$1,499,000	$149,900	$494,670	$2,143,570	$2,143,570	N/A		
	Wells	N/A	$0	$0	$0	$0	$0	N/A	$10,582,060	
O&M	Treatment Plant	$365,376	N/A	N/A	N/A	$5,042,189	$5,042,189	N/A		
	Pumping	$442,000	N/A	N/A	N/A	$6,099,600	$6,099,600	N/A	$11,141,789	
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$883,318	$883,318	N/A		$0
	Wells	N/A	N/A	N/A	N/A	$11,052	$11,052	N/A		
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$30,373	$30,373	N/A	$924,743	
Subtotal		*$807,376*	*$6,237,063*	*$1,902,983*	*$2,442,014*	*$22,648,592*	*$22,648,592*	*$0*	*$22,648,592*	
Zone B										
Capital	Treatment Plant	N/A	$4,457,063	$1,649,113	$1,831,853	$7,938,029	$7,938,029	N/A		
	Pipelines	N/A	$3,380,000	$338,000	$1,115,400	$4,833,400	$4,833,400	N/A		
	Wells	N/A	$2,160,000	$216,000	$712,800	$3,088,800	$3,088,800	N/A	$15,860,229	
O&M	Treatment Plant	$317,420	N/A	N/A	N/A	$4,151,854	$4,151,854	N/A		
	Pumping	$393,000	N/A	N/A	N/A	$5,140,440	$5,140,440	N/A	$9,292,294	
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$801,334	$801,334	N/A		
	Wells	N/A	N/A	N/A	N/A	$44,208	$44,208	N/A		
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$68,486	$68,486	N/A	$914,028	
Subtotal		*$710,420*	*$9,997,063*	*$2,203,113*	*$3,660,053*	*$26,066,551*	*$26,066,551*	*$0*	*$26,066,551*	
Shallow Wells										
Capital	Treatment Plant	N/A	$2,920,538	$1,080,599	$1,200,341	$5,201,478	N/A	$5,201,478		
	Pipelines	N/A	$1,334,000	$133,400	$440,220	$1,907,620	N/A	$1,907,620		
	Wells	N/A	$150,000	$15,000	$49,500	$214,500	N/A	$214,500	$7,323,598	
O&M	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	Pumping	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0	
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0	
Subtotal		*$0*	*$4,404,538*	*$1,228,999*	*$1,690,061*	*$7,323,598*	*$0*	*$7,323,598*	*$7,323,598*	
Total		**$1,517,796**	**$20,638,664**	**$5,335,095**	**$7,792,128**	**$56,038,740**	**$48,715,142**	**$7,323,598**	**$56,038,740**	

1. 10% Design Contingency, 27% Contractors OH&P for Treatment Plant, 10% Design Contingency only for Pipelines and Wells.
2. 13% Predesign and Final design, 7% construction services, 5% on site services, 5% change order allowance

Conceptual Design Project Enhancement Cost Breakdown (10% Contingency)

		Annual Cost	Base Cost	Construction Prorates (1)	Engineering Prorates (2)	Total Present Value	JVWCD Costs	
Zone A								
Capital	Treatment Plant	N/A	$175,000	$64,750	$71,925	$311,675	$311,675	
	Pipelines	N/A	$0	$0	$0	$0	$0	
	Wells	N/A	$0	$0	$0	$0	$0	$311,675
O&M	Treatment Plant	$25,120	N/A	N/A	N/A	$328,570	$328,570	
	Pumping	$10,200	N/A	N/A	N/A	$133,416	$133,416	$461,986
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	60,943.49	$60,943	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$0	$0	$60,943
Subtotal		*$35,320*	*$175,000*	*$64,750*	*$71,925*	*$834,604*	*$834,604*	*$834,604*
Zone B								
Capital	Treatment Plant	N/A	$1,363,467	$504,483	$560,385	$2,428,335	$2,428,335	
	Pipelines	N/A	$344,000	$34,400	$113,520	$491,920	$491,920	
	Wells	N/A		$0	$0	$0	$0	$2,920,255
O&M	Treatment Plant	$53,665	N/A	N/A	N/A	$701,938	$701,938	
	Pumping	$66,900	N/A	N/A	N/A	$875,052	$875,052	$1,576,990
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$234,234	$234,234	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$6,970	$6,970	$241,204
Subtotal		*$120,565*	*$1,707,467*	*$538,883*	*$673,905*	*$4,738,449*	*$4,738,449*	*$4,738,449*
Shallow Wells								
Capital	Treatment Plant	N/A	N/A	N/A	N/A	N/A	N/A	
	Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	
	Wells	N/A	N/A	N/A	N/A	N/A	N/A	$0
O&M	Treatment Plant	$15,985	N/A	N/A	N/A	$209,084	$209,084	
	Pumping	$245,900	N/A	N/A	N/A	$3,216,372	$3,216,372	$3,425,456
25 yr Replacement	Treatment Plant	N/A	N/A	N/A	N/A	$630,366	$630,366	
	Wells	N/A	N/A	N/A	N/A	$22,104	$22,104	
25 yr Maintenance	Pipelines	N/A	N/A	N/A	N/A	$27,030	$27,030	$679,500
Subtotal		*$261,885*	*$0*	*$0*	*$0*	*$4,104,955*	*$4,104,955*	*$4,104,955*
Total		**$417,770**	**$1,882,467**	**$603,633**	**$745,830**	**$9,678,008**	**$9,678,008**	**$9,678,008**
								$65,716,748

FAX TRANSMISSION

CAMP DRESSER & MCKEE INC.
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To:	Mark Atencio, JVWCD Richard Bay, JVWCD	**Date:**	April 14, 2000
Fax #:	(801) 565-8917	**Pages:**	4, including this cover sheet.
From:	Doug Brown		
Subject:	RO Pilot Plant Preliminary Budget		

COMMENTS:

As requested CDM has prepared the following budget estimate for conducting a 4-6 month RO Pilot Study. The general purpose of the pilot study will be 1) to evaluate the sulfate scaling potential of the feedwater for various recovery rates and antiscalant doses 2) evaluate the toxicity of the concentrate, and 3) confirm that the product water meets water quality objectives.

CDM has a mobile pilot plant trailer (Unit No. 2) suitable for testing the proposed RO membranes. The equipment is described in the attached information sheet. The typical rental rate for the equipment is $4,000 per month, and does not include any chemicals or replacement membranes. The unit currently has a set of Fluid Systems ULP membranes, which are the type, proposed for this project. The existing membranes could be used to start the system and work out any operational problems (well turbidity, bateria, chemical doses, etc.). After consistent operation is achieved the membranes tested at extreme conditions to evaluate failure modes. At this point the membranes could be replaced with a set of membranes from another manufacturer such as Hydranuatics (ESPA 1 or 2). A replacement set of membranes is $5000.

The typical pilot plant tasks and estimated budget costs are summarized below:

1.	Pilot Plant Rental 6 months @ $4,000/ month	$24,000
2.	Mobilization and setup – Labor 50 hours	$ 5,000
	Direct costs	$ 1,000
3.	SCADA and autodialer configuration	$ 2,000
4.	O&M manual and training 40 hours	$ 4,000
5.	Pilot Plant Test Plan 60 hours	$ 9,000
6.	Concentrate quality evaluation(see attached table) 140 hours	$22,000
7.	Product Water Quality data review and Tech Memo 40 hours	$ 6,000

8. Membrane Performance data review and 3 progress memos 180 hours	$22,000
9. Pilot Plant Summary Report - labor 200 hours	$25,000
10. Pilot Plant Operations (2 days per month to assist JVWCD staff) 100 hours	$12,000
Direct costs	$ 3,000
11. Project Administration (1 day per month) 50 hours	$ 8,000
Total Consultant Costs	$115,000

In addition to the above costs there will be direct costs associated with chemicals ($1500), site utilities (phone & power $400), replacement membranes ($5000), laboratory costs, well supply, etc.. The above estimate also assumes that the JVWCD staff can provide the majority of the operational labor associated with the daily operation of the Pilot Plant. We typically assume that the operators will check the system 3 times per week and spend 2 hours on-site to check chemical supply, record conductivity for each pressure vessel, differential pressure for each stage. The performance data can also be down loaded for preparation of normalized specific flux curves.

The costs identified above reflect an average level of effort for a clean water source. The costs, however, can be lower if the effort is limited to verifying performance of a single membrane and operating condition. Alternately, the costs can be substantially higher if several membranes, water sources and operating conditions are evaluated, and there is extensive operating support required. Given the number of review agencies involved and the difficulty of treating this water we recommend that you budget $200,000 to $300,000 for the pilot study Phase of the project. After you have reviewed these average costs we can discuss the anticipated level of effort in greater details and provide examples of test plans, progress reports, and summary reports for your consideration.

Concentrate Disposal Permit Scoping Study

Task	Description	Labor [2]		Laboratory Work		Total Per Task
		Hours	$	No. of samples	$	$
1	**Limited Characterization of Receiving Water Body (Storm Drainage Channel and Pump Station Retention Basin)**					
1a	Seasonal Flow Analysis	32	$3,200	-	$0	
1b	General Minerals Analysis	16	$1,600	10 @ $260 [3]	$2,600	
1c	Acute Toxicity & Short-Term Chronic Tests		$0	2 @ $1,450 [4]	$2,900	
	TASK 1 TOTAL	48	$4,800		$5,500	$10,300
2	**Characterization of Concentrate Discharge**					
2a	Seasonal Flow Analysis	8	$800	-	$0	
2b	General Minerals Analysis		$0	1 @ $260 [3]	$260	
2c	EPA Priority Pollutant Analysis		$0	1 @ $1,650 [5]	$1,650	
2d	Acute Toxicity & Short-Term Chronic Tests		$0	1 @ $1,450 [4]	$1,450	
	TASK 2 TOTAL	8	$800		$3,360	$4,160
3	**Discussion and Meetings with RWQCB**	20	$2,000	-	$0	$2,000
4	**Development of Individual NPDES Permit Application**					
4a	Analysis of Receiving Water Body Limited Characterization	8	$800	-	$0	
4b	Analysis of Concentrate Discharge Characterization	8	$800	-	$0	
4c	Estimation of Dispersion in Mixing Zone	8	$800	-	$0	
4d	Comparison of Concentrate to Basin Standards for Receiving Water	16	$1,600	-	$0	
	TASK 4 TOTAL	40	$4,000		$0	$4,000
5	**PROJECT MANAGEMENT**	24	$2,400		$0	$2,400
	GRAND TOTAL	140	$14,000		$8,860	$22,860

Notes:

(1) Assumes that no major issues arise (e.g., high toxicity or high concentration of priority pollutants in concentrate) with the recommended alternative. If so, definitive acute toxicity and short-term chronic tests (up to $1,100 each) as well as additional engineering analysis will be required. This could result in an additional budget increase of $10,000.

(2) Assumes an average labor rate of $100/hour.

(3) Includes testing of bicarbonate alkalinity, carbonate alkalinity, hydroxide alkalinity, calcium, chloride, copper, foaming agents, (MBAS), iron, magnesium, manganese, pH, potassium, sodium, sulfate, specific conductance, total dissolved solids, and zinc ($260).

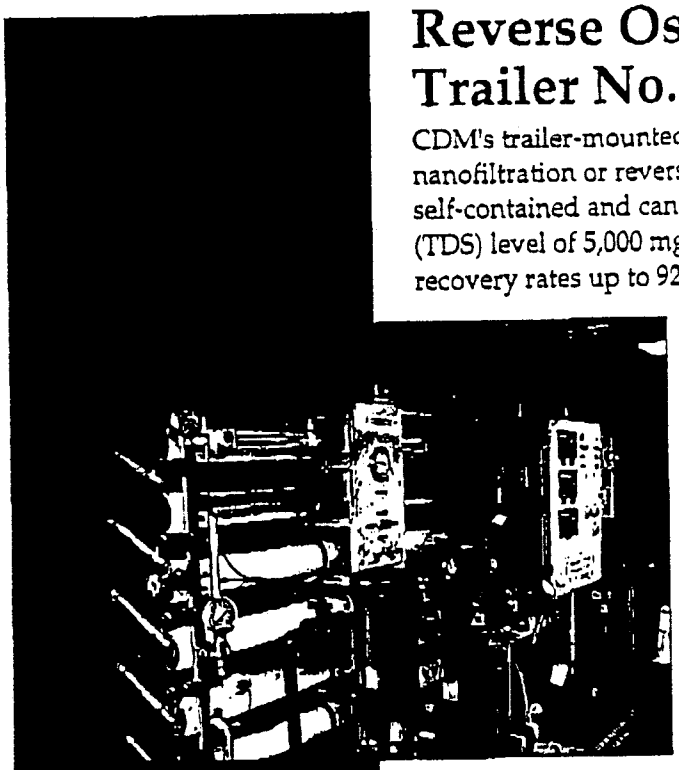
(4) Includes 96-hour non-renewal acute toxicity test for fathead minnow, stickleback minnow, or rainbow trout at 100% sample concentration ($200-250). Includes short-term chronic screening tests at 100% sample concentration. The three short-term chronic tests are a) fathead minnow larvae or menidia (fish) for 7 days;b) Ceriodaphnia dubia (water flea) for 7 days; and c) algae (plant) for 96 hours. Each screening test is $400. If screening tests are indicative of toxicity, a definitive test will be required. Definitive tests for a) and b) are $1,100 each, and a definitive test for c) is $750.

(5) Analysis for EPA priority pollutants includes Purgeable Organics by EPA 624/8240 ($275); Extractable Organics by EPA 625/8270 ($450); Pesticides, and PCB's by EPA. 608/8080 ($250); Priority Metals ($285); Priority Low-Level Metals ($325); and cyanide ($85).

Revised 4/6/00

Reverse Osmosis/Nanofiltration Pilot Trailer No. 2

CDM's trailer-mounted NF/RO pilot unit No. 2 is designed to test nanofiltration or reverse osmosis membranes for our clients. The pilot unit is self-contained and can treat groundwater of up to a total dissolved solids (TDS) level of 5,000 mg/L. It can conduct tests on membrane softening at recovery rates up to 92 percent.



The system has two stages of pressure vessels in a 2/2/1/1 array with six elements per stage. The first stage consists of four 4-inch diameter vessels containing three membrane elements each, connected so that it is essentially two parallel 6-element vessels. The second stage consists of two 4-inch diameter vessels with three membrane elements each connected to act as one vessel with six elements. The unit has a nominal capacity of 20 gpm.

Feed water enters the trailer and passes through a 5-micron cartridge filter, a 230-psi constant speed high-pressure booster pump, and then through the membranes. The pilot system has both acid and antiscalant dosing equipment including day tanks, metering pumps, acid containment tub, pH monitor, and an array of pressure gauges. There is a panel that has permeate and concentrate flow and conductivity meters, and a large pressure gauge connected to all critical pressure points through a rotary valve. A control panel has all motor starters, and a PLC to automatically start and stop the system. The system will alarm and shut down if the suction pressures or pH levels of the feed water are out of range. The system uses a PLC to communicate with a SCADA system for data monitoring and has an autodialer for remote unattended operation. A transformer is mounted inside the trailer that will allow the plant to operate on either 480-volt or 220-volt power. There is a variety of pumps, tanks and hoses with the unit to facilitate membrane cleaning or product water pumping.

Typical Costs

Rent:
$4,000/month
Purchase:
Dependent on model and options; price quotes available upon request.

The trailer is a enclosed car transport trailer unit with tandem axles and electric brakes, and is approximately 22 feet long, 8 feet wide, and 8 feet high. The floor is ¾-inch marine plywood painted with epoxy paint.

This plant has been used to perform pilot testing of low-pressure RO membranes at the Alameda County Water District for 6 months. The feed water was groundwater with a hardness of 1,000 mg/L as $CaCO_3$. The unit was constructed in 1998 and is in good condition. An O&M manual was prepared for the RO and SCADA monitoring equipment.

APPENDIX G

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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

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 12.1A, 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 ¼ 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.

APPENDIX H

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EXECUTIVE SUMMARY

Based on a detailed screening of remedial alternatives and additional studies after the completion of the Remedial Investigation and Feasibility Study, Kennecott Utah Copper has developed a Proposed Remedial Action Plan for groundwater contamination in the southwestern Jordan Valley, Utah. This Plan meshes with and incorporates the proposed Natural Resource Damage settlement plan, which was submitted to the State NRD Trustee in December 1999.

The Proposed Plan assumes perpetual operation and maintenance of the existing source control measures. Groundwater monitoring would be conducted as long as required by five-year reviews. The Plan also would include administrative controls and restrictions of land and groundwater use and point-of-use management. The Plan assumes that approximately 100 households may require point-of-use management. If municipal water supplies exceed sulfate concentrations of 500 mg/L, then point-of-use management could call upon municipal water supplied under the proposed NRD Plan.

To respond to elevated sulfate in groundwater, the Plan includes installation and operation of a sulfate extraction barrier well system for hydraulic containment of the elevated sulfate plume (groundwater containing sulfate concentrations above 1,500 m/L), and construction and operation of a RO water treatment plant for treating the extracted groundwater. A total of 2500 gpm (4000 acre-feet per year) will be extracted from the sulfate plume.

Additional non-Kennecott wells will be located in the sulfate plume east of the former Kennecott evaporation ponds. These wells also will produce about 4,000 afy, which would be sent to a non-Kennecott RO treatment plant located near the wells. After treatment, the permeate from the Bingham Creek plume and from east of the former Kennecott evaporation ponds would yield at least 7,000 afy of municipal quality drinking water. This water would be sent to local municipalities for beneficial use as envisioned in the proposed NRD plan. The RO concentrate reject from the Kennecott RO plant would be sent to the Kennecott tailings line. After mine closure, this concentrate would be discharged directly to the Great Salt

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Lake. RO concentrate reject from the non-Kennecott RO plant would be discharged to the Jordan River.

Active restoration of the acidic portion of the Bingham Creek groundwater plume would occur as follows. Groundwater extraction wells installed in the acidic plume would be pumped at a rate of approximately 1500 – 2500 gpm, which would remove more than 90 percent of the mass of the acidic plume in approximately 30 years. Active pumping of the acid plume would also protect the sulfate barrier well system and RO treatment plant from being compromised by acidic water.

The permeate from acidic water extracted from the Bingham Creek plume and treated by NF would be sent to a RO system for polishing, and the high quality effluent would then be blended with the sulfate plume extraction wells and treated with RO to provide drinking water under the proposed NRD Plan. The RO/NF concentrate reject would be sent to the Kennecott tailings line until mine closure. Subsequent to mine closure, the NF concentrate would be conveyed to:

a) A lined facility in the Kennecott waste rock dumps or tailings impoundment for storage and evaporation, **or**
b) A lime treatment plan, with sludge storage in a lined RCRA facility adjacent to the water treatment plant. The permeate from the lime treatment plant would be sent to the Kennecott RO plant for polishing.

After mine closure, the RO concentrate would be discharged directly to the Great Salt Lake.

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1.0 POTENTIAL REMEDIAL ALTERNATIVES

1.1 INTRODUCTION

The detailed analysis of alternatives presented in the Feasibility Study (Kennecott 1998) provided the relevant information needed to compare the six proposed remedial alternatives assembled for elevated sulfate and acidic groundwater in the southwestern Jordan Valley (the site). The analysis followed standard EPA procedures for development and screening of remedial action alternatives and provided the basis for identifying a preferred alternative. The results of the detailed analysis are the basis for the proposed remedial alternative for the site. This alternative is described below in the Proposed Plan.

The detailed analysis of alternatives consisted of the following components:

- Further definition of each alternative with respect to the volume of contaminated media to be addressed, the technologies to be used, and any performance requirements associated with those technologies.
- An assessment and summary profile of each alternative against seven of the nine evaluation criteria discussed below.
- A comparative analysis among the alternatives to assess the relative performance of each alternative with respect to seven of the nine evaluation criteria.

1.1.1 Synopsis of Final Screening Process

From the general response actions and technology screening process in the FS, six remedial alternatives were assembled and evaluated:

- Alternative I—No further action except continued source control and monitoring
- Alternative II—Alternative I plus institutional controls
- Alternative III—Alternative II plus point-of-use management
- Alternative IV—Alternative III plus hydrologic containment, reverse osmosis (RO) treatment and delayed extraction of acid plume and subsequent nanofiltration (NF) treatment, with RO/NF concentrate delivered:
  a) Directly to a lined heap leach facility[1] for about 10 years with remainder to Kennecott's tailings line
  b) Directly to Kennecott's tailings line
  c) Directly to the Great Salt Lake.[2]

[1] Kennecott has discontinued "heap leaching". It has been replaced in this proposal by a lined storage and evaporation facility in the waste rock dumps or tailings impoundment.

- Alternative V—Alternative III plus hydraulic containment, RO treatment and active extraction of the acid plume, with plume water delivered:
  a) To a NF treatment plant, with NF permeate to RO and RO/NF concentrate to options listed for Alternative IV (a-c); **or**
  b) Directly without treatment to the options listed for Alternative IV (a-c)
- Alternative VI—Alternative III plus hydraulic containment, RO treatment and active pumping of the acid plume, with extracted plume water delivered to a lime treatment facility and sludge to a local hazardous waste repository.

Each of the six alternatives was compared against the others to assess its relative degree of compliance with seven of the nine NCP criteria described below. In the FS natural attenuation coupled with institutional controls (including water treatment provided under a proposed Natural Resources Damages response plan) was considered to be the most effective remedy for contamination outside of the Bingham Creek plume area, including the Lark, Herriman and former Kennecott evaporation pond areas. However, under the NRD plan, Kennecott has proposed to remediate sulfate contamination in the Lark and former evaporation pond areas as well.

1.1.2. Evaluation Criteria

In accordance with the NCP, remedial actions must:

- Be protective of human health and the environment
- Attain potential applicable or relevant and appropriate requirements (ARARs) or provide grounds for invoking a waiver of potential ARARs that cannot be achieved
- Be cost-effective
- Utilize permanent solutions and alternative treatment technologies or resource-recovery technologies to the maximum extent practicable
- Satisfy the preference for treatment that reduces toxicity, mobility or volume as a principal element, or provide an explanation in the Record of Decision (ROD) as to why it does not.

In addition, the NCP emphasizes long-term effectiveness and related considerations including:

- Long-term uncertainties associated with land disposal
- Goals, objectives and requirements of the Solid Waste Disposal Act

[2] Subsequent studies eliminated the option of direct discharge of NF concentrate to the Great Salt Lake.

- Persistence, toxicity and mobility of hazardous substances and their constituents, and their propensity to bio-accumulate
- Short-and long-term potential for adverse health effects from human exposure
- Long-term maintenance costs
- Potential for future remedial action costs if the selected remedial action fails
- Potential threat to human health and the environment associated with excavation, transportation, re-disposal or containment.

Provisions of the NCP require each alternative to be evaluated against nine criteria listed in 40 CFR 300.430(e)(9). These criteria were published in the March 8, 1990, Federal Register (55 FR 8666), to provide grounds for comparison of the relative performance of the alternatives and identify their advantages and disadvantages. This approach is intended to provide sufficient information to adequately compare the alternatives and to eventually select the most appropriate alternative for implementation at the site as a remedial action. The evaluation criteria are:

Threshold:

- Overall protection of human health and the environment
- Compliance with potential ARARs

Threshold criteria must be met by a particular alternative for it to be eligible for selection as a remedial action. There is little flexibility in meeting the threshold criteria; either they are met by a particular alternative, or that alternative is not considered acceptable. If potential ARARs cannot be met, a waiver may be obtained in situations where one of the six exceptions listed in the NCP occur:

1) interim measures apply;
2) there is greater risk to health and environment;
3) technical impracticability;
4) equivalent standard of performance;
5) inconsistent application of state requirements; or
6) fund balancing (for Superfund financed actions).[3]

Balancing:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility or volume through treatment
- Short-term effectiveness

[3] See 40 CFR 300.430 (f)(1)(ii)(C)(1 to 6) for further explanation.

- Implementability
- Cost

Unlike the threshold criteria, the five balancing criteria weigh the trade-off between alternatives. A low rating on one balancing criterion can be compensated by a high rating on another.

Modifying:

- State acceptance
- Community acceptance.

The two modifying criteria are State acceptance and community acceptance. The Utah Department of Environmental Quality (UDEQ) is a party to the conduct of the Remedial Investigation and FS (RI/FS) for the site, and the finalization of this FS is guided by State review. Community comments on the Proposed Plan guide the completion of the ROD; the site Technical Review Committee (TRC) has acted as a community representative throughout this RI/FS. Both State and community acceptance will be discussed in detail in the ROD. However, because these two modifying criteria are not addressed until the ROD is issued, they were not considered in the remainder of the detailed analysis in the FS. All nine evaluation criteria are briefly described below.

Threshold Criteria. To be eligible for selection, an alternative must meet the two threshold criteria described below, or in the case of potential ARARs, must justify why a waiver is appropriate.

- **Overall Protection of Human Health and the Environment**—Protectiveness is the primary requirement that remedial actions must meet under CERCLA. A remedy is protective if it adequately eliminates, reduces or controls all current and potential risks posed by the site through each exposure pathway. The assessment against this criterion describes how the alternative achieves and maintains protection of human health and the environment.
- **Compliance with Potential ARARs**—Compliance with potential ARARs is one of the statutory requirements of remedy selection. Potential ARARs are cleanup standards, standards of control, and other substantive environmental statutes or regulations which are either "applicable" or "relevant and appropriate" to the CERCLA cleanup action (42 USC 9621 [d] [2]). "Applicable" requirements are standards, requirements or limitations that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance

at a CERCLA site. "Relevant and appropriate" requirements are those that although not "applicable" address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to environmental or technical factors at a particular site. The assessment against this criterion describes how the alternative complies with potential ARARs or presents the rationale for waiving a potential ARAR. Potential ARARs can be grouped into three categories:

- **Potential chemical-specific** ARARs are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, establish the amount or concentration of a chemical that may remain in or be sent to the environment. Chemical-specific requirements set limits on concentrations of specific hazardous substances, pollutants and contaminants in the environment.
- **Potential location-specific** ARARs restrict the concentration of hazardous substances or the conduct of activities solely because they are in specific locations, such as flood plains, wetlands, historic places, and sensitive ecosystems or habitats. Location-specific requirements set limits on certain types of activities in wetlands, flood plains and at historical sites.
- **Potential action-specific** ARARs include technology- or activity-based requirements that set controls, limits or restrictions on design performance of remedial actions or management of hazardous constituents. Action-specific requirements are technology-based restrictions that are triggered by the type of action under consideration.

Attachment 1 (Table 4-1 of the FS) presents a compilation of all the potential State and Federal chemical-specific, location-specific and action-specific ARARs considered for the site.

Balancing Criteria. The five criteria listed below represent the criteria upon which the comparative analysis of alternatives is based.

- **Long-term Effectiveness and Permanence**—This criterion reflects CERCLA's emphasis on implementing remedies that will ensure protection of human health and the environment in the long-term as well as in the short-term. The assessment of alternatives against this criterion evaluates the residual risks at a site after completing a remedial action or enacting a no action alternative.

- **Reduction of Toxicity, Mobility and Volume (TMV) through Treatment**—This criterion addresses the statutory preference for remedies that employ treatment as a principal element. The assessment against this criterion evaluates the anticipated performance of the specific treatment technologies an alternative may employ.
- **Short-term Effectiveness**—This criterion addresses short-term effects of the alternatives. The assessment against this criterion examines the effectiveness of alternatives in protecting human health and the environment (i.e., minimizing any risks associated with an alternative) during the construction and implementation of a remedy until the response objectives have been met.
- **Implementability**—The assessment against this criterion evaluates the technical and administrative feasibility of the alternative, and the availability of the goods and services needed to implement it.
- **Cost**—Cost encompasses all engineering, construction, and operation and maintenance (O&M) costs incurred over the life of the project. The assessment against this criterion is based on the estimated net present worth of these costs for each alternative. Net present worth is a method of evaluating expenditures such as construction and O&M that occur over different lengths of time. This allows costs for remedial alternatives to be compared by discounting all costs to the year that the alternative is implemented. The present worth of a project represents the amount of money which, if invested in the initial year of the remedy and disbursed as needed, would be sufficient to cover all costs associated with the remedial action. As stated in the RI/FS guidance (U.S. EPA 1988), these estimated costs are expected to provide an accuracy of plus 50 percent to minus 30 percent.

Modifying Criteria. As described in the RI/FS guidance, the final two screening criteria are State acceptance and community acceptance. These modifying criteria are described as follows:

- **State Acceptance**—This criterion, which is an ongoing concern throughout the remedial process, reflects the statutory requirement to provide for substantial and meaningful State involvement. The UDEQ has been and currently is involved in each step of the RI/FS process for this site.
- **Community Acceptance**—This criterion reflects the community's preferences for, or concerns about, the remedial alternatives. Although this criterion will be

addressed after the Proposed Plan is released, the TRC has provided community input throughout the development of the Plan.

1.1.3. Performance Monitoring

The performance of Proposed Plan will be evaluated on a periodic basis (at least every five years after initiation of action) until it is determined that contaminants no longer pose a threat to human health and the environment. Based on this review, a report would be prepared that evaluates the performance of the system and recommends continued implementation of the remedy, operational changes, a significant modification of the remedy, or, if necessary, an application for ARAR waivers.

Performance monitoring and treatability studies will provide actual data regarding the projected remediation periods and the residual risks associated with the Proposed Plan. Prior to obtaining these data, residual risk is very difficult to estimate. In addition, if the remedial system requires replacement, the risks associated with any residual contamination should be greater than the risks of installing the system.

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2.0 PROPOSED PLAN

The following sections present the Proposed Plan for remedial action at the site. It begins with a brief description of the alternative that supplements the descriptions in Sections 3.0 and 4.0 of the FS. The text then provides an analysis of the Plan against seven of the nine NCP criteria described above (the two modifying criteria are not discussed). For each criterion, the most important aspects of this analysis are described. Detailed evaluation of the proposed remedial action for each criterion is summarized in Table 2-1. The proposed action includes monitoring, five-year site review and existing source controls already implemented by Kennecott at the site.

2.1 DESCRIPTION

The Proposed Plan assumes perpetual operation and maintenance of the existing source control measures. Groundwater monitoring would be conducted according to Kennecott's ongoing Groundwater Characterization and Monitoring Plan (Kennecott 1997) or a similar program as long as required by five-year reviews.

In addition, the Plan would include administrative controls and restrictions of land and groundwater use. For those areas where the groundwater contains contaminants that exceed preliminary remediation goals (PRGs), such as the Lark, Herriman and former evaporation pond areas, institutional controls would consist of restricting the use of existing wells and the installation of new wells through local or state laws or other means such as purchasing water rights. Based on the current distribution of contamination, this would entail restricting installation of new drinking water wells on mostly Kennecott property. Because the acid plume would continue to migrate, groundwater use in the affected area would be restricted to prevent contact with contaminated groundwater above PRGs. Figures 2-1 and 2-2 depict the area expected to require groundwater use restrictions over the next 30 years, assuming EPA approves the Proposed Plan.

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TABLE 2-1
DETAILED EVALUATION OF PROPOSED RA PLAN
HYDRAULIC CONTAINMENT, RO TREATMENT, ACTIVE PUMPING OF THE ACID PLUME TO NF/RO TREATMENT WITH CONCENTRATE REJECT TO DELIVERY OPTIONS

Criteria	Alternative Evaluation
1. Overall protection of human health and the environment.	Would provide protectiveness through institutional controls, point-of-use management, containment, RO treatment, extraction of the acidic plume treated by NF/RO with concentrate reject to various delivery options and permeate to municipal supply.
2. Complies with ARARs a) Action-specific ARARs b) Chemical-specific ARARs c) Location-specific ARARs	 a) Would comply with all action-specific ARARs (see Attachment 1). b) Complies with all chemical-specific ARARs (see Attachment 1). c) Would comply with all location-specific ARARs (see Attachment 1).
3. Long-term effectiveness and permanence a) Magnitude of residual risks b) Adequacy and reliability of controls	 a) Reduces magnitude of residual risk significantly due to extraction of contaminated groundwater, with remediation time frame in tens of years b) Adequacy and reliability of the hydraulic containment and water treatment facilities are demonstrated, but will require long-term maintenance and operation.
4. Reduction in TMV through treatment a) Treatment process used and materials treated b) Degree and quantity of TMV reduction c) Irreversibility of TMV reduction d) Type and quantity of treatment residuals	 a) Groundwater collected by barrier wells treated by RO and acid extraction treatment by RO/NF with concentrate reject to various delivery options and permeate to municipal supply; demonstrated technology for site groundwater. b) Long-term operation of the hydraulic containment and water treatment facilities will significantly reduce TMV (approximately 80-90 percent removal) of the contaminated groundwater. c) TMV reduction permanent in groundwater system. d) RO/NF reject will be generated, with concentrate reject to tailings line.
5. Short-term effectiveness a) Protection of workers during remedial action b) Protection of community during remedial action c) Environmental impacts of remedial actions d) Time until RAOs are achieved	 a) Protective of workers by following standard health and safety procedures. b) Protective of community by following standard health and safety procedures. c) No environmental impacts to site expected; RO reject sent to zero-discharge leach circuit. d) Immediately meets the RAO of preventing human exposure, and once constructed, meets the RAO of preventing flow of contaminants to the Jordan River through hydraulic containment.
6. Implementability a) Technical feasibility b) Administrative feasibility c) Availability of services and materials	 a) Technically feasible; all technologies are proven. b) Administratively feasible. c) All materials needed for this alternative are available nearby or can be obtained easily.
7. Costs (Millions) a) Capital costs b) NPV operating cost c) Total NPV	 a) $xxx b) $xxx c) $xxx

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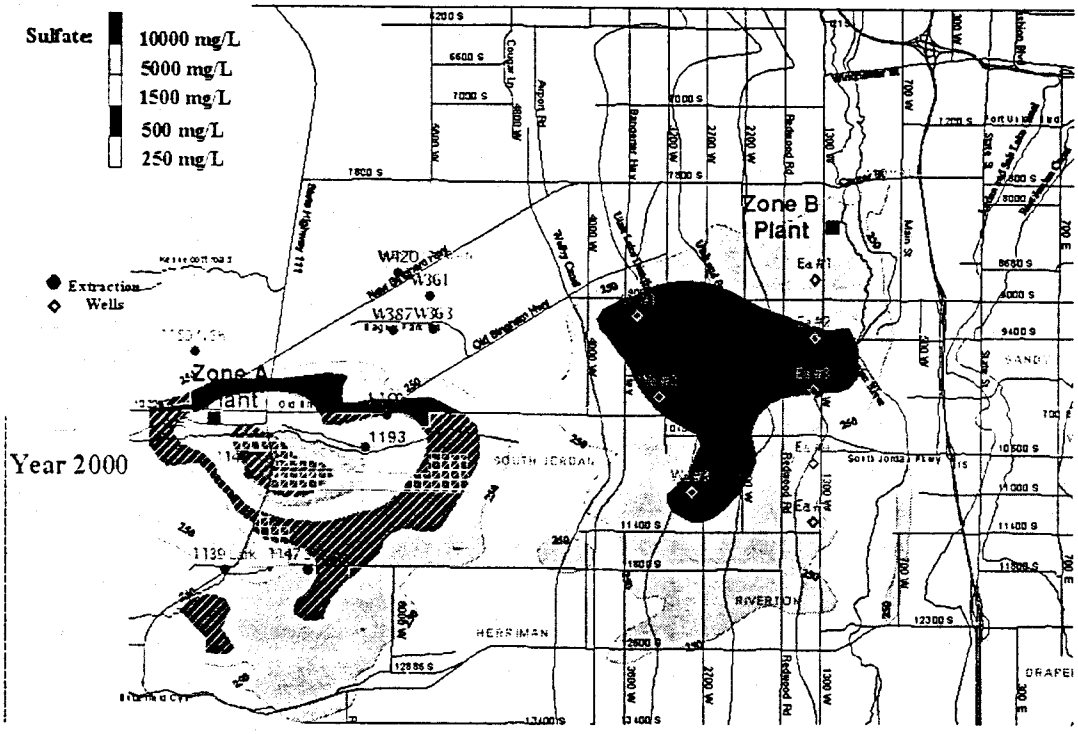

Figure 2-1. Current distribution of elevated sulfate in southwestern Jordan Valley

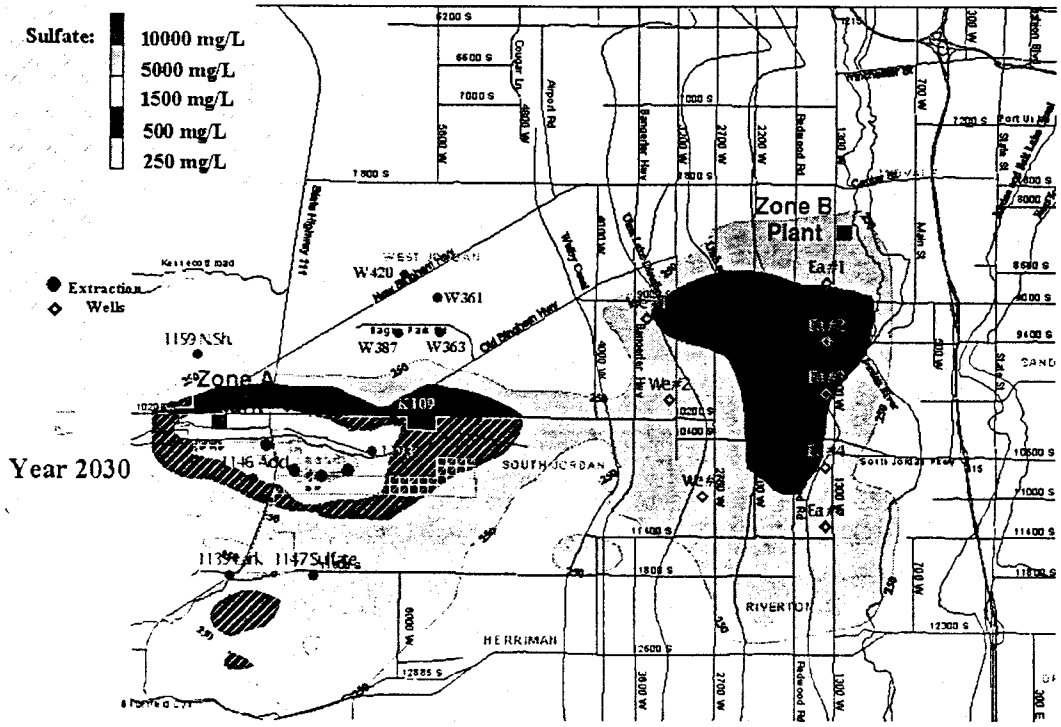

Figure 2-2. Distribution of elevated sulfate in 2030

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The Plan also includes point-of-use management. Point-of-use management options include: a) replacement of private water supplies with municipal water (where it is available) for well owners in areas where well water contains sulfate at concentrations greater than 500 mg/L, and b) installation of household reverse osmosis water treatment units to treat well water to potable water standards (where municipal water supply is unavailable) in areas where well water contains sulfate above 500 mg/L. The Plan assumes that approximately 100 households may require one of the above point-of-use management options. If municipal water supplies exceed 500 mg/L sulfate, then point-of-use management could call upon municipal water supplied under the proposed NRD Plan.

To respond to elevated sulfate in groundwater, the Plan includes installation and operation of a sulfate extraction barrier well system for hydraulic containment of the elevated sulfate plume (groundwater containing sulfate concentrations above 1,500 m/L)[4], and construction and operation of a RO water treatment plant for treating the extracted groundwater. A total of 2500 gpm will be extracted from the sulfate plume. The treatment system would be designed for a capacity of at least 2500 gpm (4000 acre-feet per year). Figure 2-3 depicts the layout of the proposed hydraulic containment system for the Bingham Creek plume, as well as the potential location of the Kennecott RO treatment plant. See Table 2-2 for extraction rates and timing.

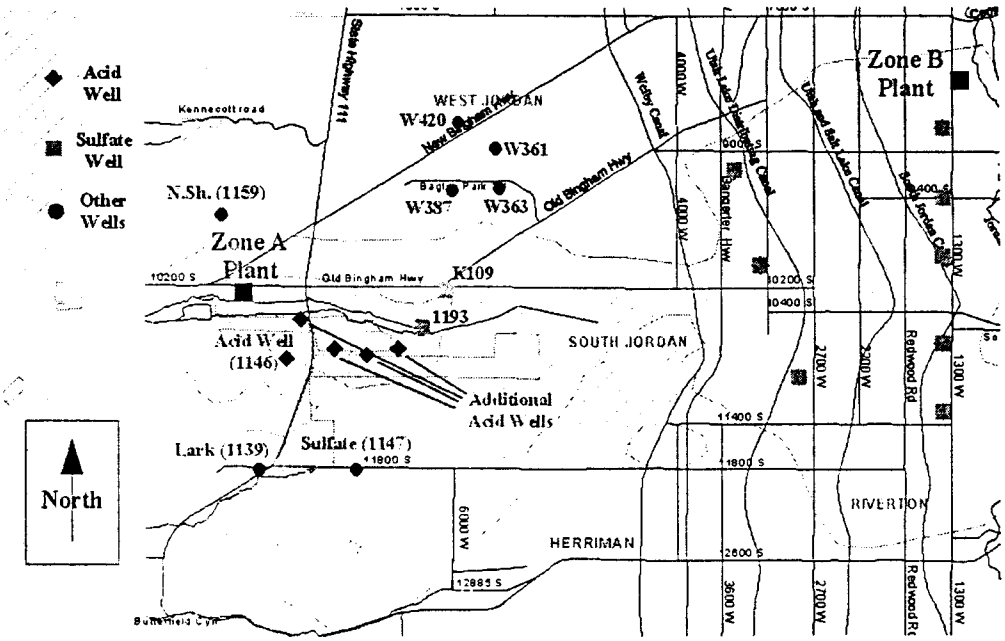

Figure 2-3. Location of acid and sulfate extraction wells and treatment plants

[4] This area is designated Zone A in the proposed NRD Plan.

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Table 2-2. Extraction rate assumptions for Proposed Plan

Well	Model Layer*	Pumping Rate (gpm)	Years
Acid Well (ECG1146)	4	1500	0-5
New Acid Well #1	4	750	5-15
New Acid Well #2	4	1250	5-30
New Acid Well #3	4	500	5-15
New Acid Well #4	4	1250	15-50
K109	4	250	0-50
K109	5	1000	0-50
K109	6	250	0-50
B2G1193	4	125	0-50
B2G1193	5	875	0-50

* Layer 3 is 0 – 150 feet below the groundwater table Layer 4 is 150 - 300 feet below the groundwater table
Layer 5 is 300 – 450 feet below the groundwater table Layer 6 is 450 – 650 feet below the groundwater table

Figure 2-3 also shows additional non-Kennecott wells located in the sulfate plume east of the former Kennecott evaporation ponds.[5] These wells also will produce about 2,500 gpm 4,000 afy, which would be sent to a non-Kennecott RO treatment plant located near the wells. After treatment, the permeate from the Bingham Creek plume and from east of the former Kennecott evaporation ponds would yield at least 7,000 afy of municipal quality drinking water. This water would be sent to local municipalities for beneficial use as envisioned in the proposed NRD plan. The RO concentrate reject from the Kennecott RO plant would be sent to the Kennecott tailings line. After mine closure, this concentrate would be discharged directly to the Great Salt Lake. RO concentrate reject from the non-Kennecott RO plant would be discharged to the Jordan River.

Active restoration of the acidic portion of the Bingham Creek groundwater plume would occur as follows. Groundwater extraction wells installed in the acidic plume (Figure 2-3) would be pumped at a rate of approximately 1500 – 2500 gpm, which would remove more than 90 percent of the mass of the acidic plume in approximately 30 years. Active pumping of the acid plume would also protect the sulfate barrier well system and RO treatment plant from being compromised by acidic water.

The permeate from acidic water extracted from the Bingham Creek plume and treated by NF would be sent to a RO system for polishing, and the high quality effluent would then be blended with the sulfate plume extraction wells in Zone A and treated with RO to provide drinking water under the proposed NRD Plan. The RO/NF concentrate reject

[5] This area is designated Zone B in the proposed NRD Plan.

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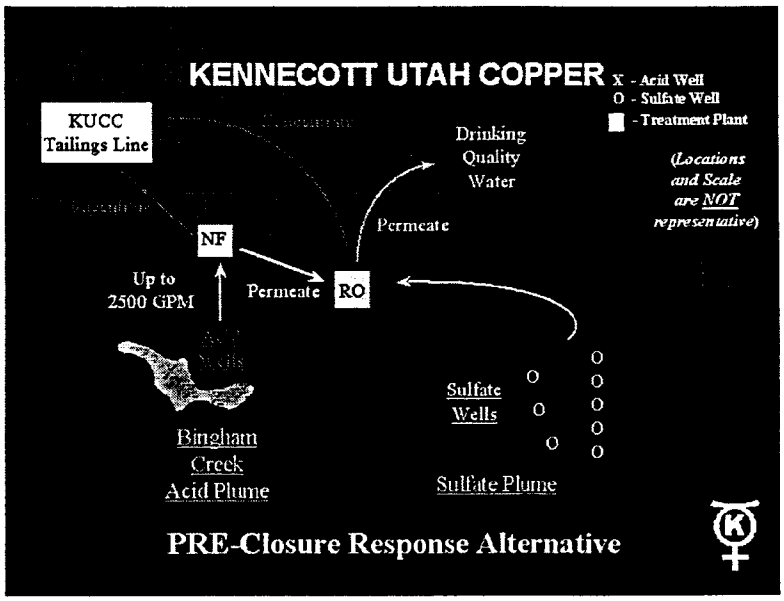
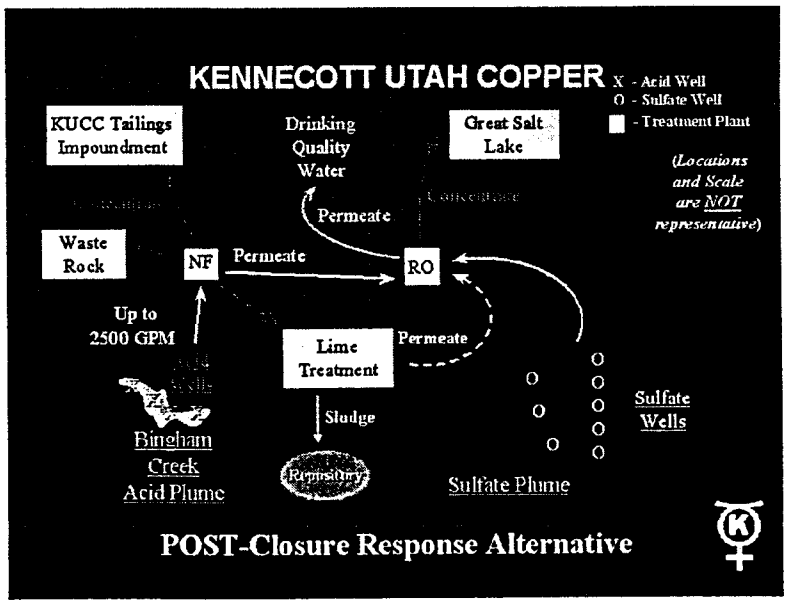
would be sent to the Kennecott tailings line until mine closure. Subsequent to mine closure, the NF concentrate would be conveyed to:

a) A lined facility in the Kennecott waste rock dumps or tailings impoundment for storage and evaporation, **or**
b) A lime treatment plan, with sludge storage in a lined RCRA facility adjacent to the water treatment plant. The permeate from the lime treatment plant would be sent to the Kennecott RO plant for polishing.

After closure, the RO concentrate would be discharged directly to the Great Salt Lake. These treatment and delivery options for the Proposed Plan are summarized below.





2.2 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The Proposed Plan would provide protectiveness of human health and the environment by eliminating human or ecological exposure pathways to contaminants through institutional controls, point-of-use management, containment of groundwater having contaminant concentrations above PRGs, and by actively restoring the acidic portion of the groundwater plume in an accelerated time frame.

- Concentrate from RO/NF treatment to direct delivery options would have to be carefully monitored during delivery.
- Delivery of the RO/NF concentrate to a lined evaporation facility would be of little or no environmental hazard if the storage system is properly constructed and operated.
- Delivery to the tailings line would result in neutralization of concentrate and precipitation of associated contaminants in a contained impoundment and should not represent a human or environmental hazard.
- Lime treatment may present potential health risks due to increased traffic associated with trucking of lime to the site as well as disposal of the lime-treated sludge.

2.3 COMPLIANCE WITH POTENTIAL ARARS

The Proposed Plan would comply with ARARs. A key component of the Plan is hydraulic containment of the acid plume, which will prevent this contaminated groundwater from affecting down gradient drinking water wells. Under this alternative, the acid plume effectively becomes a waste management unit such that the appropriate "point of compliance" for measuring compliance with ARARs is at and beyond the edge of the containment area. At the point of compliance, all PRGs for acids and metals would be met immediately. Kennecott and the State have opposing views as to whether MCLs and groundwater corrective action requirements are ARARs with respect to non-hazardous substances such as sulfate and TDS (**see Attachment 1**). Notwithstanding these opposing positions, modeling done for the FS indicates that, for sulfate, natural attenuation would achieve the PRG of 1,500 mg/L[6] outside the containment area within

[6] There are no clear cleanup standard ARARs for sulfate or TDS under the Utah groundwater corrective action regulations. The presumptive standards for groundwater Corrective Action Concentration Limits (CACLs) are the Utah groundwater quality standards (UAC R317-6-6.15.F); however, there is no such groundwater quality standard for sulfate or TDS (UAC R317-6-2). Where there is no groundwater quality standard for a particular contaminant, a CACL is proposed taking into consideration federal MCLGs, health advisories, risk-based contaminant levels or standards established by other regulatory agencies and other relevant information. An Alternate Corrective Action Concentration

approximately 5 to 10 years and the Utah drinking water standard (500 mg/L) in approximately 40 to 50 years. The point-of-use PRG of 500 mg/L will be applied to prevent the ingestion of groundwater exceeding this concentration down gradient of the 1,500 mg/L sulfate barrier wells system.

RO/NF concentrate will be delivered to the Kennecott tailings impoundment. The concentrate would consist of the byproduct of treated groundwater contaminated by former mining practices and should not be subject to the zero discharge limitations for process wastewater applicable to active mining operations. *See* 48 Fed. Reg. 7953 (Feb. 8, 1979). Discharges from the tailings impoundment would, however, need to comply with established UPDES permit limits. Alternatively, if the zero discharge limitations were deemed applicable to the delivery option, the associated discharge would qualify for the "equivalent standard of performance" ARARs waiver. Specifically, in accordance with the combined waste stream rule, the volume of effluent recycled from the tailings impoundment would establish compliance with the zero discharge limitations. *See* 40 C.F.R. § 440.131(a) (1996). In addition, delivery of RO/NF concentrate to the tailings impoundment would require compliance and does comply with groundwater protection requirements.

Construction of a repository for lime-treated sludge would require complying with Utah groundwater protection requirements.

2.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

The Proposed Plan provides long-term effectiveness and permanence by eliminating exposure to contaminated groundwater, by controlling the migration of the acidic portion of the plume, and by actively extracting acidic groundwater from the principal aquifer. The time frame over which the magnitude of the residual risk is reduced to below levels of concern may be significant, and for some proposed contaminants of concern, the remediation time frame may be longer than 30 years. For these reasons, long-term management of the site would be required, and would consist of periodic maintenance of the groundwater extraction wells, groundwater compliance monitoring (for all

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Limit (ACACL) can be established in place of a CACL if it is protective of human health and the environment and utilizes best available technology. In this case, the health-based Preliminary Remediation Goal ("PRG") for sulfate is 1,500 mg/L.

repositories and the hydraulic containment systems), and operation and maintenance of the water treatment system and the sludge repository.

Discharge of the NF concentrate to the Kennecott tailings line may result in increased total dissolved solids in the process system, and will need to be considered in view of operational or permit requirements. This issue is currently under study by Kennecott.

2.5 REDUCTION OF TOXICITY, MOBILITY AND VOLUME THROUGH TREATMENT

The Proposed Plan reduces TMV by extracting and treating contaminated groundwater. Hydraulic containment will permanently reduce the toxicity and volume of the sulfate plume and will prevent the portion of the plume currently above PRGs from migrating farther down gradient.

Extraction of acidic groundwater followed by delivery to the tailings line would permanently and significantly reduce the volume (and mass) of contaminants in the groundwater through neutralization reactions.

Extraction of the acidic groundwater followed by delivery to a lined facility would reduce TMV through the permanent removal of contaminant mass from the aquifer. Although lime treatment would generate large volumes of sludge, the sludge should be relatively non-reactive.

2.6 SHORT-TERM EFFECTIVENESS

Implementation of the Proposed Plan is not expected to result in any serious potential risks for remedial action workers or the community during construction. All construction work (drilling and well installation, pipeline construction, water treatment plant construction) would be conducted following standard health and safety practices associated with each of these activities. If necessary, dust suppression may be employed during construction of the water treatment plant. The Remedial Action Objectives of preventing human and ecological exposure to contaminated groundwater above PRGs would be achieved by institutional controls, point-of-use management of groundwater above PRGs, and hydraulic containment, which prevents the migration of the acid plume beyond the containment boundary.

Lime treatment will present some risks to the community and workers during its implementation. These risks, which are associated with lime treatment, are due to:

- The large volume of lime that would need to be trucked to Kennecott would result in a large increase in traffic, which would result in measurable risks to the community and remedial action workers. Air pollution from the truck traffic could also be a concern.
- The large volume of sludge generated by lime treatment would require disposal; if this disposal is off-site, additional traffic would be generated, resulting in additional risk associated with increased traffic volume on any nearby highway.

Some of the risks associated with increased traffic volume could be reduced by preparing contingency plans and operating plans that take into account the time of day during which most the truck traffic would occur (i.e., avoid rush hour periods, etc.). Other risks associated with typical construction activities could be controlled by adherence to health and safety plans appropriate for each construction activity.

2.7 IMPLEMENTABILITY

The Proposed Plan could be easily implemented, technically and administratively, but some of the disposal options may require obtaining or modifying permits or meeting substantive requirements of permits.

- Delivery of the RO/NF concentrate to a lined facility would require compliance with groundwater protection requirements.
- Obtaining approval for these new facilities should be possible but may be untimely in relation to construction of the groundwater extraction and water treatment plant.
- Disposal of lime-treated sludge to a newly constructed, lined repository would require compliance with groundwater protection requirements. The required approval may not be acquired in a timely manner relative to construction of the groundwater extraction and RO treatment plant.

Approval of new facilities under the NRD settlement will require coordination between the State, Kennecott and non-Kennecott parties.

2.8 COST

A detailed summary of the cost estimate, including assumptions, for the Proposed Plan is provided in Appendix M of the FS. These costs include costs associated with hooking up municipal water supplies, installing RO units, O&M costs for maintaining existing source control measures, maintaining household RO units, operating and maintaining the groundwater extraction wells, operating and maintaining the water treatment plant, installing water distribution systems, periodic site reviews, groundwater monitoring, and costs associated with enacting institutional controls. The 30-year total NPV cost for the three sub alternatives of the Proposed Plan are:[7]

a) $xxx million (with delivery to NF)

b) $xxx million (with delivery to lined facility)

c) $xxx million (with delivery to lime treatment).

3.0 REFERENCES

Kennecott Utah Copper Corporation, 1997, Groundwater characterization and monitoring plan for southwest Jordan Valley, Utah: July, 99 p.

_____, 1998, Remedial Investigation and Feasibility Study for Kennecott Utah Copper South Facilities Groundwater Plume: March 16, variously paged.

United States Environmental Protection Agency, 1988, Guidance for conducting remedial investigations and feasibility studies under CERCLA: EPA/540/G-89/004, October, 209 p.

[7] Costs have been adjusted to reflect changes to the plan since 1998. Amounts also are escalated from 1998 dollars to 2000 dollars based on the Consumer Price Index.

ATTACHMENT 1 [TABLE 4-1 of FS (Kennecott 1998)]

POTENTIAL *FEDERAL* ARARS FOR THE SWJV GROUNDWATER PLUME

final ARARs will be listed in the Record of Decision (ROD)

Standard, Requirement, Criterion or Limitation	Citation	Type of ARAR/Description	Applicable/ Relevant and Appropriate	Alternative	Comment
Safe Drinking Water Act					
National Primary Drinking Water Standards	40 C.F.R. 141.61 - 141.63				See state ARARs table.[1]
Maximum contaminant level goals (MCLGs)	40 C.F.R. 141.50 - 141.52	Chemical specific. The maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. MCLGs are non-enforceable health goals.	No/Yes	All	Under CERCLA 121(d)(2)(A), non-zero MCLGs that are "relevant and appropriat under the circumstances" of the release (*i.e.*, generally for ground or surface waters that are current or potential source of drinking water) may be used in setting cleanup levels for hazardous substances i groundwater.
National Secondary Drinking Water Standards	40 C.F.R. 143				See state ARARs table.
Underground Injection Control Regulations	40 C.F.R. 144-147				See state ARARs table
Clean Water Act					
Water Quality Criteria	40 C.F.R. 131			NA	See state ARARs table
Dredge and Fill Standards	40 C.F.R. 230	Location-specific. Regulates disposal and handling of fill and dredge materials into wetlands or waters of the United States.	Yes/No	IV, V, VI	Applicable to activities which result in on site dredging or filling of wetlands or waters of the U.S. None anticipated.

[1] See CERCLA Compliance with Other Laws Manual, OSWER Dir. 9234.1-01, p. 7-7 (Aug. 8, 1988) ("CERCLA Compliance with Other Laws Manual") ("For the purposes of identification and communication of State ARARs, the authorized State requirement [which is part of a state program that has been federally delegated] is to be documented as the potential ARAR (as it is regarded as the requirement that is in effect).")

TABLE 4-1

POTENTIAL *FEDERAL* ARARs FOR THE SWJV GROUNDWATER PLUME

(Page 2 of 10)

final ARARs will be listed in the Record of Decision (ROD)

Standard, Requirement, Criterion or Limitation	Citation	Type of ARAR/Description	Applicable/ Relevant and Appropriate	Alternative	Comment
Clean Air Act					See State ARARs Table.
Resource Conservation and Recovery Act					See State ARARs Table.
Archaeological and National Historic Preservation Act	16 USC § 469, 40 C.F.R. § 6.301(c)	Location-specific. Establishes procedures to provide for preservation of historical and archaeological data which might be destroyed through alteration of terrain as a result of a federal construction project for a federally licensed activity or program.	Yes/No	IV, V, VI	Applicable if remedial activities will disturb any archaeological or historical sites. None anticipated.
Historic Site, Buildings and Antiquities Act	16 USC § 461, 40 C.F.R. § 6.301(a)	Location-specific. Requires federal agencies to consider the existence and location of landmarks on the Historic Places and National Registry of Landmarks to avoid undesirable impacts on such places and landmarks	Yes/No	IV, V, VI	Applicable if remedial activities will disturb any historic landmarks. None anticipated.
Fish and Wildlife Coordination Act	16 USC §§ 1531-66, 40 C.F.R. § 6.302(g)	Location-specific. Requires consultation with Fish and Wildlife Service and state Wildlife Resources Agency when federal actions will result in control or structural modification of a body of water.	Yes/No	All	Applicable if remedy impacts wetlands or surface waters.
Floodplain Management	40 C.F.R. § 6.302(b) and Appendix A, Executive Order No. 11,988 EPA Guidance (Aug. 6, 1985)	Location-specific. Requires federal agencies to evaluate the potential effects of actions they may take in a floodplain and to avoid the adverse impacts associated with direct and indirect development of a flood plain. Regulates activities within the flood plain.	Yes/No	IV, V, VI	Applicable if there are floodplains designated in the vicinity that may be affected by remedial actions. None anticipated.
Protection of Wetlands	40 C.F.R. § 6.302(a) and Appendix A, Executive Order No. 11,990	Location-specific. Requires federal agencies to take action to avoid adversely impacting wetlands wherever possible, to minimize wetlands destruction and to preserve the value of wetlands, and to prescribe procedures to implement these	Yes/No	IV, V, VI	Applicable if remedial actions will impact wetlands. None anticipated.

TABLE 4-1

POTENTIAL *FEDERAL* ARARs FOR THE SWJV GROUNDWATER PLUME

final ARARs will be listed in the Record of Decision (ROD)

Standard, Requirement, Criterion or Limitation	Citation	Type of ARAR/Description	Applicable/ Relevant and Appropriate	Alternative	Comment
		policies and procedures of the Executive Order.			
Endangered Species Act	16 USC §§ 1531-1543, 40 C.F.R. 6-302(h), 50 C.F.R. 200, 50 C.F.R. 402	Location-specific. Requires action to conserve endangered species within critical habitat upon which species depend. Includes consultation with Department of Interior.	Yes/No	IV, V, VI	Applicable if remedial actions will impact endangered species (none known in Kennecott Copper area).
Occupational Safety and Health Act	20 USC §§ 651-678 29 C.F.R. 1910 and 1926	Action-specific. This program contains occupational safety and health standards which have been found to be national consensus standards or established Federal standards. Standards are provided for practices, means, methods, operations, or processes that are considered reasonably necessary or appropriate to provide safe and healthful employment and places of employment.	Yes/No	IV, V, VI	Pertinent OSHA standards are applicable to all worker activities related to remedial actions at Kennecott.
Superfund Amendments and Reauthorization Act					
Designation, Reportable Quantities, and Notification	40 C.F.R. 302	Action-specific. Notification requirements are established for releases to the environment of identified reportable quantities of hazardous substances.	Yes/No	IV, V, VI	Applicable if a remedial action released a reportable quantity of a hazardous substance.

TABLE 4-1

POTENTIAL *STATE* ARARs FOR THE SOUTHWEST JORDAN VALLEY GROUNDWATER PLUME

final ARARs will be listed in the Record of Decision (ROD)

Standard, Requirement, Criterion or Limitation	Citation	Type of ARAR/Description	Applicable/ Relevant and Appropriate	Alternative	Comment
Utah Public Drinking Water					
Water Quality Maximum Contaminant Levels (MCLs)	UAC R309-103-2	Chemical-specific. Establishes MCLs for inorganic chemicals	No/Yes	All	Would possibly be relevant and appropriate for purposes of determining cleanup levels for hazardous substances in groundwater outside the point of compliance (as shown in Figure 2-16). It is Kennecott's position that sulfate and TDS MCLs are not cleanup level ARARs because sulfates and TDS are not hazardous substances and CERCLA Section 106, 42 U.S.C. §9606, provides EPA only with authority to require Kennecott to address hazardous substances[2]. Conversely, it is the position of the State of Utah that the MCLs for sulfate and TDS are relevant and appropriate requirements for cleanup levels. Notwithstanding these opposing positions, it appears that even if the sulfate and TDS MCLs were considered relevant and appropriate requirements for cleanup, compliance with these requirements can be achieved beyond the point of compliance under certain remedial options through treatment and containment of sulfate greater than 1500 mg/L at the edge of the acidic metals plume (point of compliance) and natural attenuation. Alternatively, if necessary, an interim measures waiver would be appropriate.

2 See Jastram v. Phillips Petroleum Co., 844 F. Supp. 1139, 1140 (E.D.. La. 1994); Colorado v. United States, 867 F. Supp. 948, 952 (D. Colo. 1994); Rhodes v. County of Darlington, South Carolina, 833 F. Supp. 1163, 1178 (D.S.C. 1992); Apache Powder Co. v. United States, 968 F.2d 66, 69 n. 3 (D.C. Cir. 1992); Eagle-Picher Indus. Inc. v. EPA, 759 F.2d 922, 932 (D.C. Cir. 1985).

TABLE 4-1

POTENTIAL *STATE* ARARs FOR THE SOUTHWEST JORDAN VALLEY GROUNDWATER PLUME

final ARARs will be listed in the Record of Decision (ROD)

Standard, Requirement, Criterion or Limitation	Citation	Type of ARAR/Description	Applicable/ Relevant and Appropriate	Alternative	Comment
Water Quality Maximum Contaminant Levels (MCLs)	UAC R309-103-2	Action-specific	Yes/Yes	III, IV, V, VI	MCLs for all constituents (including sulfates and TDS) would be applicable "action-specific" requirements if water is delivered through a public drinking water system. May be relevant and appropriate if well water at individual households is treated for potable water use.
Public Water System Requirements	UAC R309-102, 104-113	Action-specific. Standards applicable to public drinking water systems, including design and construction standards, operation and maintenance requirements, disinfection, source development, distribution systems and source protection.	Yes/No	IV, V, VI	Applicable if remediation includes construction on site of a municipal water treatment plant to be used to supply water to a public drinking water system.
Water Quality Regulations					
Water Quality Standards	UAC R317-2-3	Action-specific. Anti-degradation Policy. Requires surface waters whose existing quality is better than the established standards for the designated uses to be maintained at high quality, and requires existing instream water uses to be protected.	Yes/No	IV, V, VI	Would be applicable if there are any on-site point source discharges from the site to surface waters.
	UAC R317-2-5	Action-specific. Mixing zone restrictions. Prohibits acutely lethal concentrations (as determined by bioassay or other approved method) of pollutants in mixing zone.	Yes/No	IV, V, VI	Would be applicable if there are any on-site point source discharges from the site to surface waters.
	UAC R317-2-7	Action-specific. Water quality standards. Establishes numeric water quality standards for each of the classes assigned to waters of the State; prohibits point source discharges that will interfere with designated uses protected by the assigned classes or that will cause water quality standards to be violated; and, through a narrative standard, prohibits point source discharges which may become offensive or are a nuisance or produce undesirable physiological responses in desirable aquatic life, or undesirable human health effects.	Yes/No	IV, V, VI	Would be applicable if there are any on-site point source discharges from the site to surface waters.

TABLE 4-1

POTENTIAL *STATE* ARARs FOR THE SOUTHWEST JORDAN VALLEY GROUNDWATER PLUME

final ARARs will be listed in the Record of Decision (ROD)

Standard, Requirement, Criterion or Limitation	Citation	Type of ARAR/Description	Applicable/ Relevant and Appropriate	Alternative	Comment
Design Requirements for Wastewater Collection, Treatment & Disposal Systems	UAC R317-3	Action-specific. Design requirements for collection, treatment and disposal of wastewater largely originating from domestic sources. Not pertinent for industrial wastes.	No/No	NA	Waste waters at issue here do not originate from, nor are they similar to wastewaters from, domestic sources.
Groundwater Quality Protection Regulations	UAC R317-6-2	Chemical-specific. Groundwater Quality Standards.[3] Lists standards for protection of groundwater quality. These standards are identical to MCLs for most contaminants listed.[4]	Yes/No	All	Possibly applicable for purposes of setting groundwater cleanup levels for hazardous substances.
	UAC R317-6-4	Action-specific. Groundwater Class Protection Levels. Protection levels are groundwater pollutant concentration limits, set by groundwater class, for the operation of facilities that discharge or would probably discharge to groundwater.	Yes/No	IV,V,VI	Protection levels are not chemical-specific ARARs for the purpose of determining clean-up levels for contaminated groundwater. Utah Admin. Code R317-6-6.15. However, they are action-specific ARARs if the remedy includes activities/ facilities that would require a groundwater permit.
	UAC R317-6-6	Action-specific. Groundwater implementation regulations. This regulation establishes substantive standards for facilities subject to groundwater permitting requirements, including compliance with protection levels, applicable TDS limits and groundwater quality standards, use of best available technology to minimize pollutant discharges, and monitoring.	Yes/No	V,VI	Applicable to any facility constructed as part of the remedy "which discharges or would probably result in a discharge of pollutants that may move directly or indirectly into groundwater..." Utah Admin. Code R317-6-6.1.A.

[3] Do not confuse Groundwater Quality Standards with Groundwater Class Protection Levels established under R317-6-4 (discussed next).

[4] The Groundwater Quality Standards do not specifically list any standards for sulfates or TDS.

TABLE 4-1

POTENTIAL *STATE* ARARs FOR THE SOUTHWEST JORDAN VALLEY GROUNDWATER PLUME

final ARARs will be listed in the Record of Decision (ROD)

Standard, Requirement, Criterion or Limitation	Citation	Type of ARAR/Description	Applicable/ Relevant and Appropriate	Alternative	Comment
Groundwater Quality Protection Regulations (continued)	UAC R317-6-6.15	Chemical Specific. Groundwater corrective action regulations. Specifies "corrective action concentration limits" (cleanup standards).	Yes/No	All	Applicable for purposes of selecting groundwater cleanup standards for hazardous substances. It is Kennecott's position that there is no groundwater cleanup standard ARAR for sulfate or TDS because these substances are not hazardous substances and CERCLA Section 106, 42 U.S.C. §9606, provides EPA only with authority to require Kennecott to address hazardous substances[5]. Conversely, the State of Utah takes the position that groundwater corrective action limits (based on MCLs) are applicable requirements for selecting cleanup standards for sulfate and TDS. Whether or not the groundwater corrective action requirements are applicable requirements for non-hazardous substances such as sulfate or TDS, the ARAR for sulfate and TDS may be achieved under certain remedial options through treatment and containment of sulfate greater than 1500 mg/L at the edge of the acidic metals plume (point of compliance) and natural attenuation. If the CACL (or ACACL) is 1500 mg/L (the health based PRG determined by human health risk assessment (see Section 4 of the FS)), compliance would be achieved within

5 See note 2. Moreover, there are no clear cleanup standard ARARs for sulfate or TDS under the Utah groundwater corrective action regulations. The presumptive standards for groundwater Corrective Action Concentration Limits (CACLs) are the Utah groundwater quality standards (UAC R317-6-6.15.F); however, there is no such groundwater quality standard for sulfate or TDS (UAC R317-6-2). Where there is no groundwater quality standard for a particular contaminant, a CACL is proposed taking into consideration federal MCLGs, health advisories, risk-based contaminant levels or standards established by other regulatory agencies and other relevant information. An Alternate Corrective Action Concentration Limit (ACACL) can be established in place of a CACL if it is protective of human health and the environment and utilizes best available technology.

TABLE 4-1

POTENTIAL *STATE* ARARs FOR THE SOUTHWEST JORDAN VALLEY GROUNDWATER PLUME

final ARARs will be listed in the Record of Decision (ROD)

Standard, Requirement, Criterion or Limitation	Citation	Type of ARAR/Description	Applicable/ Relevant and Appropriate	Alternative	Comment
					approximately 5 to 10 years. Even if the CACL were established at State MCL levels for sulfate or TDS, compliance would be achieved in approximately 40 to 50 years. Alternatively, if necessary, an interim measures waiver would be appropriate.
Underground Injection Control Program	UAC R317-7	Action-specific. Specifies conditions under which wastes may be injected underground.	Yes/No	IV, V, VI	Applicable to any remedial activity involving use of on site underground injection wells. No anticipated.
Utah Pollutant Discharge Elimination System (UPDES) Regulations	UAC R317-8	Action-specific. Establishes substantive requirements limiting point source discharges to surface waters, including monitoring and compliance with technology-based effluent limitations, new source performance standards, toxic effluent standards, and water quality based standards.	Yes/No	IV, V, VI	Would be applicable if there are any on-site point source discharges from the site to surface waters.
Utah Air Conservation Regulations					
Air Quality Standards for Control of Installations	UAC R307-1-3	Action-specific. Regulates new installations which will or might reasonably be expected to become a source or indirect source of air pollution. Pollution control for emissions must meet BACT.	Yes/No	IV, V, VI	Applicable if municipal water treatment plant or other "installations" will or might reasonably be expected to become a source of air pollution.
Fugitive Dust and Emissions Standards	UAC R307-12	Action-specific. Requires control of fugitive dust and emissions for construction/demolition activities and roadways.	Yes/No	IV, V, VI	Applicable if remediation activities result in fugitive dust or emissions
National Emission Standards for Hazardous Air Pollutants (NESHAPs)	UAC R307-10	Incorporates by reference federal NESHAP standards at 40 C.F.R. 61 Subpart A.	No/No	NA	"NESHAPs are not generally applicable to Superfund remedial activities because CERCLA sites do not usually contain one of the specific source categories regulated. Moreover, NESHAPs as a whole are generally not relevant and appropriate because the standards of control are intended for the specific type of source regulated and not all sources of that

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Standard, Requirement, Criterion or Limitation	Citation	Type of ARAR/Description	Applicable/ Relevant and Appropriate	Alternative	Comment
					pollutant."[6]
State Engineer, Department of Natural Resources	UAC R655-4	Action-specific. Standards for drilling and abandonment of wells. Includes such requirements as performance standards for casing joints, requirements for abandoning a well, etc.	Yes/No	IV, V, VI	Applicable to drilling and abandonment of wells.
	Salt Lake Valley Interim Ground-Water Management Plan (April 5, 1991)	Action-specific. Limits the volume of groundwater withdrawals from the principal aquifer in each groundwater management area in the Salt Lake Valley to prevent "mining" of groundwater. Also requires withdrawals to be distributed over the valley to ensure that localized interference and water quality problems do not result.	Yes/No	IV, V, VI	Applicable to remedies involving groundwater withdrawals.
Hazardous Waste Regulations					
	UAC R315-2	Action-specific. Standards for identifying and listing hazardous waste.	Yes/No	IV, V, VI	Applicable for determining whether wastes generated during remedial activities are hazardous wastes.
	UAC R315-3 and R315-8	Action-specific. Application and plan approval procedures and general facility standards for owners and operators of fully regulated and interim status TSDFs.	No/No	NA	None of the remedial alternatives will involve the treatment, storage or disposal of hazardous wastes because the contaminants at the site are Bevill-exempt extraction/ beneficiation wastes. Hazardous waste TSDF requirements are therefore not applicable and it is "not appropriate" to impose these requirements on such wastes.[7]

6 CERCLA Compliance with Other Laws Manual, Part II, OSWER Dir. 9234.1-02, p. 2-9 (Aug. 1989) ("Compliance with Other Laws Manual, Part II").

7 See CERCLA Compliance with Other Laws Manual, p.1-68 ("A requirement may also be found relevant but not appropriate when another requirement is available that has been designed to apply to that specific situation, reflecting an explicit decision about the requirements appropriate to that situation. For example, the Agency has made a determination under RCRA that Subtitle C is not an appropriate means of regulating on a national basis certain mining waste from the extraction or benefaction of ores and minerals (51 FR 24496, July 3, 1986). Therefore, since that explicit, formal determination has been made, Subtitle C requirements will generally not be relevant and appropriate to these wastes from extraction or beneficiation of ores and minerals.")

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POTENTIAL *STATE* ARARs FOR THE SOUTHWEST JORDAN VALLEY GROUNDWATER PLUME

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Standard, Requirement, Criterion or Limitation	Citation	Type of ARAR/Description	Applicable/ Relevant and Appropriate	Alternative	Comment
	UAC R315-5	Action-specific. Hazardous waste generator standards.	Yes/No	IV. V. VI	Generator standards are applicable to extent hazardous wastes are generated on-site during remedial actions.
	UAC R315-9	Action-specific. Standards for notification and response to spills of hazardous wastes.	Yes/No	IV. V. VI	Applicable if reportable amount of hazardous waste is spilled during remedial actions.
	UAC R315-13	Action-specific. Land disposal restriction standards.	Yes/No	IV, V. VI	None of the remedial alternatives will involve on-site land disposal of hazardous wastes. Generator LDR requirements apply if hazardous wastes subject to LDRs are generated and transported off site.
	UAC R315-101	Chemical-specific. Cleanup action and risk-based closure standards, requiring source-control and defining clean closure.	No/No	NA	These standards are not applicable because contamination at site is Bevill-exempt extraction/ beneficiation waste. It is not "appropriate" to subject such wastes to hazardous waste requirements.
Solid Waste Regulations					
	UAC R315-304	Action-specific. Industrial solid waste facility requirements. Specifies performance, design and O&M requirements.	No/Yes	V	On-site industrial landfills are not subject to solid waste landfill requirements but these requirements could be considered relevant and appropriate if KUC constructed an on-site repository for wastewater treatment sludges.
State OSHA Rules	UAC R574	Action-specific. Adopts federal OSHA standards for practices, means, methods, operations, or processes that are considered reasonably necessary or appropriate to provide safe and healthful employment and places of employment.	Yes/No	IV, V, VI	Pertinent OSHA standards are applicable to all worker activities related to remedial actions at Kennecott.