Attachment 2
Groundwater Modified Corrective Action Plan

State of Utah

Department of Environmental Quality

Dianne R. Nielson, Ph.D.
Executive Director

DIVISION OF SOLID & HAZARDOUS WASTE
Dennis R. Downs
Director

OLENE S. WALKER
Governor

GAYLE F. McKEACHNIE
Lieutenant Governor

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JAN 2 2004

January 23, 2004

Dwayne J. Woolley, General Manager
Trans Jordan Landfill
10873 South 7200 West
South Jordan, Utah 84095-5610

RE: Modified Corrective Action Plan Approval

Dear Mr. Woolley:

We have reviewed the Modified Corrective Action Plan submitted January 9, 2004 by Trans-Jordan Cities (TJC). The plan is approved, with the stipulation that an update on the implementation and status of the plan be included in TJC's Solid Waste Facility Annual Report and whenever changes to or deviations from the plan are made. We appreciate your efforts in addressing this issue.

If you have any questions please call Ralph Bohn or Phil Burns at 801-538-6170.

Sincerely,

Dennis R. Downs, Executive Secretary
Utah Solid and Hazardous Waste Control Board

DRD/PEB/kk

c: Patti Pavey, M.S., Executive Director, Salt Lake Valley Health Department

TN200400066
Salt Lake County/Trans Jordan LF

MODIFIED CORRECTIVE ACTION PLAN

Trans-Jordan Cities

FOR

TRANS-JORDAN LANDFILL

TRANS JORDAN

December 19, 2003

GENERAL MANAGER: DWAYNE J. WOOLLEY

ENGINEER: IGES, BRETT MICKELSON, P.E.

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EXECUTIVE SUMMARY

General

Pursuant to Regulation R315-308-3 (1) V of the Solid Waste Permitting and Management Rules, Trans-Jordan Cities (TJC) solicited input from affected and /or interested parties with regard to potential Ground Water impacts from Trans-Jordan Landfill (TJL).

Public Comment

The public comment meeting was conducted as part of a larger public comment period where TJC solicited input from interested or affected parties. The public comment period ran from September 29, 2003 to October 29, 2003 as stated in the attached advertisement published in the local newspapers. The only comments received by TJC during the course of the public comment period were from Mr. Jonathan Cherry of Kennecott Utah Copper (KUC).

Response to Public Comment

On December 9, 2003, TJC issued a written response to the State of Utah DSHW, regarding all questions and comments received during the Public Comment Period. A copy of this letter and KUC comments are included as Attachment 1.

Changes to Plan

Based on comments received, review of recent and existing data, TJC sees no compelling reason to significantly modify the previously submitted plan. Comments from Attachment 1 are referenced where appropriate. Minor editorial changes have also been made to the original submitted Corrective Action Plan. These are updates that do not change the intent of the original plan.

TRANS-JORDAN LANDFILL GROUND WATER REVIEW

General

The TJL began operation in 1958 and is a cooperatively operated solid waste landfill operated by TJC. TJC was officially formed as a political subdivision of the State of Utah in 1986 to dispose of solid wastes generated in the southern half of Salt Lake County. TJC operates under an Interlocal Agreement between its' member cities (the Cities of Draper, Midvale, Murray, Riverton, Sandy, South Jordan, and West Jordan) with a combined population of 307,000 (2000 census). The TJL is overseen by a Board of Directors with each member city having one board position. Daily operations and management of the Landfill is coordinated by Mr. Dwayne J. Woolley, General Manager.

TJL in conjunction with South Valley Water Reclamation Facility (SVWRF) cooperatively fund the operation and maintenance of a wood products and green waste grinding facility established in 1996. SVWRF is the operator of this facility located immediately south and adjacent to the landfill.

During 1999, TJL constructed and placed on-line, a citizen drop-off facility at the landfill. The citizen drop-off facility is comprised of two areas, one area provides a safe area for citizen unloading of residential wastes, and a second area is used to separate Household Hazardous Waste (HHW) and recyclables from the waste stream. The HHW program is a joint operation with Salt Lake Valley Health Department (SLVHD).

The existing landfill facility is located on TJC owned land in Section 15 of Township 3 South, Range 2 West. The street address for the landfill is 10873 South 7200 West, South Jordan Utah.

Landfill access is provided from U-111 (old State Route 111) at the landfill site's northwest corner. TJL is located within the city of South Jordan and West Jordan city limits are approximately 1/2 mile northeast. The community of Herriman lies approximately 3 miles south-southeast and Copperton is 1.5 miles to the west. Drawing 1 (Attachment 2) shows the general arrangement of the TJL site.

Ground Water Monitoring Requirements

The State of Utah Department of Environmental Quality Division of Solid and Hazardous Waste (DSHW) in conjunction with (SLVHD) regulate the design, construction and operation of municipal solid waste (MSW) landfills in Salt Lake County. Section R315-308 of the State regulations and Health Regulation #1 of Salt Lake County stipulate requirements required for ground water monitoring at MSW facilities.

Detection Monitoring:

Each facility must have at least one upgradient well and two downgradient wells. During the first year of facility operation after the wells are installed, a minimum of eight independent samples from the upgradient and four independent samples from each downgradient well are analyzed for the constituents in Section R315-308-4 to establish

background water quality. The detection monitoring program requires the owner or operator of the facility to semiannually determine ground water quality at each monitoring well during the operation, closure and post-closure care period of the facility.

If, during the performance of the detection monitoring, a constituent is detected in the downgradient wells that has a statistically significant increase over the upgradient (background) water quality, the facility owner or operator must:

- Enter the information in the operating record of the facility.
- Notify the Executive Secretary (DSHW) and Director (SLVHD) of the findings.
- Immediately resample all wells to further evaluate the water quality.

If there is a statistically significant increase over background of any constituent, the owner or operator of the facility has 90 days to demonstrate that the source of the contamination is not associated with the facility. If the facility does not establish that the contamination is not associated with the facility, the ground water monitoring program moves into assessment monitoring.

Assessment Monitoring:

Assessment monitoring starts with sampling all downgradient wells and analyzing the water for all constituents listed in Appendix II of 40 CFR Part 258. For any constituent detected in the Appendix II list, a minimum of four independent samples must be collected, analyzed, and statistically analyzed to establish background concentrations. The owner or operator of the facility shall sample quarterly and compare the concentrations to ground water protection standards.

If after two consecutive sampling events, the concentrations of all constituents being analyzed are shown to be at or below established background values, the owner or operator must notify the Executive Secretary and upon approval return to detection monitoring.

If concentrations of any of the constituents are statistically measured at concentrations exceeding the protection standards, the owner or operator must notify the Executive Secretary, local health officials, and adjacent landowners, then characterize the nature and extent of the release. If the owner or operator cannot demonstrate that the source of the contamination is other than the landfill, then the facility enters into a corrective action phase.

Corrective Action:

As a facility enters into corrective action, the owner or operator of the facility takes any interim measures to protect human health and the environment and assesses possible corrective actions. Based upon the corrective action assessment and public comment, the

owner or operator must select a remedy, which shall be submitted to the Executive Secretary.

Upon approval of the selected corrective action, the Executive Secretary will notify the owner or operator of such approval and will require that the corrective action plan proceed according to the approved schedule.

TJL Ground Water Monitoring Program

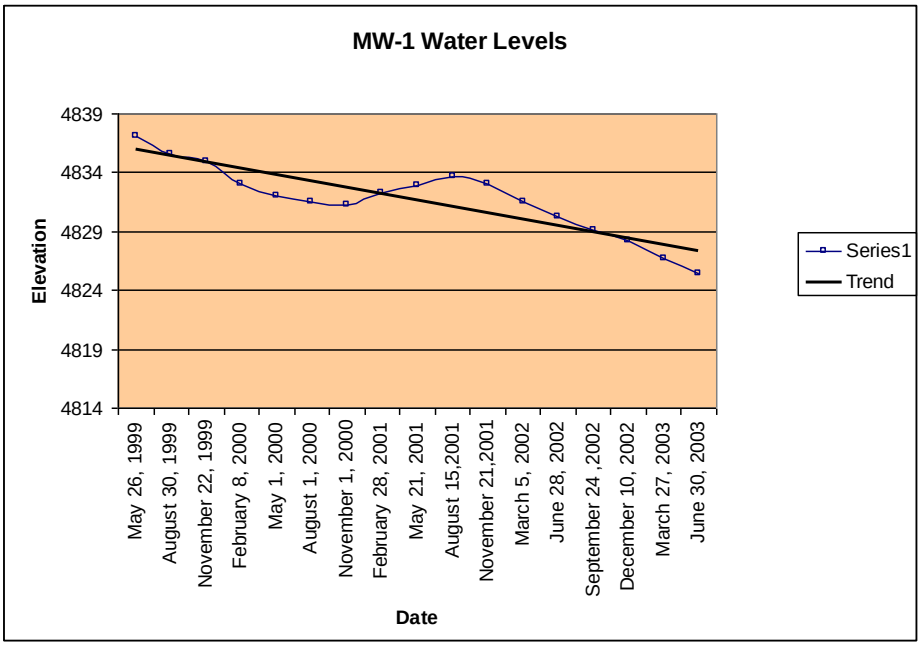
A ground water monitoring program was initiated in March of 1994 with the installation of monitor well one (MW-1). Water from MW-1 was compared with water well data in the vicinity of the landfill and it was determined that MW-1 was completed in a perched water system not representative of the documented low pH water known to be found in surrounding Kennecott Utah Copper (KUC) wells. As a result MW-1 has not been used as an upgradient well. Installation of monitor well two (MW-2) was performed in January of 1995 to serve as the upgradient monitor well for water quality evaluations. Monitor well three (MW-3) was installed in December of 1995 and served as the initial downgradient well for water quality evaluations.

Monitor well four (MW-4) was installed in November of 1997 to function as the second downgradient well. Monitor well five (MW-5) was installed in August of 1998 to monitor ground water closer to the active cell.

These sampling wells were originally located based on the predominant groundwater flow being west to east. However, down gradient pumping and the recent construction of a surface and alluvial cutoff system by KUC and other activities related to the Copper Mine located up gradient from the site, have each altered the groundwater conditions at the landfill. Drawing 2 (Attachment 2) shows the location of the five TJL monitoring wells.

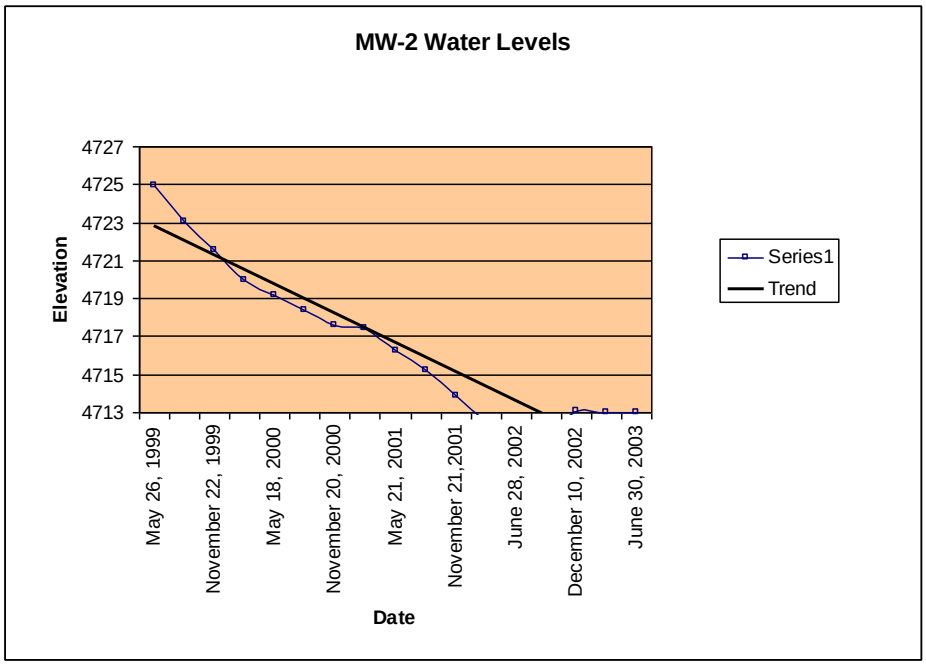
Ground Water Elevations

Modifications to the ground water recharge regime (by KUC), several years of below average precipitation and increased demand on downgradient wells have all contributed to the drop in ground water elevations, drying up 2 of TJL monitor wells. The groundwater elevations in the two remaining downgradient monitoring wells (MW-4 and MW-5) have dropped by over 1 foot in the last 3 months. The following graphs illustrate the decreasing water levels for the last 4 years for each of the monitoring wells. The bottom of each of the graphs corresponds to the bottom elevation of each well:



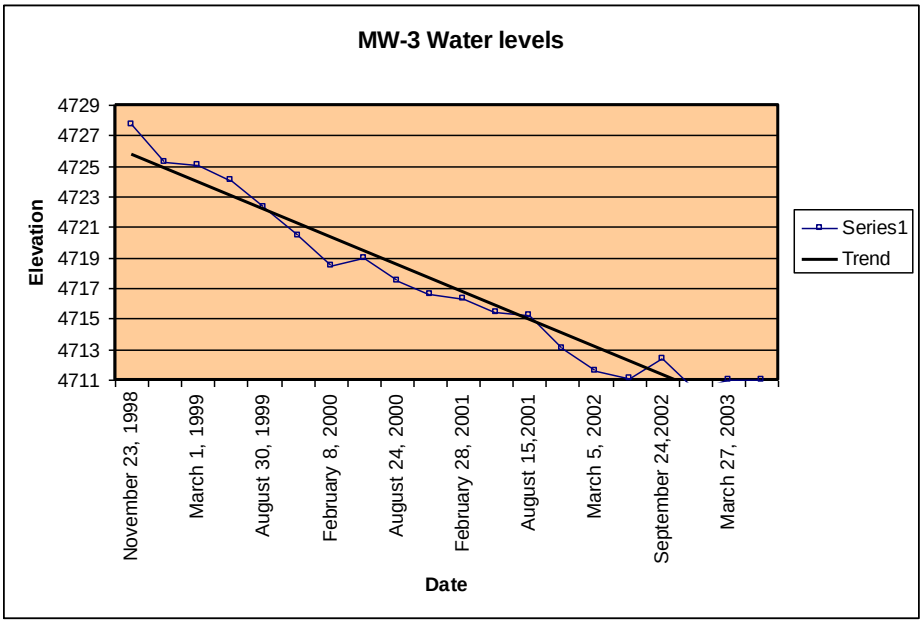
Well #1 Data: Well Depth = 365'
Bottom Elev. = 4814'
Initial Water Column = 39'
Water Column Remaining = 11'

Well #1 Status: Not currently utilized for groundwater analysis.



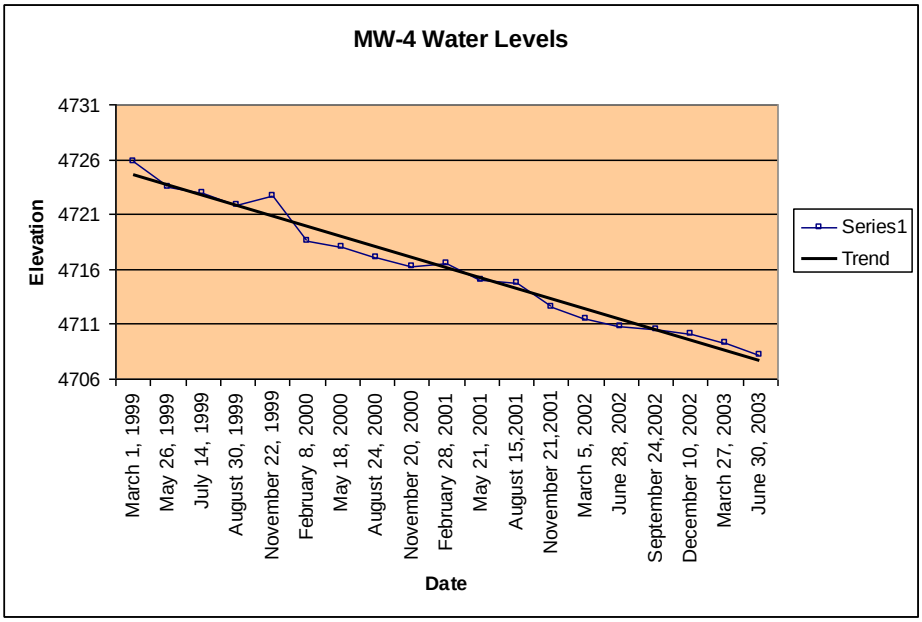
Well #2 Data: Total Depth = 455'
Bottom Elev. = 4713'
Initial Water Column = 34.5'
Water Column Remaining = 0

Well #2 Status: No viable sample since June 2002



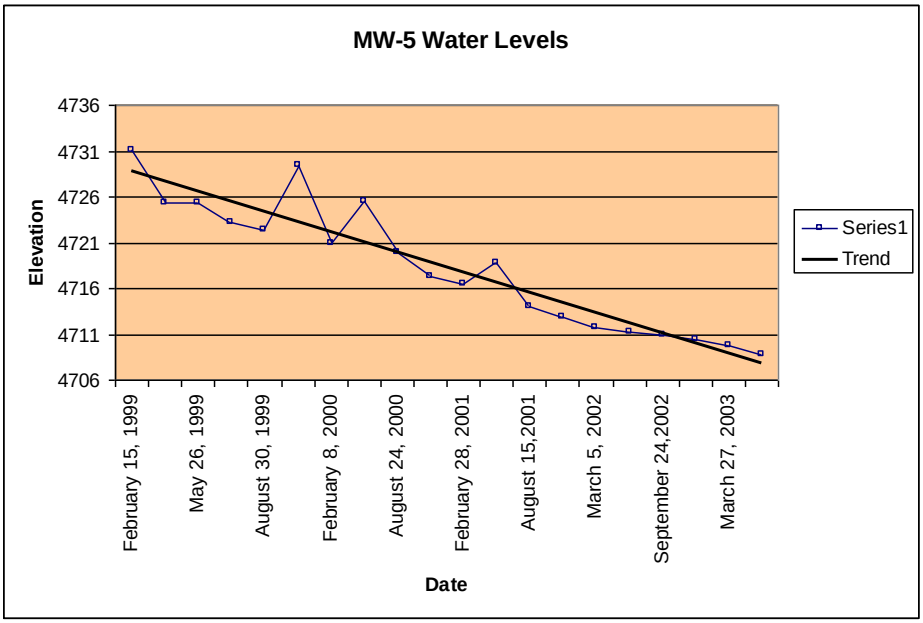
Well #3 Data: Total Depth = 319'
Bottom Elev. = 4711'
Initial Water Column = 30.5'
Water Column Remaining = 0

Well #3 Status: No viable sample since June of 2002



Well #4 Data: Total Depth = 365',
Bottom Elev. = 4706'
Initial Water Column = 22'
Water Column Remaining = 2'

Well #4 Status: Operational (Projected date being dry: 1st quarter 2004)



Well #5 Data: Total Depth = 365',
Bottom Elev. = 4706'
Initial Water Column = 21'
Water Column Remaining = 3'

Well #5 Status: Operational (Projected date being dry: 1st quarter 2004)

Ground Water Quality

The most recent summary of the ground water quality at the TJL is presented in the 2002 Ground Water Monitoring Report, which was part of the annual landfill report submitted to DSHW in February of 2002. This Ground Water Monitoring Report presents the results of recent ground water analysis, including ground water chemistry, depth to water and the interpreted direction of ground water flow under the TJL. The "*Trans-Jordan Landfill 2002 Ground Water Monitoring Report*" is included as Attachment 3.

Potential Constituents of Concern

The 2002 Ground Water Monitoring Report details the procedures for analyzing the concentration of constituents in ground water. The ground water at TJL is analyzed for ground water constituents as prescribed by the DSHW regulations. Most of the chemicals analyzed for are either non-detect or are present at low enough concentrations to not exceed ground water standards. Statistical analysis is performed on all measurable constituents to determine if ground water is potentially being impacted from landfilling operations.

Potential Constituents of Concern for TJL are the following organic compounds:

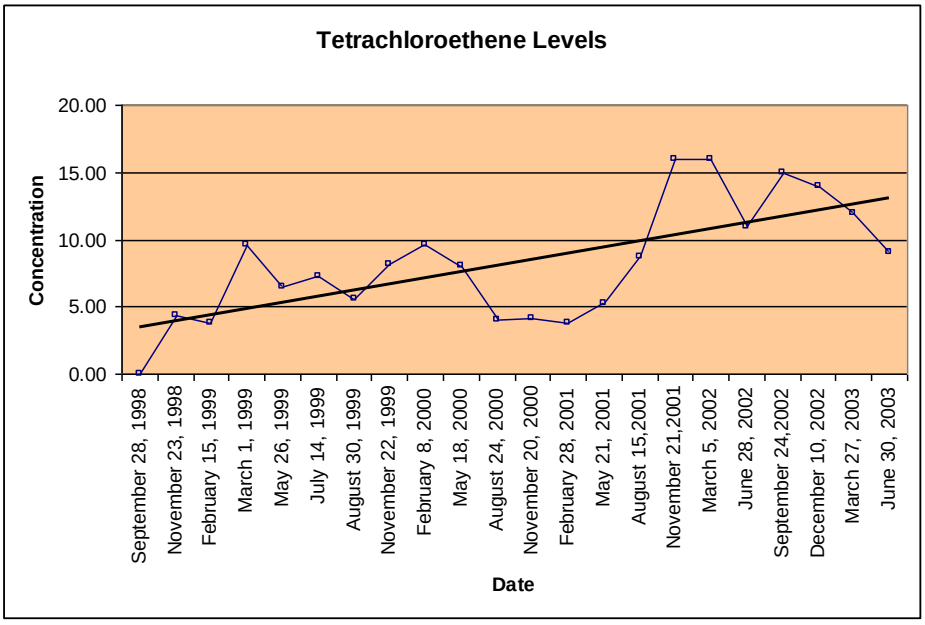
- 1,1 Dichloroethene

- Tetrachloroethene
- 1,1,1 Trichloroethane
- Trichloroflouromethane
- Dichlorodiflouromethane

Of the five potential constituents of concern listed above, four (1,1 Dichloroethene, 1,1,1 Trichloroethane, Trichloroflouromethane, and Dichlorodiflouromethane) have been measured in the ground water at TJL at concentrations lower than the ground water protection standards.

Only Tetrachloroethene in TJMW-5 was identified as a constituent of concern, which is identified as having concentrations higher than the groundwater protection standards and having higher concentrations downgradient than upgradient.

The following chart shows the concentration of Tetrachloroethene over time in well #5:



Confidence Interval analysis for Tetrachloroethene utilizing the data through March 2003 showed that Tetrachloroethene has exceeded the ground water protection standard of 5 parts per billion with all data subsets.

CORRECTIVE ACTION #1 – ACCELERATED CLOSURE OF UNLINED LANDFILL

General

Tetrachloroethene (PCE) is a dense non-aqueous phase liquid (DNAPL). One problem with the chlorinated solvents is that they are heavier than water and can result in deep

contamination. PCE can migrate under the influence of gravity as a liquid, or can volatize and migrate in a vapor phase. Due to the nature of PCE, depth to ground water, and the inherent challenges in investigating the source and mechanism of the PCE transport, TJC proposes to mitigate both of the primary mechanisms for transport.

The first of the corrective actions summarized in this plan will be to minimize the potential for liquid based solute transport by constructing a landfill cover system that will reduce the infiltration of liquid into the landfill. TJC has modified the landfilling operations to accelerate the closure of the unlined landfill. The active landfill face has been moved from the lined cells and located over the unlined landfill to bring the unlined area to a final grade sooner. Bringing the unlined landfill to grade sooner will allow for the installation of a synthetic cover over the top of the unlined area in the most time efficient manner and minimize the potential infiltration of water into the MSW. TJC has elected to incorporate synthetic materials for cover construction rather than a monolithic soil cover to improve methane collection, storm water management and infiltration reduction efforts. Reducing the infiltration of water in the landfill will minimize the generation of leachate which will reduce the potential for additional PCE transport in a liquid medium.

To accomplish the accelerated closure of the unlined landfill, while maintaining a manageable landfill operation, TJC has developed a phased closure plan for the entire landfill operation. The following presents the scheduled closure phases at the Landfill:

Side Slopes Closure

Drawing 3 (Attachment 2) indicates the areas of the landfill to be covered with a minimum of 5 feet of acceptable soil cover. Drawing 3 also shows the locations that test pits have been excavated to document soil depth and the locations of future test pits. Once final cover soils have been placed on the remaining side slopes, test pits will be excavated to document the remaining side slopes soil thickness. All side slopes will have received final cover by late fall of 2003. The side slopes indicated on the drawing are slopes that in general bound the unlined areas of the landfill.

TJL has accelerated the side slope closure, as previously discussed with DSHW personnel, to aid in the implementation of the first corrective action. All side slopes will receive a minimum of 5 feet of site soils. All test pits excavated to date showed the minimum 5-foot cover thickness. Once test pits are excavated in the remaining areas to document cover thickness, topsoil and/or compost will be placed on all side slopes and the areas revegetated.

All areas of the landfill will be closed in accordance with applicable final cover requirements in the regulations.

Closure Phases A through H

Phases A through H as indicated on Drawings 4, 5, 6, and 7 (Attachment 2) represent the future closure phases of the landfill. The cover system utilized in Phases A through H will incorporate synthetic materials designed to the lower liner permeability criteria of the lined cells. The utilization of synthetic materials in the cover design will aid in the design and operation of a future landfill gas recovery system.

The approximate closure schedule and associated area for each Phase is as follows:

Phase	Cover Area	Date of Closure
North side slopes	26 acres	Summer 2003
Phase A	11 acres	Summer 2004
Phase B	7 acres	Summer 2005
Phase C	10 acres	Summer 2007
Phase D	15 acres	Summer 2011
Phase E	17.5 acres	Summer 2016
Phase F	18.5 acres	Summer 2021
Phase H	30.5 acres	Summer 2030

Duration of Corrective Action #1

All landfill covers will be maintained from initial installations through the closure, and through the post-closure care periods.

CORRECTIVE ACTION #2 – INSTALLATION OF A GAS COLLECTION SYSTEM

General

The second of the corrective actions summarized in this plan will be to install a landfill gas collection system that will depressurize the landfill while recovering methane, thus minimizing the potential for a vapor phase transport of the PCE.

The installation of a gas recovery system is part of a comprehensive waste management plan that is being implemented at the landfill. Installation of the system allows for the safe, long-term methane management that will help to minimize the potential for further environmental impacts to the ground water.

Existing Gas Recovery Design

As part of the New Source Review program of the State of Utah Division of Air Quality, TJC had a methane collection system designed. The design of the methane collection system met the requirements of the Air Quality Regulations and, at the time of the design, represented the anticipated closure sequence of the landfill.

The existing gas collection system design was prepared by HDR Engineering, Inc. in 1999 and had provisions for some 45 vertical wells uniformly distributed across the landfill. The design package included all requisite engineering details and specifications to support a bid package.

Gas to Energy Project

TJC is negotiating a final contract to partner with a developer in support of a Landfill Gas-to-Energy Project (LGEP). The LGEP is a proactive partnership in the beneficial use of landfill gas.

The contract is a culmination of a RFP process where TJC received 6 competitive proposals in April of 2003. Trans-Jordan personnel reviewed and ranked all 6 proposals based upon landfill gas-to-energy experience, project approach, schedule and proposed fee. Out of the 6 proposals, 3 were selected to prepare presentations to Trans-Jordan's personnel. The 3 remaining bidders were given additional information reflecting the change in closure sequence and additional site-specific data. Final presentations to TJC were conducted the 21st of August 2003. As this contract is finalized, TJC will proceed with the LGEP early next year.

TJL will install a gas collection system as part of its methane management plan, but with the price of natural gas steadily increasing, the prospects of a viable gas-to-energy project increase substantially.

System Construction

The construction of any gas collection system or gas-to-energy system will be of a phased nature. The system will be installed concurrent with or just subsequent to the closure of each of the Phases outlined previously.

Duration of Corrective Action #2

Landfill gas will be continually collected from the initial system installation through closure and post-closure care periods or until landfill gas is measured below 25% of the LEL for Methane in the system.

CORRECTIVE ACTION #3 – KUC GROUND WATER RECOVERY SYSTEM

General

The third and final portion of the proposed corrective actions summarized in this plan is a ground water recovery system being implemented by KUC. Though KUC is responsible for the aspects of their ground water recovery program, TJC appears to be an indirect beneficiary of KUC's actions. KUC actions, independent of the Corrective Actions #2 and #3 may mitigate TJL impact to the ground water.

Geologic Background

The TJL is located in the southwestern portion of the Jordan River Valley, usually called the Salt Lake Valley, east of the northern Oquirrh Range and the mouth of Bingham Canyon. Bingham Creek flows from the Oquirrh Range eastward down Bingham Creek (immediately north of the landfill) and out into the Salt Lake Valley to the Jordan River. West of the landfill area are the mining operations of the Bingham Canyon Mine that is located at the confluence of Bingham and Carr Fork Canyons. The Bingham Mining District has been developed in intrusive and meta-sedimentary rocks.

KUC Ground Water Impacts

Kennecott Utah Copper has been conducting mining operations west of the landfill location for decades. As part of the mining operations, a reservoir (Bingham Canyon Reservoir) has been operated in the Bingham Creek drainage to serve as storage for process waters. The reservoir is located hydraulically upgradient from the TJL, approximately 8,900 feet to the west. Seepage losses from the historic operation of the Bingham Creek Reservoir have been estimated at over 1,000,000 gallons per day since construction in 1965. The Bingham Creek Reservoir (unlined) has since been decommissioned and replaced with a lined reservoir, but the residual downgradient acid and sulfate waters still remain. Additionally, KUC has installed several groundwater cutoff walls.

The affected ground waters have been estimated to extend over 20,000 feet downgradient to the east and about 10,000 feet wide, fully encompassing the landfill. The sulfate concentration in some of the monitor wells within the plume has historically exceeded 50,000 mg/l with some pH values less than 3.0.

Previous hydrogeologic work has delineated a 10,000 mg/l TDS contour line running beneath the landfill. The wide range in TDS concentrations in the study area reflects the impact of historic mining operations on the groundwater.

KUC Ground Water Treatment

KUC has been working with the State of Utah Division of Water Quality for several years to implement a groundwater recovery and treatment plan. KUC's recovery effort involves pumping impacted groundwater from a network of wells designed and installed to recover both the low pH water and the high TDS waters. "The Southwest Jordan Valley Ground Water Cleanup Project" is currently undergoing a public comment period while preliminary work has already been started. A new acid recovery well has been installed within 200 feet of the TJL boundary. The volume of water pumped from this well and others located near the landfill will drastically alter the groundwater elevations under the landfill. KUC has shared information on two of the possible pumping scenarios.

Scenario #1 pumping rates:	Scenario #2 pumping rates:
Zone A: Acid Well 1146 (950 gpm) New Acid Well (750gpm) Jordan Wells (2600 acre feet/yr) Lark Well (200 gpm) Sulfate Well (1000 gpm) Sulfate Well B2G1193 (1100gpm) Sulfate Well B2G1200 (1100gpm) Riverton Wells (4308 acre feet/yr) Zone B: Wells 1-6 (235gpm each) Well 7 (1200 gpm)	Zone A: Acid Well 1146 (950 gpm) New Acid Well (750gpm) W. Jordan Wells (2600 acre feet/yr) Lark Well (200 gpm) Sulfate Well (1000 gpm) Sulfate Well B2G1193 (1700gpm) Sulfate Well B2G1200 (1700gpm) Riverton Wells (4308 acre feet/yr) Zone B: Wells 1-6 (235gpm each) Well 7 (1200 gpm)

10, 20, and 40 Year Drawdowns

KUC's drawdown data for each of the above scenarios is presented on Drawings 8, 9, 10, 11, 12 and 13 (Attachment 2). Drawings 8, 9, and 10 represent the predicted groundwater drawdown for scenario #1 at 10, 20, and 40 years. Drawings 11, 12, and 13 represent the predicted groundwater drawdown for scenario #2 for the same 10, 20, and 40 year periods.

The predicted 10-year groundwater drawdown for the groundwater in the vicinity of the landfill ranges from 30 to 60 feet. The predicted 20 and 40-year groundwater drawdowns for the landfill areas are from 50 to 80 feet and 70 to 90 feet respectively.

KUC Water Destinations

Water from the acid wells will be directed to the KUC tailings ponds north of Magna and water recovered from wells B2G1193 and BFG1200 will be sent to a reverse osmosis plant for treatment to drinking water standards for public use.

Duration of Corrective Action #3

The duration of the KUC recovery actions is scheduled for the next 40 years. When the groundwater under TJL has reached equilibrium, groundwater will be sampled and analyzed to document that the Corrective Action was successful.

FUTURE GROUND WATER MONITORING

Impacts to Trans-Jordan Landfill's Ground Water Monitoring

As previously detailed, the groundwater under the landfill is dropping. Two of the five monitoring wells are now dry and the two remaining downgradient wells are anticipated to become dry within 9 months. The predicted drop of ground water and subsequent drying out of MW-4 and MW-5 does not include an increase in the rate of ground water drop due to the upcoming pumping plan. If water recovery efforts start soon, the entire groundwater monitoring system at the landfill may be rendered useless.

New Well Installation

These two pumping scenarios may not be the only variations in a KUC plan, but are only the scenarios shared with TJC. The impacts to the groundwater elevations under and surrounding the landfill might be enormous. Based upon the magnitude of the groundwater elevation change, the level of accuracy of the modeling, and the numerous scenarios being considered, the true impact to the groundwater elevations are still unknown.

The anticipated drawdown of the ground water surface may result in the change of direction of flow of the groundwater under the landfill. The effects of the change in direction of flow are also an unknown.

The magnitude of these unknowns (final depth to groundwater and final direction of flow) are such that the location selection for and the installation of a new monitor well is extraordinarily difficult. Without knowing the steady state conditions associated with the remediation efforts, the installation of a new well will have a low likelihood of providing useful water quality data. As a result, TJC proposes to not install a new groundwater monitoring well.

Once the ground water regime stabilizes, TJC will assess the long-term ground water monitoring requirements of the landfill and install monitoring wells if deemed necessary.

Proposed Ground Water Monitoring

TJC is in contact with KUC and discussing the potential of accessing adjacent KUC wells for potential groundwater sampling. If KUC grants access, TJC will analyze the water sampled from the production well for a list of constituents mutually agreeable to the State Department of Solid and Hazardous Waste (DSHW), TJC and KUC.