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2011.00279

February 1, 2011

Mr. Scott T. Anderson
Executive Secretary
Utah Solid and Hazardous Waste Control Board
Utah Department of Environmental Quality
195 North 1950 West
PO Box 144880
SLC UT 84114-4880

Re: Corrective Action Plan – **Ironton Canal**
Reilly Industries, Inc.
Provo, **Utah**
UTD009087644

Vertellus **File** #2253

Dear Mr. Anderson:

On behalf of Vertellus Specialties, Inc., (Vertellus), URS Corporation (URS) is submitting this Corrective Action Plan for the Ironton Canal located adjacent to the former Reilly Coal Tar Refinery in Provo, Utah. The Utah Department of Environmental Quality (UDEQ) Division of Solid and Hazardous Waste requested corrective action at the Site in letters dated January 19, 2010 and November 2, 2010. In the January 19, 2010 letter, DSHW requested that corrective action at the Ironton Canal be given the highest priority; therefore, this plan was prepared first. Corrective actions for other areas at the Site, including Site surface soils, Site subsurface soils, solid waste management unit (SWMU) #12 evaporation area, and Site groundwater, as identified in the January 19, 2010 letter, are currently being evaluated.

If you have any questions, please feel free to contact me at 801-904-4016 or John Jones of Vertellus at 317-248-6427.

Very Truly Yours,

Tina Maniatis

Tina Maniatis, PE
Project Manager

cc: Mr. Brad Maulding, UDEQ
Mr. Rolf Johnson, UDEQ

Attachment

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CORRECTIVE ACTION PLAN FOR THE IRONTON CANAL

Former Reilly Industries Coal Tar Refinery
Provo Utah
UTD009087644

February 1, 2011

Prepared For

Vertellus Specialties
201 North Illinois St , Suite 1800
Indianapolis, IN 46204

Prepared By

URS

URS Corporation
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Salt Lake City, UT 84107

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EXECUTIVE SUMMARY

Background

This Corrective Action Plan (CAP) is for the Ironton Canal at the former Reilly Industries Coal Tar Refinery in Provo, Utah (Site) and was prepared by URS Corporation (URS) at the request of the Vertellus Specialties Inc , (Vertellus) and the Utah Department of Environmental Quality (UDEQ) Division of Solid and Hazardous Waste (DSHW) The Site is currently undergoing Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) A Phase II RCRA Facility Investigation (RFI) was completed in 2010 (ERM, 2010a) Sediments and surface water within the Ironton Canal, which runs along the northern edge of the property, were investigated as part of the RFI Analytical results of sediment samples showed concentrations of polycyclic aromatic hydrocarbons (PAHs) above screening levels Analytical results of surface water samples showed that concentrations of benzene and PAHs above Utah Water Quality Standards (UT WQS)

Following the receipt of the initial Phase II RFI Supplemental Investigation Report in October 2009, DSHW recommended in the letter dated January 19, 2010 that Vertellus address the Ironton Canal, along with other areas at the Site, in a CAP (UDEQ, 2010a) In the approval letter for the Phase II RFI Supplemental Investigation Report and the Groundwater and Surface Water Monitoring Report dated November 2, 2010, DSHW requested a CAP be submitted within 90 days (UDEQ, 2010b) During a meeting with UDEQ on December 9, 2010, UDEQ and Vertellus agreed that the first CAP would address the Ironton Canal Corrective action and/or risk assessments for the other areas at the Site, including Site surface soils, Site subsurface soils, solid waste management unit (SWMU) #12 evaporation area, and Site groundwater are currently being evaluated

Recent and Current Work

Work has already been performed to address some of the areas identified by UDEQ to be included in a CAP This additional work included sealing a drainage pipe that ran along Industrial parkway which discharged to the Ironton Canal, and excavating and disposing surface tar derived material (TDM) off site A security fence with locked gates surrounds the entire perimeter of the Site and with the removal of surface TDM the risk of exposure has substantially decreased Land use controls and appropriate environmental covenants will be put in place in the future to further ensure exposure risks are managed

Evaluating the soil and groundwater results is ongoing and risk assessments to support potential corrective action determinations are currently underway

Target Cleanup Objectives

The target cleanup objectives for the Ironton Canal CAP are as follows

1 Prevent impacted groundwater from migrating to surface water
2 Prevent human and ecological receptors from exposure to impacted sediments
3 Prevent impacted sediments from migrating downgradient from Site

Corrective Action Alternatives

Five Corrective Action Alternatives were considered for the Ironton Canal

1. No action
2. Install groundwater barrier and surface water level control
3. Pipe surface water, cap sediments with backfill
4. Install concrete liner to cap canal sediments
5. Install AquaBlock® liner to cap canal sediments

Comparison Criteria

R315-101-1(b)(4) presents the criteria to be used to determine appropriate corrective action at a site These criteria were used in this CAP to determine the appropriate corrective action for the Ironton Canal The criteria are (in order of importance)

a. The impact or potential impact of the contamination on the human health,
b. The impact or potential impact of the contamination on the ecological health,
c. The technologies available for use in clean-up, and
d. Economic considerations and cost-effectiveness of cleanup options

Selected Corrective Action

Five corrective action alternatives were examined for the Ironton Canal to determine the best corrective action to prevent exposure to impacted sediments, migration of impacted sediments downstream, and impacted groundwater from mixing with surface water and migrating off site It was determined that two alternatives would meet the criteria of protecting human health, protecting ecological health, and technical feasibility Those alternatives were piping and backfilling and installation of concrete liner However, due to concerns about the potential for ongoing maintenance, the concrete liner was discounted Therefore, it has been determined that piping and backfilling the canal is the most appropriate corrective action for the Ironton Canal

1 0 INTRODUCTION

This Corrective Action Plan (CAP) was prepared by URS Corporation (URS) at the request of Vertellus Specialties Inc , (Vertellus) and the Utah Department of Environmental Quality (UDEQ) Division of Solid and Hazardous Waste (DSHW) This CAP applies to the Ironton Canal at the former Reilly Industries Coal Tar Refinery in Provo, Utah (Site) Corrective action and risk assessments for other areas at the Site, including Site surface soils, Site subsurface soils, solid waste management unit (SWMU) #12 evaporation area, and Site groundwater are currently being evaluated

1 1 Site History

The Site is currently undergoing Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) A Phase II RCRA Facility Investigation (RFI) was completed in 2010 (ERM, 2010a) The Ironton Canal, which runs along the northern edge of the property, was investigated as part of the RFI

The Ironton Canal originates approximately one mile east of the Site at a diversion point on Spring Creek The canal is piped across the former Ironton Steel facility On the east side of the Site, the canal emerges from a culvert underneath the railroad tracks and becomes an open channel on the northern boundary of the Site before again being diverted into a culvert at the west side of the Site to the Pacific States Cast Iron Pipe Company (PSCIPCo) site PSCIPCo operates a gate valve to maintain the water level on the canal for a source of non-contact cooling water Approximately 1 5 miles west of the Site the canal discharges into Utah Lake (ERM, 2008)

During operations at the Site, the Ironton Canal was used to provide non-contact cooling water for coal tar distillation operations The water was discharged back to the canal following use under Utah Pollutant Discharge Elimination System (UPDES) permit UU0000370 Seasonally stormwater collected from the southwest portion of the site may have drained into the Ironton Canal, a discharge covered by UPDES permit URT000415 (ERM, 2008)

The Ironton Canal was identified as solid waste management unit (SWMU) 1, Ironton Canal by the U S Environmental Protection Agency (EPA) in the 1993 Preliminary Assessment Plus (Morrison Knudsen, 1993) In 1996 DSHW established a Stipulation and Consent Agreement with Reilly Industries to investigate and perform corrective action at Site SWMUs (UDEQ, 1996) The Phase I RFI was completed in 2000 (August Mack Environmental, 2000) and UDEQ approved the Phase I RFI on July 18, 2002 The Phase II RFI was completed in 2010 and UDEQ approved the Phase II Supplemental Reports and requested corrective action in a letter dated November 2, 2010 (UDEQ, 2010b)

1 2 Purpose and Objectives of the Corrective Action

The purpose of the Corrective Action is to protect human health and the environment The objectives of the Corrective Action are to prevent groundwater from migrating to surface water in the canal, prevent exposure to impacted sediments, and prevent impacted sediments from migrating downstream

As described m the Consent Agreement, the CAP should develop and evaluate corrective action alternatives and outline one or more alternative corrective action(s) which satisfy the target clean up objectives R315-101-1(b)(4) identifies criteria to be used to m the determination of appropriate corrective action

1 3 Elements of the CAP

The elements to be included in the CAP can be found m the Stipulation and Consent Agreement and are listed below (UDEQ, 1996)

a Project Management Plan
b A summary of Phase II RFI information as needed to prepare the CAP
c Proposed remediation goals or target cleanup objectives
d The corrective measures used to satisfy cleanup objectives
e Data Collection Quality Assurance / Quality Control Plan
f Data Management Plan
g A schedule for implementation of the corrective action(s)

2 0 SUMMARY OF PHASE II RFI

2 1 Summary of the Phase II RFI

The Phase II RFI Supplemental Investigation Report (ERM, 2010a) and Groundwater and Surface Water Monitoring Report (ERM, 2010b) were approved by DSHW on November 2, 2010 (UDEQ, 2010b) As part of the RFI, sediments and surface water within the Ironton Canal were sampled to assess Site-related impacts and groundwater-surface water interaction Below is a review of the findings of the reports that pertain to the Ironton Canal

During the RFI, sediment samples were collected from ten locations in the Ironton Canal (Figure 1) and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and cyanide Generally three sediment samples were collected at each location, one sample near the surface of the canal, one sample at the bottom of the boring (generally about 8 to 10 feet (ft) below the bottom of the canal), and one sample from the interval that exhibited the highest potential for impacts based on visual and field screening Analytical results showed concentrations of polycyclic aromatic hydrocarbons (PAHs) above screening levels in all but one sediment sampling location (Table 1) Benzene was detected at a concentration above screening levels at one location upstream of the cooling pond outfall Generally, the highest concentrations of PAHs occurred at about 2 to 4 ft below the canal bottom (ERM, 2010a)

Surface water samples were collected from four locations along or associated with the Ironton Canal quarterly from April 2009 to January 2010 (Figure 2) Generally, surface water in the Ironton Canal does not have concentrations of VOCs above the Utah Water Quality Standards (UT WQS) Only during the January 2010 sampling event were concentrations of VOCs, benzene in particular, detected above estimated values (Table 2), but less than the UT WQS This sample was from location SW-4, which was an outfall from a pipe that roughly trends along Industrial Parkway to location SW-5 Concentrations of PAHs in surface water samples were above UT WQS in 2004 and 2005, however, during the recent sampling, data were inconclusive due to high reporting limits (ERM, 2010b)

In an effort to assess groundwater-surface water interaction along the Ironton Canal, two monitoring wells and three temporary wells were installed along the banks of the canal The wells were used to assess groundwater quality as well as groundwater elevation Additionally, two staff gages were installed in the canal to measure surface water elevation Groundwater and surface water elevations were measured nine times between February 2009 and January 2010 Results of these measurements show that the Ironton Canal is generally a losing stream in the summer and fall and a gaining stream in the winter and spring Benzene and benzo(a)pyrene were detected above UT WQS in temporary wells TW-1 and TW-2 on the south side of the canal and benzene was detected above UT WQS in monitoring well MW-34 on the north side of the canal (ERM, 2010b)

The RFI also included groundwater and soil investigations of the rest of the Site, however, this CAP focuses on the Ironton Canal Groundwater and soil investigation data is currently being assessed and will undergo separate corrective action planning

2 2 Ironton Canal Interim Measure Work Plan

The Ironton Canal Interim Measure (IM) Work Plan was submitted to DSHW on February 18, 2008 (ERM, 2008) The purpose of the IM Work Plan was to address the potential for exposure to affected surface water and sediment within the canal The IM Work Plan proposed to either line the canal or pipe the surface water, thereby removing the exposure pathway to affected sediments and removing interaction between surface water and groundwater or affected sediments (ERM, 2008) In a letter dated April 28, 2008, DSHW requested that prior to implementing any interim measure, the Phase II Supplemental Investigation should be completed (UDEQ, 2008)

2 3 UDEQ Request for Corrective Action

Following the receipt of the initial Phase II RFI Supplemental Investigation Report (ERM, 2010a) in October 2009, DSHW recommended in the letter dated January 19, 2010 (UDEQ, 2010a) that Vertellus submit a CAP for several areas of the Site DSHW requested that Ironton Canal be given high priority in the development of a CAP The letter specified that a CAP be submitted to DSHW within 90 days of receiving approval of the Phase II RFI Report Approval of the Phase II RFI Supplemental Investigation Report and the Groundwater and Surface Water Monitoring Report was given by DSHW on November 2, 2010 (UDEQ, 2010b) In the letter DSHW required that a CAP be submitted within 90 days

On December 9, 2010, Vertellus, URS and UDEQ met at UDEQ offices to discuss the November 2, 2010 approval letter and request for corrective action At this meeting it was discussed that the Ironton Canal would be addressed in this first CAP due 90 days after November 2, 1010 and soil and groundwater would be addressed soon after and possibly in conjunction with risk assessments

3 0 RECENT AND CURRENT WORK

Work has already been performed to address some of the areas identified by UDEQ to be included in a CAP This additional work included sealing a drainage pipe that ran along Industrial parkway which discharged to the Ironton Canal and excavation, and off site disposal of surface tar derived material (TDM) A security fence with locked gates surrounds the entire perimeter of the Site, and with the removal of surface TDM, the risk of exposure to potential contamination has substantially decreased

Additionally, an evaluation of groundwater – surface water interaction at the Ironton Canal has been completed to support this CAP and is discussed further in the next section Corrective action planning and risk assessments to support corrective action determinations are currently underway for Site soils and groundwater

3 1 Sealing of Drainage Pipe

To address the UDEQ concern expressed m the November 2, 2010 letter that potentially contaminated groundwater was migrating from the site via surface water through SW-4, a surface water drainage line was sealed off The drainage pipe is on the west side of the Site and roughly trends along the east side of Industrial Parkway The north end of the drainage pipe was surface water location SW-4 and the south end of the drainage pipe was surface water location SW-5 (Figure 2) The pipe drained surface water from the seasonally inundated area and the roadway and discharged it to the Ironton Canal The pipe also captured groundwater from the western portion of the Site

The drainage pipe was observed to be an approximately 8-inch to 10-inch diameter open jointed concrete reinforced pipe The pipe was sealed off at four locations the influent (south end), the effluent (north end), and two locations in between To seal the pipe at the influent and effluent, soil surrounding the pipe was removed and bentonite chips were placed approximately 3 to 4 ft inside the pipe and around the outside of the pipe A ¼-inch thick 18-inch by 18-inch steel plate was placed at both ends (SW-4 and SW-5) of the pipe Bentonite chips were then placed in front of the plate and covered with soil At two locations in between the influent and effluent, the pipe was excavated, broken, filled with bentonite, and the surface regraded

The sealing off of the drainage pipe eliminates a potential groundwater discharge to surface water pathway

3 2 Evaluation of Site Groundwater – Surface Water Interaction

An evaluation of Site groundwater hydrology and the groundwater – surface water interaction in the vicinity of the Ironton Canal was conducted using data from the Phase II RFI Supplemental Investigation Report (ERM, 2010a), the Phase II RFI – Groundwater and Surface Water Monitoring Report (ERM, 2010b) and data collected by URS in January 2011 The purpose of the evaluations was to better understand Site hydrology and how it affects Site plume stability and potential for migration off site if a barrier is put between the surface water of the canal and groimdwater (i e , a pipe or liner)

Five potentiometric maps (and corresponding data) were available for review of groundwater flow directions and gradients December 2004 and April 2005 (conducted by August Mack Environmental and included in Appendix E of the Phase II RFI Supplemental Investigation Report [ERM, 2010a]), April 2009 (ERM, 2010a) and October 2009 (ERM, 2010b), and January 2011 (URS, this report)

The potentiometric surface maps from 2004, 2005, and April 2009 generally show that groundwater flow across the Site is to the south or southwest However, groundwater flow direction in the northwest comer of the Site is towards the northwest The northwesterly flow in that area appears to be related to a leaking deep well (capped in June 2009)

The October 2009 potentiometric surface map shows that groundwater at the Site flows in a south to south-easterly direction (Figure 4) The potentiometric surface shown in Figure 4 indicates that a mound of groundwater is located underneath the PSCIPCo property, west of the Site, and a generally flat gradient exists across the Site

Groundwater elevations were measured in January 2011 to verify previous findings The January 2011 potentiometric surface is shown on Figure 5 The potentiometric surface shown in Figure 5 shows that groundwater in the northwest comer of the Site flows to the west while groundwater on the rest of the Site generally flows to the south The groundwater gradient during January 2011 is also much flatter than it is during October 2009

These seasonally variable changes in the groundwater flow direction and the generally flat gradient across the Site have likely kept and will continue to keep the Site groundwater plumes stable by limiting migration in any one direction Concentrations in groundwater at wells within the plumes have also remained relatively stable since 2004

Groundwater elevations in monitoring wells installed adjacent to the Ironton Canal were compared to canal surface water elevations measured at staff gages (Figures 4 and 5, Tables 3 and 4) Monitoring wells TW-1, MW-3, and MW-31 were compared to staff gage SG-1 and monitoring wells TW-3, MW-35, MW-5, and PZ-9 were compared to staff gage SG-2 Analysis of bi-monthly groundwater and surface water elevation data show that seasonal variations in the head difference between groundwater and surface water near the canal vary minimally, between -0 34 to 0 63 ft Farther from the canal at locations MW-31 and PZ-9 head differences are slightly higher (-0 87 to 1 40) A negative difference between groundwater and surface water implies a "losing stream", i e , the surface water in the canal is recharging groundwater A positive difference between groundwater and surface water implies a "gaining stream", i e , the canal is capturing groundwater The data show that the canal is generally a minimally gaming stream during the winter and spring and a minimally losing stream during the summer and fall Given the relatively equal magnitude of both the positive and negative elevation differences between surface water and groundwater and the intervals of gaining and losing, it can be concluded that the canal operates at or near equilibrium or in a net balance with groundwater and fails to influence groundwater to any significant degree

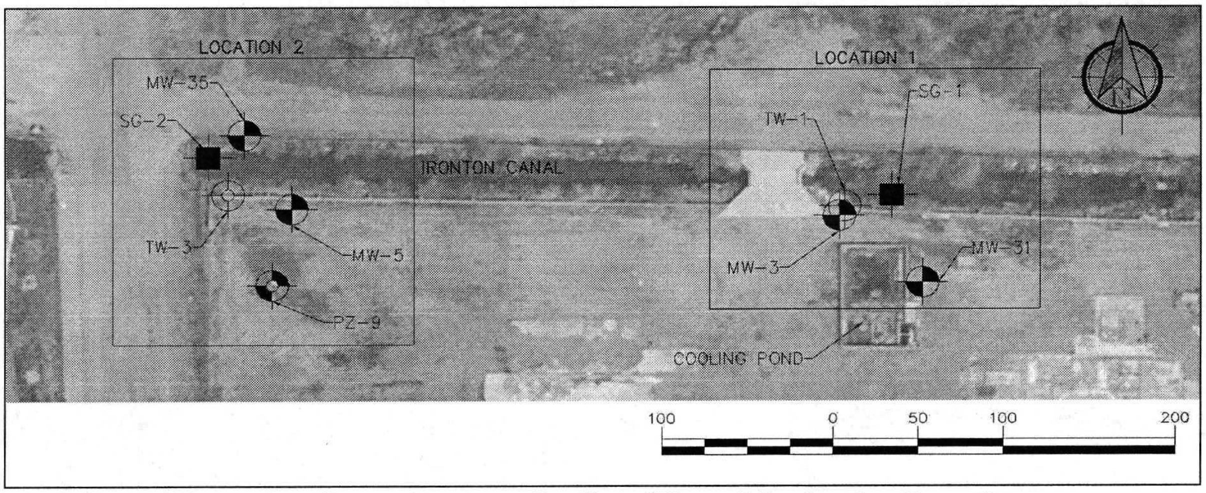

Figure 3 – Groundwater – Surface Water Monitoring Locations

Comparison of MW-35, located on the north side of the canal, and TW-3, located on the south side of the canal, shows that groundwater on the north side of the canal typically has a higher head than on the south side of the canal, which is consistent with the location of a wetland area north of the Site. When the relative differences between SG-2 and MW-35 and TW-3 are compared, it can be seen that MW-35 typically has a greater magnitude during gaining intervals and a lesser magnitude during losing intervals. This hydraulic scenario implies that the site groundwater flow regime is independent or at most minimally affected by this section of the Ironton Canal. The larger local control of groundwater flow direction is likely the wetland area north of the Ironton Canal and/or the mounding of groundwater west of the Site on PSCIPCo property, likely related to the million gallon pond and canal gate valve located on their property. This mound of water to the north and northwest of the Site should continue to control Site groundwater hydrology and should act as a barrier to northward plume migration if the canal groundwater interaction is removed.

Plume stability is also noted from groundwater analytical results collected since 2004 that show benzene concentrations in groundwater have remained relatively constant. The limits of the benzene plumes have not changed. This evidence suggests that the groundwater plumes have not migrated from the decades old source areas. These observations are consistent with the conclusion that the seasonally variable direction of groundwater flow and the generally flat gradient across the Site have kept the plumes stable.

Removing the minor interaction of the Ironton Canal on the groundwater flow regime will not substantially change groundwater flow conditions or affect plume stability. Additionally, removing the minimal groundwater drain (the canal during the winter and spring) by installing a barrier between surface water in the canal and groundwater (a pipe or liner for example) will eliminate the migration of groundwater to surface water, which is one objective of this corrective action. Additionally, removing the groundwater interaction with the Canal should not affect plume migration north of the Site, which is instead controlled by mounding of water in the wetland area and the million gallon pond at PSCIPCO

3 3 Collection of Additional Sediment Samples

Sediment samples will be collected from two additional locations within the Ironton Canal to fill the data gap that exists between sediment sample location 2-S-1-5 and the railroad crossing at the east end of the canal At each location three sediment samples will be collected, one sample from the canal surface (0-0 5 ft below ground surface [bgs]), one sample from the interval exhibiting the highest potential for impacts based on visual observations and field screenings, and one deep unimpacted sample (up to 10 ft bgs) to bound the depth of impacts The sediment samples will be analyzed for

- VOCs by SW846 Test Method 8260B or equivalent
- SVOCs by SW846 Test Method 8270C or equivalent
- Cyanide by SW846 Test Method 9000 Series or equivalent

3 4 Preliminary Risk Assessments

Work on preliminary risk assessments, including human and ecological health, is currently underway to support the evaluation of corrective action alternatives for soil and groundwater at the Site

4 0 TARGET CLEANUP OBJECTIVES

The target cleanup objectives for the Ironton Canal CAP are as follows

1 Prevent impacted groundwater from migrating to surface water in the canal
2 Prevent human and ecological receptors from exposure to impacted sediments
3 Prevent impacted sediments from migrating downgradient from Site

5 0 CORRECTIVE ACTION ALTERNATIVES EVALUATION

5 1 Comparison Criteria

Several Corrective Action Alternatives were considered for the Ironton Canal Criteria identified in R315-101-1(b)(4) were used to determine appropriate corrective action These criteria are (in order of importance)

a The impact or potential impact of the contamination on the human health,
b The impact or potential impact of the contamination on the ecological health,
c The technologies available for use in clean-up, and
d Economic considerations and cost-effectiveness of cleanup options

5 2 Site Considerations

The Ironton Canal upstream of the Site was piped as part of redevelopment activities at the former U S Steel Ironton facility The Ironton site is currently being redeveloped by the City of Provo The staff at the Provo City Office of Economic Development stated that the pipe, upstream of the railroad crossing (the eastern boundary of the Site), is a 54-inch (") concrete pipe Under the railroad crossing itself appears to be two 60" concrete pipe culverts Provo City staff also stated that the minimal slope on the 54" pipe is 0 12% A 54" concrete pipe at a slope of 0 12% has the maximum conveyance capacity of approximately 63 5 cubic ft per second (cfs) at a velocity of 4 1 ft per second (ft/sec) Staff from the Department of Public works of Provo City indicated that the minimal flow is between 12 to15 cfs

The dimensions of the current Ironton Canal at the Site have been estimated from aerial photography, former drawings, and field observations (see Figure 6) Although these estimates are sufficient to develop alternative solutions, these solutions are conceptual and will need survey data for the design phase

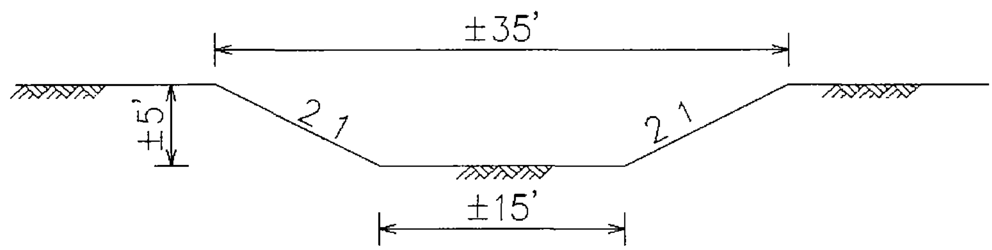

Figure 6 – Cross-Section Current Ironton Canal

The current depth of the Ironton Canal was estimated at 5 ft

Assuming that the slope of the canal is equal to 0 12%, the capacity of the canal can be estimated using Manning's equation as follows

$$V = \left(\frac{1\ 486}{n}\right) R^{\frac{2}{3}} S^{\frac{1}{2}}$$, where

V is the cross-sectional average velocity (ft/s)
n is the Manning coefficient (estimated at 0 04)
R_h is the hydraulic radius (ft)
S is the slope (estimated at 0 12%)

At 1 foot of freeboard, $R_h = \frac{A}{P} = \frac{15*4+½*10*5}{15+2*\sqrt{4^2+10^2}} = \frac{80}{36\ 54} = 2\ 19\text{ ft}$

$$V = \left(\frac{1\ 486}{0\ 04}\right) 2\ 19^{\frac{2}{3}} 0\ 0012^{\frac{1}{2}} = 2\ 17\text{ ft/s}$$

$$Q = V * A = 2\ 17 * 80 = 173\ 6\text{ ft}^3\text{/s}$$

A is the area in flow (square ft [ft^2])
P is the wetted perimeter ft

However, the water level control structure at PSCIPCo significantly controls the capacity of the current canal by backing water upstream

The design flow for each alternative is set at a maximum conveyance capacity of 63 5 cfs, which is taken from the 54" concrete pipe calculation It is assumed that the entire length of the canal on the site will be addressed Sediment samples will be collected at two additional locations to confirm if corrective action is warranted for the eastern portion of the canal The section of the canal on PSCIPCo with impacted sediments will also be included in the corrective action

5.3 Corrective Action Alternatives Evaluated

Five Corrective Action Alternatives were considered for the Ironton Canal

1 No action
2 Install groundwater barrier and surface water level control
3 Pipe surface water, cap sediments with backfill
4 Install concrete liner to cap canal sediments
5 Install AquaBlok® liner to cap canal sediments

Each alternative is considered and discussed in the following sections

5 3 1 No Action

The no action alternative was considered and was dismissed because it would not meet objectives in Section 4 0

5 3 2 Groundwater Barrier and Surface Water Level Control

This alternative involves the construction of a concrete groundwater barrier along the south side of the Ironton Canal at the Site The groundwater barrier would be constructed to a depth sufficient to limit the migration of impacted groundwater from the Site into the canal A surface water control structure (such as a gate valve) would be installed at the downstream (west) end of the canal The purpose of the surface water control would be to maintain a losing stream environment along the length of the canal by maintaining the surface water at a higher elevation than surrounding groundwater

This alternative was considered and was dropped because it did not meet objections in Section 4 0

5 3 3 Pipe Surface Water

This alternative involves the placement of a 54" closed joint concrete pipe in the canal, and covering the pipe and canal with backfill (Figure 7) This alternative will allow the transfer of surface water across the site while preventing groundwater from migrating off site via the canal It will also cap in-place impacted sediments on the bottom of the canal at a depth of approximately 10 ft bgs

In order to install the concrete pipe at the correct elevation, some impacted sediments will have to be removed It is estimated that 350 cubic yards (cy) of impacted sediments will be removed to a depth of one foot along the 930 ft of canal These sediments will be transported to Republic Services/Allied Waste's ECDC Class V landfill (ECDC) located in Carbon County, Utah for proper disposal

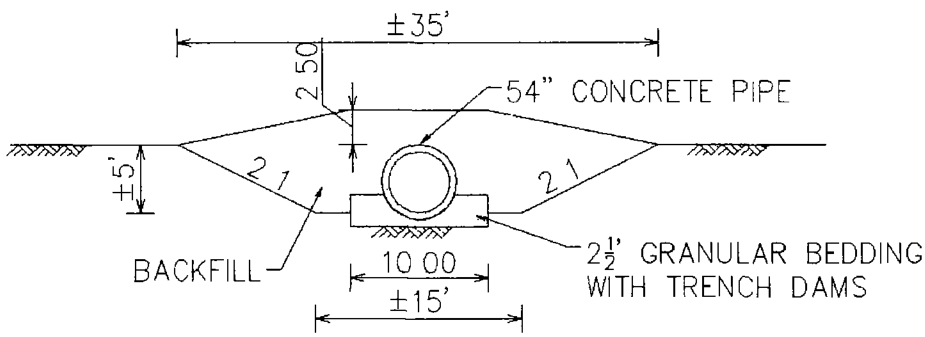

Figure 7 – Cross-Section of Piping Alternative

This piping of surface water alternative is evaluated as follows

<u>Impact to Human Health</u>

The placement and burial of a closed joint concrete pipe in the Ironton Canal will prevent human exposure to surface water, sediments and groundwater Once the pipe is installed, sediments will be capped in-place at a depth of 10 ft bgs, thus eliminating the exposure pathway The pipe will prevent impacted groundwater from mixing with surface water and migrating off site, thus eliminating the exposure pathway to impacted surface water

Impact to Ecological Health
The placement and burial of a closed joint concrete pipe in the Ironton Canal will prevent ecological exposure to surface water and sediments Once the pipe is installed, sediments will be capped in-place at a depth of 10 ft bgs, thus eliminating the exposure pathway The pipe will prevent impacted groundwater from mixing with surface water and migrating off site, thus eliminating the exposure pathway to impacted surface water

Technological Availability and Feasibility
The technology to construct a buried closed joint concrete pipe to convey surface water across the site is available and action is proven and feasible Upstream of the Site on the Ironton Property the canal has been successfully piped The concrete pipe will prevent groundwater from leaking in and mixing with surface water, thus preventing the transport of impacts off site via surface water The trench dams constmcted along the pipe bedding will prevent groundwater from flowing off site via a pipe bedding preferential pathway The backfill around the pipe will act to cap in-place impacted sediments to a depth of approximately10 ft bgs, thus preventing human or ecological exposure

Cost
The preliminary cost for this altemative has been estimated at $360,000

5 3 4 Line Canal Sediments with Concrete
This altemative involves the placement of a **4**" thick concrete slipline liner with wire mesh and fiber reinforcement in the canal The size of the lined canal will be reduced because of the over capacity of the current canal and the friction improvement of the concrete versus the current canal conditions According to the guidelines of the U S Bureau of Reclamation (USBR) (Design Standard # 3), the bottom width of a small concrete canal should be approximately equal to the depth in the canal (USBR, 1967) Backfill will be placed around and under the concrete liner to cap impacted sediments in-place at a depth of up to approximately 3 ft below the canal bottom This altemative will allow the transfer of surface water across the site while preventing groundwater from migrating off site via the canal

In order to install the concrete liner at the correct elevation, it is anticipated that some impacted sediments will have to be removed It is estimated that 117 cy of impacted sediments will need to be removed to a depth of 0 5 ft along the 930 ft of canal These sediments will be transported to ECDC for proper disposal

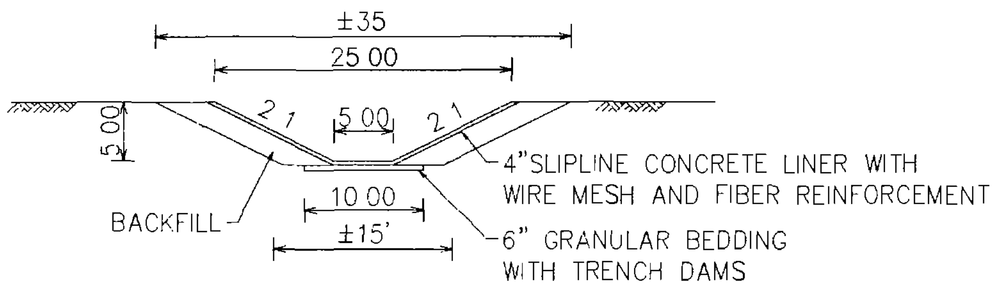

Figure 8 – Cross Section of Concrete Lining Alternative

The lining of the canal with concrete alternative is evaluated as follows

Impact to Human Health
The construction of a concrete liner in the Ironton Canal will prevent human exposure to impacted sediments and groundwater Once the liner is installed, sediments will be capped in-place at a depth of up to 3 ft below the canal bottom, thus eliminating the exposure pathway The liner will prevent impacted groundwater from mixing with surface water and migrating off site, thus eliminating the exposure pathway to surface water

Impact to Ecological Health
The construction of a concrete liner in the Ironton Canal will prevent ecological exposure to impacted sediments Once the liner is installed, sediments will be capped in-place at a depth of up to 3 ft below the canal bottom, thus eliminating the exposure pathway The liner will prevent impacted groundwater from mixing with surface water and migrating off site, thus eliminating the exposure pathway to surface water

Technological Availability and Feasibility
The technology to construct a concrete liner in the Ironton Canal to convey surface water across the site is available and the action is feasible The concrete liner will prevent groundwater from leaking in and mixing with surface water, thus preventing the transport of impacts off site via surface water The concrete liner and backfill will act to cap impacted sediments in place to a depth of up to approximately 3 ft below the canal bottom, thus preventing human or ecological exposure

Cost
The preliminary cost for this alternative has been estimated at $300,000

5 3 5 Line Canal Sediments with AquaBlok®

This alternative involves the placement of a 4" thick dry (6" thick hydrated) AquaBlok® liner covered by 8" of armor rock along the length and width of the canal AquaBlok® is a bentonite coated aggregate that forms an impermeable layer when hydrated An 8" thick layer of cobble-sized armor rock would be placed on top of the AquaBlok® liner to prevent erosion and ecological disturbance This alternative will allow the transfer of surface water across the site while preventing groundwater from migrating off site via the canal

In order to install the AquaBlok® liner at the correct elevation, it is anticipated that some impacted sediments will have to be removed It is estimated that 520 cy of impacted sediments will need to be removed to a depth of one foot along the 930 ft of canal These sediments will be transported to ECDC for proper disposal

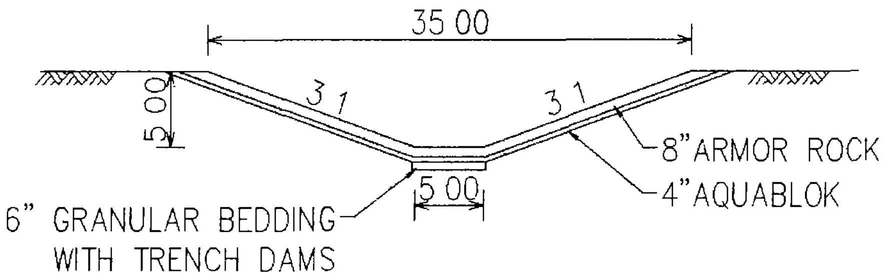

Figure 9 – Cross Section of AquaBlok® Liner Alternative

The lining of the canal with AquaBlok® altemative is evaluated as follows

<u>Impact to Human Health</u>
The construction of an AquaBlok® liner in the Ironton Canal will prevent human exposure to impacted sediments and groundwater Once the Imer is installed, sediments will be capped in-place at a depth of 1 5 ft below the canal bottom, thus eliminating the exposure pathway The liner will prevent impacted groundwater from mixing with surface water and migrating off site, thus eliminating the exposure pathway to surface water

<u>Impact to Ecological Health</u>
The constmction of an AquaBlok® liner in the Ironton Canal will prevent ecological exposure to impacted sediments Once the liner and armor rock are installed, sediments will be capped in-place at a depth of 1 5 ft below the canal bottom, thus eliminating the exposure pathway The liner will prevent impacted groundwater from mixing with surface water and migrating off site, thus eliminating the exposure pathway to surface water

<u>Technological Availability and Feasibility</u>
Constmction of an AquaBlok® Imer m the Ironton Canal to convey surface water across the site is not feasible due to the required 3 1 slope

6 0 SELECTION OF CORRECTIVE ACTION

After comparison to the criteria listed in Section 5 1, it was determined that the installation of a concrete liner and installation of a pipe with backfill to cap sediments would be acceptable corrective actions Piping of the canal was determined to be the best corrective action Piping of the canal was selected for the following reasons

- Piping removes exposure pathway to surface water onsite
- Current upstream piping of the canal demonstrates that it is proven and effective
- Potential for ongoing maintenance associated with concrete liner

7 0 PROJECT MANAGEMENT PLAN, DATA COLLECTION QUALITY ASSURANCE/QUALITY CONTROL PLAN, DATA MANAGEMENT PLAN

The Ironton Canal CAP will generally follow the Project Management Plan, Data Collection Quality Assurance/Quality Control Plan, and Data Management Plan found m the Second Revised Phase II RFI Work Plan (August Mack Environmental, 2004) The plans can be found in the following sections of the RFI Work Plan

- Section 5 0 – Data Collection Quality Assurance/Quality Control Plan
- Section 6 0 – Data Management Plan
- Section 8 0 – Project Management Plan

8 0 CORRECTIVE ACTION DESIGN AND CONSTRUCTION DETAILS

This section details the corrective action design and construction details for installation of a pipe in the Ironton Canal

8 1 Site Preparation

Prior to the piping of the Ironton Canal the Site must be prepared for construction All necessary equipment and materials will be mobilized and staged at the Site The current bridge/culvert will be removed Vegetation will be cleared and grubbed from the canal and disposed of at ECDC

8 2 Excavation and Disposal of Impacted Sediments

In order to install the concrete pipe at the correct elevation, it is anticipated that some impacted sediments will have to be removed It is estimated that 350 cy of impacted sediments be removed to a depth of one foot along the 930 ft of canal Impacted sediments will be transported to ECDC and disposed of as non-hazardous

8 3 Dewatering of Canal

Installation of a pipe in the Ironton Canal requires dewatering of the canal during construction

8 3 1 Surface Water

During construction, coffer dams will be built to dewater the canal Surface water will then be rerouted by pumps and hoses past the construction site and back into the canal

8 3 2 Groundwater

After surface water has been rerouted around the canal it is possible that groundwater will flow into the canal If specified by temporary water discharge permit, groundwater will be pumped through a granular activated carbon (GAC) unit The effluent from the GAC unit will then be pumped in the canal at a downstream location To minimize the groundwater influx to the dewatered canal, it is advisable to construct during the summer months when groundwater elevations are lowest The flow of groundwater into the canal has been estimated as follows, using Darci's equation (Freeze and Cherry, 1979)

$$Q = K * i * A$$

Estimated hydraulic Conductivity (K) is 0 003 ft/sec (sandy-gravel)
Estimated hydraulic gradient (i) is 4/100 (4 ft of head over 100 ft length)
Cross-Sectional Area (A) is 2520 ft^2 (630x4)

$$Q = 2 * 0\ 003 * \frac{4}{100} * 2520 = 0\ 3\,\text{cfs}$$

$$Q = 271\ 4\,\text{gallons per mm}$$

This flow is very conservative and will diminish over time as the aquifer dewaters

8 4 Pipe Design Specifications

The piping of surface water is a technically viable way to deal with impacted sediments and groundwater at the Site There are some technical considerations that are required for this alternative

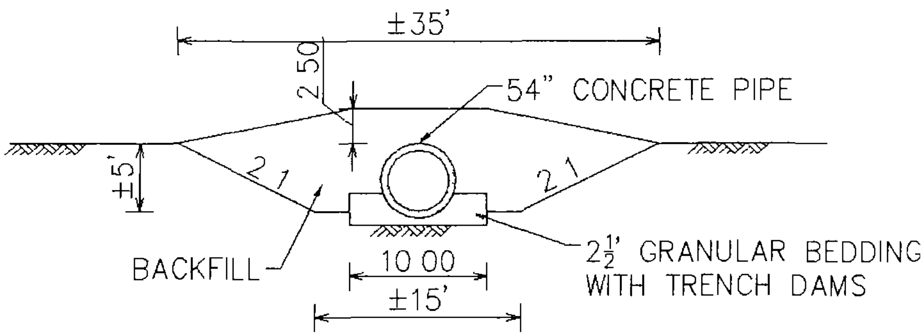

Figure 10 – Cross Section of Piping Design

A closed joint reinforced concrete pipe will be installed in the Ironton Canal The minimum diameter of the concrete pipe is 54", matching the upstream concrete pipe The slope is assumed at 0 12% If the slope of the canal is less than 0 12%, the 54" diameter pipe will not be sufficient to match the required 63 5 cfs A larger pipe diameter or box culvert could be necessary and will be decided in the design phase

Prior to the installation of the pipe, the canal sidewalls will be sloped at a 2 1 ratio and the canal bottom modified to a width of 15 ft The pipe will be placed on a 10 ft wide by 2 5 ft deep area of granular bedding with two to three trench dams (compacted clay) to prevent a groundwater preferential flow pathway along the bedding The pipe will be covered with backfill to a depth of 2 5 ft sourced from the south parcel of the Site Some mounding of backfill may be needed to provide adequate cover over the concrete pipe (see Figure 9) Backfill will be compacted to 75-80% compaction The pipe will tie into the culvert at the Union Pacific railroad on the east and the west control structure will tie into the existing pipe on the west side of the Site

8 5 Required Permits

8 5 1 Stream Alteration Permit

A stream alteration permit is not required, because the Ironton Canal is a man-made drainage facility

8 5 2 Groundwater Discharge Permit

It will be determined during the final design if a groundwater discharge permit will be needed during the construction of the pipe

9 0 SCHEDULE

Implementation of the CAP will occur following approval from DSHW It is anticipated that it will take approximately 60 days following approval of the CAP to finalize the design and obtain contractor bids Construction activities will likely take 3 weeks to complete Groundwater elevations indicate that between the months of July to October are the best times to complete construction activities DSHW will be notified prior to the start of work to allow DSHW the opportunity to be present during construction activities

10 0 CONCLUSIONS

Five corrective action alternatives were examined for the Ironton Canal to determine the best corrective action to prevent exposure to impacted sediments, migration of impacted sediments downstream, and impacted groundwater from mixing with surface water and migrating off site It was determined that two altematives would meet the criteria of protecting human health, protecting ecological health, and technical feasibility However, due to concems about the potential for ongoing maintenance, the concrete liner was discounted Therefore, it has been determined that piping and backfilling the canal is the best corrective action

11 0 REFERENCES

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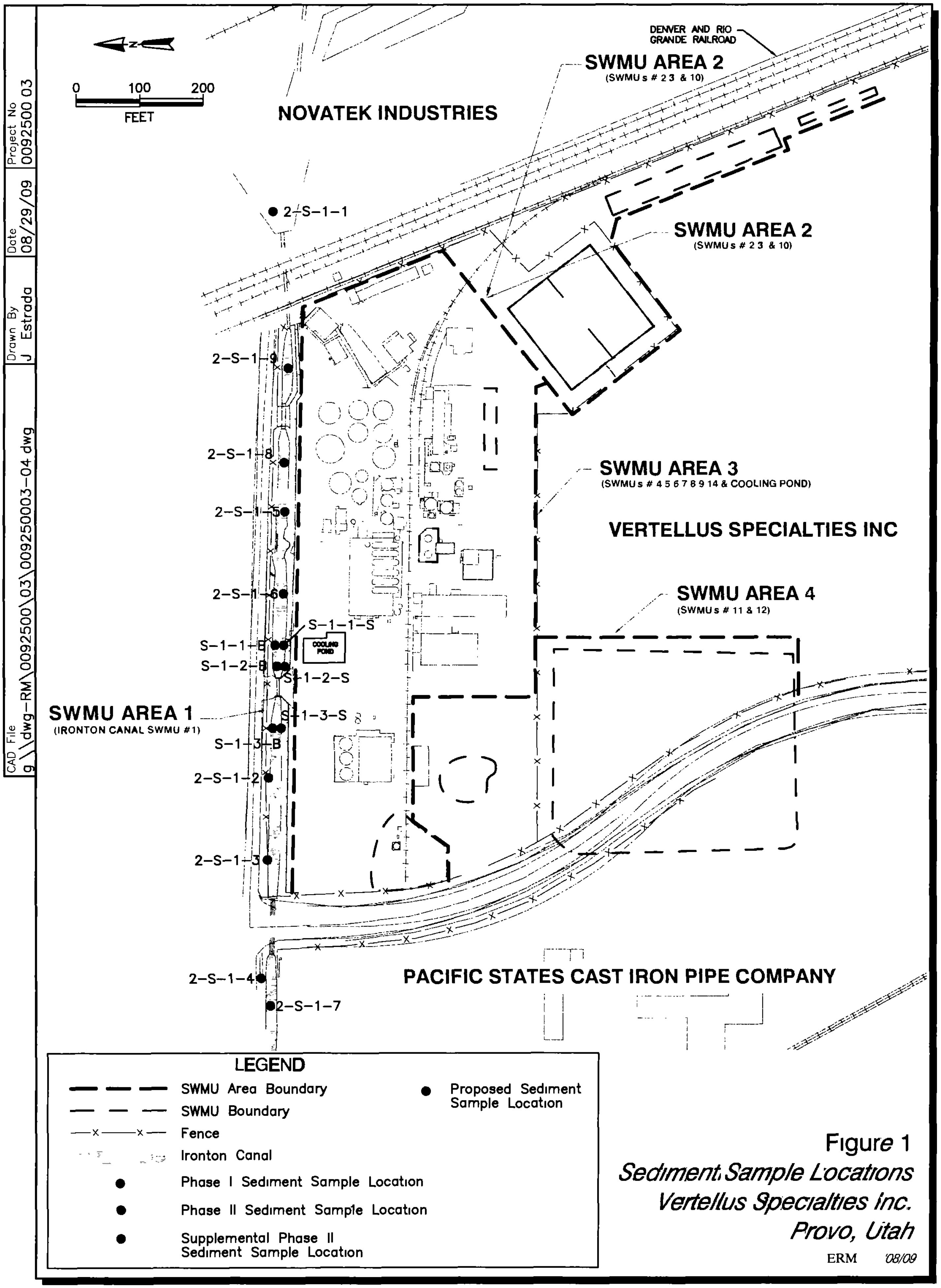

Figure 1
Sediment Sample Locations
Vertellus Specialties Inc.
Provo, Utah

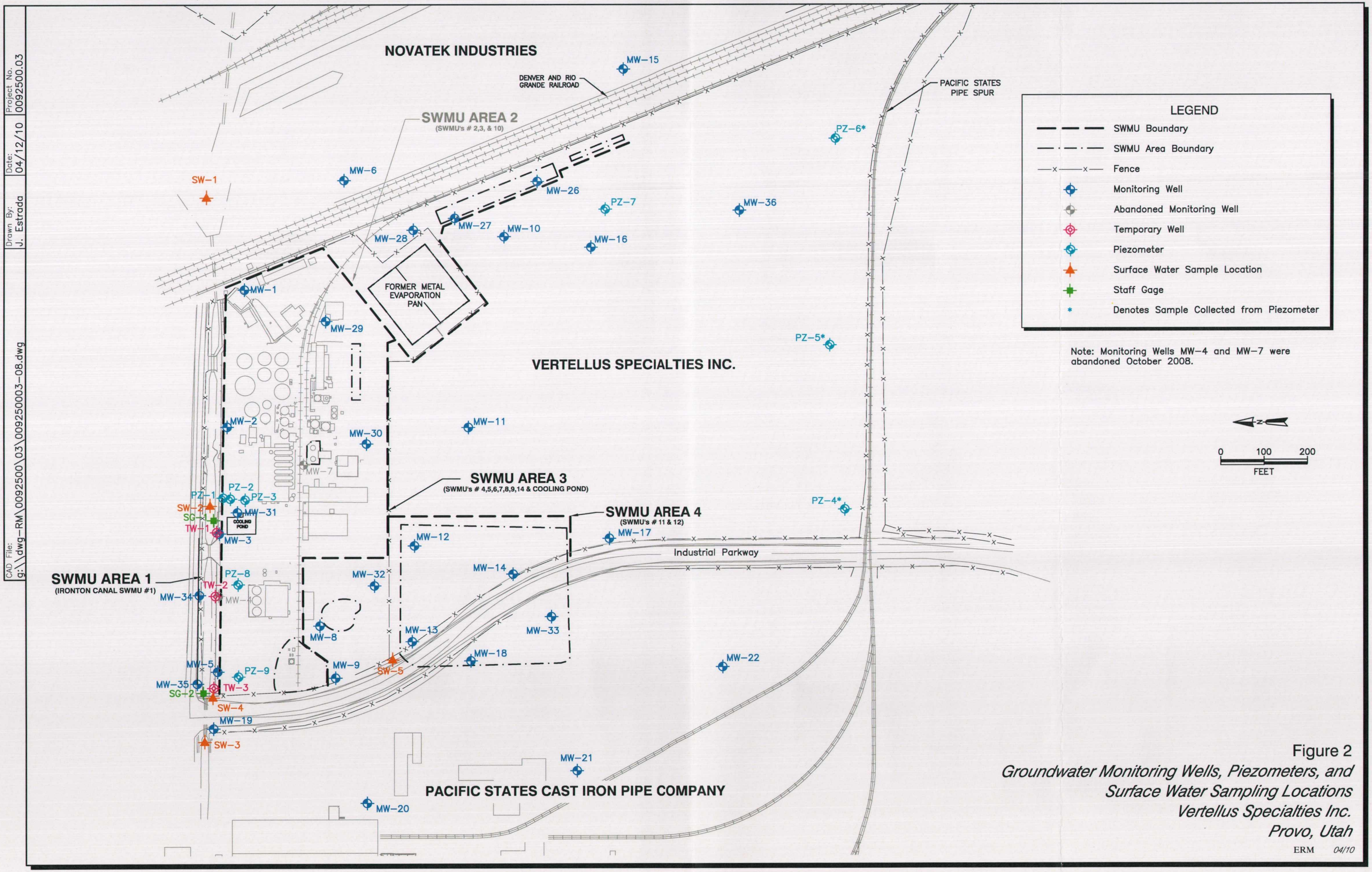

Figure 2

Groundwater Monitoring Wells, Piezometers, and Surface Water Sampling Locations

Vertellus Specialties Inc.

Provo, Utah

LEGEND

- Monitoring Well
- Abandoned Monitoring Well
- Temporary Well
- Piezometer
- Deep (Artesian) Well
- Staff Gauge
- 4489.85 Groundwater Elevation (ft. amsl)
- 4493 Groundwater Elevation Contour (ft. amsl).
- Flow Direction
- * Not Used in Contouring

Note:
1. Monitoring Wells MW-4 and MW-7 were abandoned October 2008.
2. Data taken from ERM, 2010b.

GRAPHIC SCALE

200 0 100 200 400

(IN FEET)

Figure 4
Groundwater Elevation Contours
October, 2009
Vertellus Specialties Inc.
Provo, Utah

URS
756 EAST WINCHESTER STREET
SUITE 400
SALT LAKE CITY, UTAH 84107

LEGEND

- Monitoring Well
- Abandoned Monitoring Well
- Temporary Well
- Piezometer
- Deep (Artesian) Well
- Staff Gauge
- 4489.85 Groundwater Elevation (ft. amsl)
- 4493 Groundwater Elevation Contour (ft. amsl).
- Flow Direction
- * Not Used in Contouring

Note:
1. Monitoring Wells MW-4 and MW-7 were abandoned October 2008.
2. Monitoring Well MW-6 was not found.

GRAPHIC SCALE

200 0 100 200 400

(IN FEET)

Figure 5
Groundwater Elevation Contours
January 10, 2011
Vertellus Specialties Inc.
Provo, Utah

URS

756 EAST WINCHESTER STREET
SUITE 400
SALT LAKE CITY, UTAH 84107

Table 1[1]
SWMU Area 1 Sediment Analytical Results
Vertellus Specialties
Provo, Utah

Constituent	EPA RSL Industrial Soil	Upstream of Site (Ironton Waste Water Settling Pond)				Upstream of Cooling Pond Outfall								
		2-S-1-1 Phase II				2-S-1-5 Apr 17, 2009				2-S-1-6 Apr 17, 2009			S-1-1-B Phase I	S-1-1-S Phase I
		(Top)	(Silt)	(Silt / Clay)	(Bottom)	(0 - 1 ft)	(0 - 1 ft DUP)	(2 - 3 ft)	(8 - 10 ft)	(0 - 1 ft)	(2.5 - 3 ft)	(8 - 10 ft)	(1 - 2 ft)	(2 - 4 ft)
VOCs (ug/kg)														
Acetone	610000000	5600 U	5100 U	4800 U	480 U	27.2 J	143 J	2420 J	92.8 J	119 J	4170 J	65.1 J	200 U	200 U
Benzene	5600	185 J	170 J	160 J	160 J	2.0 U	2.1 U	328 J	1.7 U	14	7510 J	1.5 U	3 U	3 U
Carbon disulfide	3000000	670 J	620 J	250 J	250 J	1.8 U	3.9 J	140 U	1.5 U	3.6 J	380 U	4.2 J	15	5 J
Chloroform	1500	730 U	670 U	640 U	63 U	1.8 U	1.9 U	140 U	1.5 U	1.5 U	370 UJ	1.4 U	8 U	5 J
Ethylbenzene	29000	510 U	470 U	450 U	44 U	1.8 U	1.9 U	2580	1.5 U	26.9	45900 J	1.4 U	8 U	10 U
Methyl ethyl ketone	190000000	3000 U	2700 U	2600 U	260 U	9.5 U	10 U	4040 J	8.1 U	14.4 J	5570 J	7.5 U	20 U	100 J
Methylene bromide	10000000	480 U	440 U	420 U	41 U	2.8 U	3.0 U	230 U	2.4 U	2.3 U	590 U	2.2 U	6 U	8 U
Methylene chloride	54000	45 U	420 U	390 U	39 U	3.5 U	3.6 U	280 U	3.0 U	2.8 U	730 UJ	2.7 U	80 U	20 U
Toluene	46000000	1500 J	1000 J	320 U	32 U	1.8 U	1.9 U	140 U	1.5 U	10.5	5250	2.9 J	20 U	20 U
Xylenes	2600000	5600 J	2660 J	700 U	69 U	5.3 U	5.6 U	934 J	4.6 U	46.4	43000	4.2 U	8 U	10 U
SVOCs (ug/kg)														
2,4-Dimethylphenol	12000000	16 U	15 J	14 U	970	790 U	860 U	820 U	68 U	650 U	4520 J	69 U	1500 J	15000 J
2-Methylphenol	31000000	18 J	26 J	8.2 U	62 J	540 U	590 U	570 U	46 U	450 U	2900 U	47 U	1500 J	15000 J
3&4-Methylphenol	3100000	71 J	57 J	200 J	140 J	820 U	890 U	850 U	70 U	908 J	4400 U	71 U	1500 J	15000 J
Acenaphthene	33000000	740	1100	3000	3900	2670	2470 J	149000	87.4 J	32100	1150000	52 U	4950	145000
Acenaphthylene	--	850	2000	2400	1800	2200 J	730 U	6110	57 U	3980	264000	58 U	1500 J	15000 J
Anthracene	170000000	1400	2700	1400	1100	6810	6670	44800	69 U	95900	860000	70 U	6440	211000
Benzenethiol	10000	ND	ND	ND	ND	2500 U	2700 U	2600 U	210 U	2100 U	13000 U	220 U	30000 U	150000 J
Benzo(a)anthracene	2100	2900	6700	710	470	16100	23900	33500	79 U	136000	402000	80 U	9570	370000
Benzo(a)pyrene	210	2800	5900	740000	430000	20000	24300	21600	69 U	128000	276000	70 U	8300	360000
Benzo(b)fluoranthene	2100	2600	5600	770	460	22000	29800	25000	90 U	142000	316000	91 U	7430	274000
Benzo(k)fluoranthene	21000	1200	2700	280 J	150 J	10000	13300	12900	98 U	36000	215000	99 U	7760	317000
Chrysene	210000	2900	6000	830	590	21300 J	36200 J	37600 J	70 UJ	197000 J	499000 J	71 UJ	12200	271000
Dibenzo(a,h)anthracene	210	570	1100	160 J	110 J	2420 J	2780	2020 J	74 U	13900	29900	75 U	1500 J	89100
Fluoranthene	22000000	4900	16000	2000	1500	25400	28200	145000	96 U	248000	1290000	97 U	23400	683000
Fluorene	22000000	1000	1900	3000	2600	3530 J	1960 J	104000 J	65 UJ	22300 J	967000 J	66 UJ	4290	119000
Indeno(1,2,3-cd)pyrene	2100	1800	3700	570	350	9530	10400	6870	82 U	49500	107000	84 U	3800	168000
Naphthalene	20000	8500	190000	2200000	1100000	1000 J	996 J	4950	51 U	13200	1440000	52 U	1500 J	15000 J
Phenanthrene	--	4000	8700	4900	4400	21500	20000	170000	79 U	168000	2310000	80 U	15000	386000
Phenol	180000000	55 J	52 J	320 J	210 J	1000 U	1100 U	1000 U	85 U	830 U	5400 U	87 U	1500 J	15000 J
Pyrene	17000000	5400	11000	1800	1500	30500	37400	126000	100 U	265000	1050000	110 U	25400	845000
Resorcinol	--	ND	ND	ND	ND	2500 U	2700 U	2600 U	210 U	2100 U	13000 U	220 U	15000 J	150000 J
Total cPAHs (BaP Equiv)	*91000* [a]	*4100*	*8600*	*740000*	*430000*	*27000*	*34000*	*30000*	*85*	*180000*	*390000*	*86*	*12000*	*530000*
Conventionals														
Cyanide (mg/kg)	20000	--	--	--	--	1.6	0.96	2.2	0.061 U	1.3	3.9	0.19	0.06	1.4

[1]From ERM, 2010a

Table 1
SWMU Area 1 Sediment Analytical Results
Vertellus Specialties
Provo, Utah

Constituent	EPA RSL Industrial Soil	Downstream of Cooling Pond Outfall					Downstream of Cooling Pond Outfall (continued)							
		S-1-2-B Phase I	S-1-2-S Phase I	S-1-3-B Phase I		S-1-3-S Phase I	2-S-1-2 Phase II					2-S-1-3 Phase II		
		(2 - 3 ft)	(4 - 6 ft)	(0 - 1 ft)	(5 - 6 ft)	(4 - 6 ft)	(0 - 0.5 ft)	(0 - 0.5 ft DUP)	(4 - 6 ft)	(4 - 6 ft DUP)	(6 - 8 ft)	(0 - 0.5 ft)	(4 - 6 ft)	(6 - 8 ft)
VOCs (ug/kg)														
Acetone	610000000	900 U	200 U	200 U	700 U	200 U	4.1 J	3.9 J	50 J	13 B	35 BJ	12	117 BJ	19 BJ
Benzene	5600	20 U	3 U	2 U	55 J	3 U	0.22 U	0.22 U	2.2 J	1.4 J	2 U	3.4 J	12 J	12 J
Carbon disulfide	3000000	83 J	4.5 J	3.5 J	20 J	4 J	0.38 J	0.37 J	6.6 J	1.3 J	1.55 J	1.7 J	0.85 J	0.85 J
Chloroform	1500	50 U	9 U	7 U	20 J	8 U	0.43 U	0.44 U	4 U	0.4 U	3.9 U	0.45 U	2.2 U	2.2 U
Ethylbenzene	29000	780 J	9 U	7 U	630 J	8 U	0.3 U	0.31 U	21 J	7.8	2.8 U	1.5 J	8.5 J	9.5 J
Methyl ethyl ketone	190000000	250 J	90 U	70 U	200 J	90 U	1.7 U	1.8 U	16 U	3.4 J	16 U	2.9 J	9 U	8.5 U
Methylene bromide	10000000	50 U	7 U	6 U	20 J	7 U	0.28 U	0.28 U	2.6 U	0.26 U	2.5 U	0.29 U	1.4 U	1.4 U
Methylene chloride	54000	90 U	20 U	20 U	70 U	20 U	1.9 J	2.8 J	2.5 U	0.92 J	2.4 U	0.49 J	1.4 U	1.3 U
Toluene	46000000	90 U	20 U	20 U	360 J	20 U	0.32 J	0.4 J	2.9 J	0.57 BJ	2.5 BJ	1 J	2.8 BJ	2.6 BJ
Xylenes	2600000	325 J	9 U	7 U	1270 J	8 U	0.47 U	0.49 U	4.4 U	1.38 J	4.3 U	1.15 J	4.5 J	2.7 J
SVOCs (ug/kg)														
2,4-Dimethylphenol	12000000	100000 J	150 J	1000 J	10000 J	500 J	9.4 U	9.6 U	8.8 U	4350 J	33 J	9.8 U	9.5 U	9.3 U
2-Methylphenol	31000000	100000 J	300 U	1000 J	10000 J	500 J	5.5 U	5.7 U	5.2 U	15 J	29 J	58 U	5.6 U	5.5 U
3&4-Methylphenol	3100000	100000 J	150 J	1000 J	10000 J	500 J	4.7 U	7.3 J	4.4 U	13 J	93 J	5 U	4.8 U	4.7 U
Acenaphthene	33000000	743000	150 J	1000 J	82500	1020	5.5 U	19 J	2600 J	5400 J	2200000	13 J	2800 J	2750 J
Acenaphthylene	--	100000 J	150 J	1000 J	10000 J	500 J	4.5 U	4.6 U	4.2 U	4.2 U	590	5 J	4.6 U	4.5 U
Anthracene	170000000	548000	150 J	2640	25700	1020	6.3 U	6.4 U	5.9 U	5.9 U	3800	17 J	6.4 U	6.2 U
Benzenethiol	10000	1000000 J	1500 J	10000 J	100000 J	5000 J	ND	ND	ND	ND	47 J	ND	ND	ND
Benzo(a)anthracene	2100	221000	429	6600	10000 J	1680	6.7 U	6.9 U	6.3 U	6.2 U	11000	84 J	6.8 U	6.6 U
Benzo(a)pyrene	210	100000 J	660	6300	10000 J	1800	7.3 U	7.5 U	6.8 U	6.8 U	12000	110 J	7.4 U	7.2 U
Benzo(b)fluoranthene	2100	100000 J	561	4290	10000 J	1060	6.2 U	6.4 U	5.8 U	5.8 U	13000	120 J	6.3 U	6.2 U
Benzo(k)fluoranthene	21000	100000 J	594	7260	10000 J	2150	7.7 U	7.8 U	7.2 U	7.1 U	4200	54 J	7.8 U	7.6 U
Chrysene	210000	254000	825	9240	10000 J	2280	5.3 U	5.5 U	5 U	5 U	14000	100 J	5.4 U	5.3 U
Dibenzo(a,h)anthracene	210	100000 J	150 J	1000 J	10000 J	500 J	11 U	12 U	11 U	11 U	2000	22 J	12 U	11 U
Fluoranthene	22000000	891000	957	15200	66000	4620	5.7 U	5.8 U	5.3 U	5.3 U	18000	110 J	5.8 U	5.6 U
Fluorene	22000000	644000	150 J	1000 J	56800	500 J	6.54 U	6.6 U	61 U	6.1 U	1300	7.9 J	6.6 U	6.4 U
Indeno(1,2,3-cd)pyrene	2100	100000 J	495	2640	10000 J	500 J	14 U	14 U	13 U	13 U	7700	76 J	14 U	14 U
Naphthalene	20000	100000 J	150 J	1000 J	149000	500 J	4.8 U	11 J	4.5 U	18 J	1200	100 J	4.9 U	4.8 U
Phenanthrene	--	1430000	462	8250	126000	1950	7.1 U	7.2 U	6.6 U	6.6 U	14000	76 J	7.2 U	7 U
Phenol	180000000	100000 J	150 J	1000 J	10000 J	500 J	7.2 J	13 J	5.8 J	19 J	62 J	10 J	8.5 J	6.2 J
Pyrene	17000000	769000	990	17200	51200	4650	5.3 U	5.4 U	5 U	4.9 U	25000	120 J	5.4 U	5.3 U
Resorcinol	--	1000000 J	3000 U	10000 J	100000 J	5000 J	ND	ND	ND	ND	ND	ND	ND	ND
Total cPAHs (BaP Equiv)	*91000 [a]*	*240000*	*970*	*8700*	*23000*	*2600*	*11*	*11*	*10*	*10*	*17000*	*160*	*11*	*10*
Conventionals														
Cyanide (mg/kg)	20000	0.07 U	0.33	0.13	0.05 U	0.27	--	--	--	--	--	--	--	--

[1]From ERM, 2010a

Table 1
SWMU Area 1 Sediment Analytical Results
Vertellus Specialties
Provo, Utah

Constituent	EPA RSL Industrial Soil	Downstream of Site					
		2-S-1-4 Phase II			2-S-1-7 Apr 15, 2009		
		(0 - 0.5 ft)	(2 - 4 ft)	(6 - 8 ft)	(0.5 - 2 ft)	(5 - 6 ft)	(8 - 10 ft)
VOCs (ug/kg)							
Acetone	610000000	19	19 J	7 B	118 J	44.9 J	61 J
Benzene	5600	2.2 J	1.6 J	0.2 U	5.9	1.8 U	2.7 J
Carbon disulfide	3000000	1.8 J	3.6 J	0.43 J	8.1 J	1.7 U	2.8 J
Chloroform	1500	0.43 U	2.1 U	0.41 U	1.4 U	1.6 U	1.6 U
Ethylbenzene	29000	21	3.4 J	1.2 J	12.6	1.6 U	1.6 U
Methyl ethyl ketone	190000000	4.3 J	8.5 U	1.7 U	16.7 J	8.8 U	8.5 U
Methylene bromide	10000000	0.28 U	1.4 U	0.26 U	2.2 U	2.6 U	2.5 U
Methylene chloride	54000	2.2 J	2.4 J	1.3 J	3 J	3.2 U	3.1 U
Toluene	46000000	1.4 J	1.3 J	0.38 BJ	3.8 J	1.6 U	4.2 J
Xylenes	2600000	7.3 J	2.3 U	0.5 J	11.7 J	4.9 U	4.8 U
SVOCs (ug/kg)							
2,4-Dimethylphenol	12000000	9.3 U	9.1 U	1600	2200 U	71 U	71 U
2-Methylphenol	31000000	6.5 J	5.4 U	2400	1500 U	49 U	49 U
3&4-Methylphenol	3100000	9 J	5.9 J	3100	2300 U	73 U	73 U
Acenaphthene	33000000	5.5 U	120000 J	190000 J	401000	54 U	54 U
Acenaphthylene	--	4.5 U	17 J	4.3 U	10500	60 U	60 U
Anthracene	170000000	6.3 U	81 J	17 J	261000	73 U	73 U
Benzenethiol	10000	ND	ND	ND	6900 U	220 U	220 U
Benzo(a)anthracene	2100	6.7 U	190 J	22 J	104000	83 U	83 U
Benzo(a)pyrene	210	7.3 U	220	18 J	70400	73 U	73 U
Benzo(b)fluoranthene	2100	6.2 U	240	19 J	78400	94 U	94 U
Benzo(k)fluoranthene	21000	7.6 U	89 J	8.3 J	40200	100 U	100 U
Chrysene	210000	5.3 U	220	21 J	124000	73 U	73 U
Dibenzo(a,h)anthracene	210	11 U	42 J	11 U	7940	78 U	78 U
Fluoranthene	22000000	5.7 U	450	40 J	365000	100 U	100 U
Fluorene	22000000	6.5 U	81 J	44 J	288000	68 U	68 U
Indeno(1,2,3-cd)pyrene	2100	14 U	140 J	13 U	24000	87 U	87 U
Naphthalene	20000	6.6 J	33 J	1400	22400	54 U	54 U
Phenanthrene	--	7 U	500	65 J	388000	83 U	83 U
Phenol	180000000	20 J	12 J	4000	2800 U	90 U	90 U
Pyrene	17000000	5.3 U	410	40 J	331000	110 U	110 U
Resorcinol	--	ND	ND	ND	6900 U	220 U	220 U
Total cPAHs (BaP Equiv)	*91000* [a]	*11*	*320*	*28*	*100000*	*89*	*89*
Conventionals							
Cyanide (mg/kg)	20000	--	--	--	1	0.064 U	0.19

[1]From ERM, 2010a

Notes:

[a] Value shown is the total carcinogenic polynuclear aromatic hydrocarbon (cPAH) risk-based remediation goal RBRG for the Ironton site, as Benzo(a)pyrene equivalents (BaP Equiv)

U = compound was not detected above the reporting limit shown

J = estimated value

B = compound was detected above the method detection limit but below the practical quantitation limit; value is approximate

ND = Not retected, repoting limit not provided

EPA RSL = EPA Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites

Blue shading Blue shading denotes detected concentration which exceeds EPA RSL for industrial soil or Ironton site total cPAH risk-based remediation goal

Table 2[1]
Surface Water Analytical Results
Vertellus Specialties
Provo, Utah

Constituent	UT WQS Human Health (Consumption)	SW-1			SW-2										
		Oct 1, 2004			Oct 1, 2004			Apr 11, 2005			Apr 17, 2009	Jul 14, 2009	Oct 1, 2009	Jan 28, 2010	
		SW-1A	SW-1B	SW-1C	SW-2A	SW-2B	SW-2C	SW-2A	SW-2B	SW-2C	SW-2	SW-2	SW-2	SW-2	SW-2 DUP
VOCs (ug/L)															
Acetone	--	4.49 U	4.49 U	4.49 U	4.49 U	4.49 U	4.49 U	2.93 U	2.93 U	2.93 U	2.6 U	2.6 U	4.7 U	4.7 U	4.7 U
Benzene	51	0.127 U	0.127 U	0.127 U	0.127 U	0.127 U	0.127 U	0.142 U	0.142 U	0.142 U	0.46 U	0.46 U	0.5 U	0.50 U	0.50 U
Carbon disulfide	--	0.219 U	0.219 U	0.219 U	0.219 U	0.219 U	0.219 U	1.3	0.51 J	0.130 U	0.51 U	0.51 U	0.53 U	0.53 U	0.53 U
Chloroform	470	0.151 U	0.151 U	0.151 U	0.151 U	0.151 U	0.151 U	0.0925 J	0.0925 J	0.0925 J	0.54 U	0.54 U	0.64 U	0.64 U	0.64 U
Ethylbenzene	2100	0.0526 U	0.0526 U	0.0526 U	0.0526 U	0.0526 U	0.0526 U	0.142 U	0.142 U	0.142 U	0.45 U	0.45 U	0.55 U	0.55 U	0.55 U
Methyl ethyl ketone	--	1.95 U	1.95 U	1.95 U	1.95 U	1.95 U	1.95 U	2.44 U	2.44 U	2.44 U	2.5 U	2.5 U	3.9 U	3.9 U	3.9 U
Methylene bromide	--	0.0551 U	0.0551 U	0.0551 U	0.0551 U	0.0551 U	0.0551 U	0.289 U	0.289 U	0.289 U	0.41 U	0.41 U	0.65 U	0.65 U	0.65 U
Methylene chloride	590	0.123 U	0.123 U	0.123 U	0.123 U	0.123 U	0.123 U	0.231 U	1.3	0.231 U	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U
Toluene	15000	0.0574 U	0.0574 U	0.10 J	0.13 J	0.11 J	0.11 J	0.163 U	0.163 U	0.163 U	0.48 U	0.48 U	0.43 U	0.43 U	0.43 U
Xylene (total)	10000	0.109 U	0.109 U	0.109 U	0.109 U	0.109 U	0.109 U	0.246 U	0.246 U	0.246 U	1.4 U	1.4 U	1.7 U	1.7 U	1.7 U
SVOCs (ug/L)															
2,4-Dimethylphenol	850	1.900 U	1.900 U	1.900 U	1.900 U	1.800 U	1.8100 U	0.862 U	0.862 U	0.87 U	2.6 U	1.3 U	1.3 U	1.3 U	1.3 U
2-Methylphenol	--	0.065 U	0.065 U	0.065 U	0.065 U	0.064 U	0.0633 U	0.103 U	0.103 U	0.10 U	1.2 U	0.83 U	0.86 U	0.83 U	0.83 U
3&4-Methylphenol	--	0.053 U	0.053 U	0.053 U	0.053 U	0.052 U	0.0519 U	0.102 U	0.37 J	0.10 U	1.1 U	1.6 U	1.6 U	1.6 U	1.6 U
Acenaphthene	990	0.082 U	0.082 U	0.082 U	0.082 U	0.081 U	0.080 U	0.0781 U	0.0781 U	0.079 U	1.4 U	1.6 U	0.043 U	0.042 U	0.042 U
Acenaphthylene	--	0.390 U	0.390 U	0.390 U	0.390 U	0.380 U	0.380 U	0.0599 U	0.0599 U	0.061 U	1.6 U	1.2 U	0.074 U	0.072 U	0.072 U
Anthracene	--	0.092 U	0.092 U	0.092 U	0.092 U	0.091 U	0.0899 U	0.365 U	0.365 U	0.37 U	1.8 U	1.1 U	0.055 U	0.054 U	0.054 U
Benzenethiol	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.9 U	1.3 U	1.3 U	1.3 U	1.3 U
Benzo(a)anthracene	0.018	0.047 J	0.047 J	0.047 J	0.047 J	0.0465 J	0.0919 U	0.0745 U	0.95 J	0.075 U	1.4 U	1.1 U	0.042 U	0.041 U	0.041 U
Benzo(a)pyrene	0.018	0.0445 J	0.0445 J	0.0445 J	0.0445 J	0.044 J	0.0434 J	0.0275 J	1.2 J	0.028 J	1.5 U	1.1 U	0.066 U	0.064 U	0.064 U
Benzo(b)fluoranthene	0.018	0.080 U	0.080 U	0.080 U	0.080 U	0.079 U	0.0782 U	0.0736 U	1.2 J	0.074 U	1.5 U	0.87 U	0.062 U	0.060 U	0.060 U
Benzo(k)fluoranthene	0.018	0.140 U	0.140 U	0.140 U	0.140 U	0.140 U	0.140 U	0.0698 U	0.55 J	0.071 U	1.6 U	1.1 U	0.057 U	0.056 U	0.056 U
Chrysene	0.018	0.075 U	0.075 U	0.075 U	0.075 U	0.074 U	0.0736 U	0.100 U	1.2 J	0.10 U	1.3 U	0.98 U	0.046 U	0.044 U	0.044 U
Dibenzo(a,h)anthracene	0.018	0.08 J	0.08 J	0.08 J	0.08 J	0.08 J	0.08 J	0.2625 J	0.2625 J	0.265 J	1.2 U	1.6 U	0.061 U	0.060 U	0.060 U
Fluoranthene	140	0.058 U	0.058 U	0.058 U	0.058 U	0.057 U	0.0569 U	0.0748 U	1.9 J	0.076 U	1.6 U	0.97 U	0.047 U	0.046 U	0.046 U
Fluorene	5300	0.062 U	0.062 U	0.062 U	0.062 U	0.061 U	0.0607 U	0.117 U	0.117 U	0.12 U	2.0 U	1.3 U	0.066 U	0.064 U	0.064 U
Indeno(1,2,3-cd)pyrene	0.018	0.085 J	0.085 J	0.085 J	0.085 J	0.085 J	0.0835 J	0.063 J	1.0 J	0.065 J	2.4 U	1.8 U	0.062 U	0.061 U	0.061 U
Naphthalene	--	0.087 U	0.087 U	0.087 U	0.220 J	0.086 U	0.0851 U	0.38 J	0.65 J	0.065 U	1.4 U	1.1 U	0.26	0.075 U	0.075 U
Phenanthrene	--	0.089 U	0.089 U	0.089 U	0.089 U	0.087 U	0.0866 U	0.09 U	1.2 J	0.091 U	1.6 U	0.97 U	0.077 U	0.075 U	0.075 U
Phenol	1700000	0.170 U	0.170 U	0.170 U	0.170 U	0.170 U	0.1670 U	0.21 J	0.56 J	0.092 U	0.52 U	0.75 U	0.78 U	0.75 U	0.75 U
Pyrene	4000	0.093 U	0.093 U	0.093 U	0.093 U	0.092 U	0.0910 U	0.0702 U	1.9 J	0.071 U	1.1 U	1.7 U	0.081 U	0.079 U	0.079 U
Conventionals															
Cyanide, Total (mg/L)	0.14	0.00232 U	0.003 B	0.00232 U	0.00232 U	0.00232 U	0.00232 U	0.00141 U	0.00141 U	0.00141 U	0.0054 B	0.0013 U	0.004 U	0.0040 U	0.0040 U

[1]From ERM, 2010a

Table 2
Surface Water Analytical Results
Vertellus Specialties
Provo, Utah

Constituent	UT WQS Human Health (Consumption)	SW-3										
		Oct 1, 2004			Apr 11, 2005			Apr 17, 2009	Jul 14, 2009		Oct 1, 2009		Jan 28, 2010
		SW-3A	SW-3B	SW-3C	SW-3A	SW-3B	SB-3C	SW-3	SW-3	SW-3 DUP	SW-3	SW-3 DUP	SW-3
VOCs (ug/L)													
Acetone	--	4.49 U	4.49 U	4.49 U	2.93 U	3.5 J	2.93 U	2.7 J	2.6 U	2.6 U	4.7 U	4.7 U	4.7 U
Benzene	51	0.127 U	0.127 U	0.127 U	0.142 U	0.142 U	0.142 U	0.46 UJ	0.46 U	0.46 U	0.5 U	0.5 U	0.50 U
Carbon disulfide	--	0.219 U	0.219 U	0.219 U	0.130 U	0.130 U	0.130 U	0.51 U	0.51 U	0.51 U	0.53 U	0.53 U	0.53 U
Chloroform	470	0.151 U	0.151 U	0.151 U	0.0925 J	0.0925 J	0.0925 J	0.54 UJ	0.54 U	0.54 U	0.64 U	0.64 U	0.64 U
Ethylbenzene	2100	0.0526 U	0.0526 U	0.0526 U	0.142 U	0.142 U	0.142 U	0.45 UJ	0.45 U	0.45 U	0.55 U	0.55 U	0.55 U
Methyl ethyl ketone	--	1.95 U	1.95 U	1.95 U	2.44 U	2.44 U	2.44 U	2.5 U	2.5 U	2.5 U	3.9 U	3.9 U	3.9 U
Methylene bromide	--	0.0551 U	0.0551 U	0.0551 U	0.289 U	0.289 U	0.289 U	0.41 UJ	0.41 U	0.41 U	0.65 U	0.65 U	0.65 U
Methylene chloride	590	0.123 U	0.123 U	0.123 U	0.231 U	0.231 U	0.231 U	0.41 UJ	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U
Toluene	15000	0.10 J	0.11 J	0.14 J	0.163 U	0.163 U	0.163 U	0.48 U	0.48 U	0.48 U	0.43 U	0.43 U	0.43 U
Xylene (total)	10000	0.109 U	0.109 U	0.109 U	0.246 U	0.246 U	0.246 U	1.4 UJ	1.4 U	1.4 U	1.7 U	1.7 U	1.7 U
SVOCs (ug/L)													
2,4-Dimethylphenol	850	1.900 U	1.800 U	1.800 U	0.88 U	0.88 U	0.88 U	2.6 U	1.3 U	1.3 U	1.3 U	1.3 U	10.4
2-Methylphenol	--	0.065 U	0.065 U	0.065 U	0.11 U	0.11 U	0.11 U	1.2 U	0.83 U	0.83 U	0.83 U	0.85 U	13.6
3&4-Methylphenol	--	0.053 U	0.053 U	0.053 U	0.10 U	0.10 U	0.10 U	1.1 U	1.6 U	1.6 U	1.6 U	1.6 U	3.2 J
Acenaphthene	990	0.082 U	0.082 U	0.082 U	0.080 U	0.080 U	0.080 U	1.4 U	1.6 U	1.6 U	0.042 U	0.042 U	0.042 U
Acenaphthylene	--	0.390 U	0.390 U	0.390 U	0.061 U	0.061 U	0.061 U	1.6 U	1.2 U	1.2 U	0.072 U	0.073 U	0.072 U
Anthracene	--	0.092 U	0.092 U	0.092 U	0.37 U	0.37 U	0.37 U	1.7 U	1.1 U	1.1 U	0.054 U	0.054 U	0.054 U
Benzenethiol	--	ND	ND	ND	ND	ND	ND	9.8 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U
Benzo(a)anthracene	0.018	0.047 J	0.047 J	0.047 J	0.076 U	0.076 U	0.31 J	1.4 U	1.1 U	1.1 U	0.041 U	0.042 U	0.041 U
Benzo(a)pyrene	0.018	0.0445 J	0.0445 J	0.0445 J	0.028 J	0.028 J	0.028 J	1.5 U	1.1 U	1.1 U	0.064 U	0.065 U	0.064 U
Benzo(b)fluoranthene	0.018	0.080 U	0.080 U	0.080 U	0.075 U	0.075 U	0.075 U	1.5 U	0.87 U	0.87 U	0.06 U	0.061 U	0.060 U
Benzo(k)fluoranthene	0.018	0.140 U	0.140 U	0.140 U	0.071 U	0.071 U	0.071 U	1.6 U	1.1 U	1.1 U	0.056 U	0.057 U	0.056 U
Chrysene	0.018	0.075 U	0.075 U	0.075 U	0.10 U	0.10 U	0.37 J	1.3 U	0.98 U	0.98 U	0.044 U	0.045 U	0.044 U
Dibenzo(a,h)anthracene	0.018	0.08 J	0.08 J	0.08 J	0.27 J	0.27 J	0.27 J	1.2 U	1.6 U	1.6 U	0.06 U	0.06 U	0.060 U
Fluoranthene	140	0.058 U	0.058 U	0.058 U	0.076 U	0.076 U	0.56 J	1.6 U	0.97 U	0.97 U	0.046 U	0.046 U	0.064 J
Fluorene	5300	0.062 U	0.062 U	0.062 U	0.12 U	0.12 U	0.12 U	2.0 U	1.3 U	1.3 U	0.064 U	0.065 U	0.25
Indeno(1,2,3-cd)pyrene	0.018	0.085 J	0.085 J	0.085 J	0.065 J	0.065 J	0.065 J	2.4 U	1.8 U	1.8 U	0.061 U	0.061 U	0.061 U
Naphthalene	--	0.087 U	0.087 U	0.087 U	0.066 U	0.30 J	0.37 J	1.4 U	1.1 U	1.1 U	0.075 U	0.076 U	21.8
Phenanthrene	--	0.088 U	0.088 U	0.088 U	0.092 U	0.092 U	0.39 J	1.5 U	0.97 U	0.97 U	0.075 U	0.076 U	0.32
Phenol	1700000	0.170 U	0.170 U	0.170 U	0.093 U	0.20 J	0.093 U	0.51 U	0.75 U	0.75 U	0.75 U	0.76 U	4.9 J
Pyrene	4000	0.093 U	0.093 U	0.093 U	0.072 U	0.072 U	0.56 J	1.1 U	1.7 U	1.7 U	0.079 U	0.08 U	0.079 U
Conventionals													
Cyanide, Total (mg/L)	0.14	0.00232 U	0.0024 B	0.0032 B	0.00141 U	0.00141 U	0.00141 U	0.0039 B	0.0016 B	0.0022 B	0.004 U	--	0.0040 U

[1]From ERM, 2010a

Table 2
Surface Water Analytical Results
Vertellus Specialties
Provo, Utah

Constituent	UT WQS Human Health (Consumption)	SW-4						SW-5				
		Apr 11, 2005			Apr 17, 2009	Oct 1, 2009	Jan 28, 2010	Apr 11, 2005			Apr 17, 2009	Jan 28, 2010
		SB-4A	SW-4B	SW-4C	SW-4	SW-4	SW-4	SW-5A	SW-5B	SW-5C	SW-5	SW-5
VOCs (ug/L)												
Acetone	--	4.3 J	2.93 U	2.93 U	4.3 J	4.7 U	4.7 U	2.93 U	2.93 U	2.93 U	4.9 J	4.7 U
Benzene	51	0.20 J	0.18 J	0.16 J	3.4 J	0.5 U	17.8	0.142 U	0.142 U	0.142 U	0.46 U	0.50 U
Carbon disulfide	--	0.24 J	0.130 U	0.130 U	0.51 U	0.53 U	0.53 U	0.130 U	0.130 U	0.130 U	0.51 U	0.53 U
Chloroform	470	0.0925 J	0.0925 J	0.0925 J	0.54 UJ	0.64 U	0.64 U	0.0925 J	0.0925 J	0.0925 J	0.54 U	0.64 U
Ethylbenzene	2100	0.142 U	0.142 U	0.142 U	0.45 UJ	0.55 U	1.0 J	0.142 U	0.142 U	0.142 U	0.45 U	0.55 U
Methyl ethyl ketone	--	2.44 U	2.44 U	2.44 U	2.5 U	3.9 U	3.9 U	2.44 U	2.44 U	2.44 U	2.5 U	3.9 U
Methylene bromide	--	0.289 U	0.289 U	0.289 U	0.41 UJ	0.65 U	0.65 U	0.289 U	0.289 U	0.289 U	0.41 U	0.65 U
Methylene chloride	590	0.231 U	0.231 U	0.27 J	0.41 UJ	0.41 U	0.41 U	0.231 U	0.231 U	0.231 U	0.41 U	0.41 U
Toluene	15000	0.163 U	0.163 U	0.163 U	4.2	0.43 U	4.3	0.163 U	0.163 U	0.163 U	0.48 U	0.43 U
Xylene (total)	10000	0.246 U	0.246 U	0.246 U	1.4 UJ	1.7 U	1.8 J	0.246 U	0.246 U	0.246 U	1.4 U	1.7 U
SVOCs (ug/L)												
2,4-Dimethylphenol	850	0.87 U	0.862 U	0.862 U	2.6 U	1.3 U	9.2	0.862 U	0.862 U	0.862 U	2.6 U	1.3 U
2-Methylphenol	--	0.10 U	0.103 U	0.103 U	1.2 U	0.85 U	10.3	0.103 U	0.103 U	0.103 U	1.2 U	0.83 U
3&4-Methylphenol	--	0.10 U	0.102 U	0.102 U	1.1 U	1.6 U	384	0.102 U	0.102 U	0.102 U	1.1 U	1.6 U
Acenaphthene	990	0.079 U	0.0781 U	0.0781 U	1.4 U	0.042 U	0.042 U	0.15 J	0.0781 U	0.0781 U	1.5 U	0.042 U
Acenaphthylene	--	0.061 U	0.0599 U	0.0599 U	1.6 U	0.073 U	0.072 U	0.0599 U	0.0599 U	0.0599 U	1.6 U	0.072 U
Anthracene	--	0.37 U	0.365 U	0.365 U	1.8 U	0.055 U	0.054 U	0.365 U	0.365 U	0.365 U	1.8 U	0.063 J
Benzenethiol	--	ND	ND	ND	9.9 U	1.3 U	1.3 U	ND	ND	ND	10 U	1.3 U
Benzo(a)anthracene	0.018	0.075 U	0.0745 U	0.0745 U	1.4 U	0.042 U	0.041 U	0.0745 U	0.0745 U	0.0745 U	1.4 U	0.37
Benzo(a)pyrene	0.018	0.028 J	0.0275 J	0.0275 J	1.5 U	0.066 U	0.064 U	0.0275 J	0.0275 J	0.0275 J	1.6 U	0.48
Benzo(b)fluoranthene	0.018	0.074 U	0.0736 U	0.0736 U	1.5 U	0.062 U	0.060 U	0.0736 U	0.0736 U	0.0736 U	1.5 U	0.71
Benzo(k)fluoranthene	0.018	0.071 U	0.0698 U	0.0698 U	1.6 U	0.057 U	0.056 U	0.0698 U	0.0698 U	0.0698 U	1.6 U	0.23
Chrysene	0.018	0.10 U	0.100 U	0.100 U	1.3 U	0.045 U	0.044 U	0.100 U	0.100 U	0.100 U	1.3 U	0.41
Dibenzo(a,h)anthracene	0.018	0.265 J	0.2625 J	0.2625 J	1.2 U	0.061 U	0.060 U	0.2625 J	0.2625 J	0.2625 J	1.3 U	0.060 U
Fluoranthene	140	0.076 U	0.0748 U	0.0748 U	1.6 U	0.047 U	0.045	0.0748 U	0.0748 U	0.0748 U	1.6 U	0.63
Fluorene	5300	0.12 U	0.117 U	0.117 U	2.0 U	0.066 U	0.064 U	0.117 U	0.117 U	0.117 U	2.1 U	0.064 U
Indeno(1,2,3-cd)pyrene	0.018	0.065 J	0.063 J	0.063 J	2.4 U	0.061 U	0.062 U	0.063 J	0.063 J	0.063 J	2.4 U	0.37
Naphthalene	--	0.065 U	0.18 J	0.42 J	2.9 J	0.077U	1.3	0.50 J	0.23 J	0.42 J	1.5 U	0.075 U
Phenanthrene	--	0.16 J	0.16 J	0.0900 U	1.6 U	0.077 U	0.075 U	0.16 J	0.0900 U	0.0900 U	1.6 U	0.17 J
Phenol	1700000	0.43 J	0.44 J	0.50 J	0.52 U	0.77 U	1.7 J	0.51 J	0.46 J	0.44 J	0.52 U	0.75 U
Pyrene	4000	0.071 U	0.0702 U	0.0702 U	1.1 U	0.081 U	0.079 U	0.0702 U	0.0702 U	0.0702 U	1.1 U	0.69
Conventionals												
Cyanide, Total (mg/L)	0.14	0.00141 U	0.00141 U	0.00141 U	0.0082 B	0.004 U	0.029	0.00141 U	0.00141 U	0.0045 B	0.0071 B	0.0074 B

[1]From ERM, 2010a

Notes:

U = compound was not detected above the reporting limit shown
J = estimated value
B = compound was detected above the method detection limit but below the practical quantitation limit; value is approximate
ND = Not retected, repoting limit not provided
NR = Not reported; compound does not recover from water-matrix samples
UT WQS = Utah Water Quality Standard (UT WQS) for human health criteria for consumption of organism only, Designated Use Classes 3A, 3B, 3C, 3D (UAC R317-2 Table 2.14.6)
Green Shading Green shading denotes non-detected result where reporting limit exceeds UT WQS
Blue shading Blue shading denotes detected concentration which exceeds UT WQS

Table 3

Groundwater – Surface Water Interaction at SG-1
Vertellus Specialties
Provo, Utah

Date	SG-1	TW-1		MW-3		MW-31	
	Water Surface		Delta		Delta		Delta
2/2/2009	4494.14	4494.38	0.24	4494.77	0.63	4495.54	1.4
4/8/2009	4494.12	4494.32	0.2	4494.68	0.56	4495.49	1.37
6/11/2009	4494.56	4494.48	-0.08	4494.7	0.14	4495.24	0.68
6/18/2009	4494.68	4494.6	-0.08	4494.77	0.09	4494.96	0.28
7/14/2009	4494.42	4494.42	0	4494.58	0.16	4494.72	0.3
8/14/2009	4494.78	4494.44	-0.34	4494.65	-0.13	4494.55	-0.23
10/1/2009	4494.6	4494.52	-0.08	4494.51	-0.09	4494.41	-0.19
12/17/2009	4494.82	4494.83	0.01	4495.06	0.24	4495.1	0.28
1/28/2010	4493.84	4494.38	0.54	4494.65	0.81	4494.94	1.1
1/10/2011	4494.48	4494.65	0.17	4494.89	0.41	4495.29	0.81

Table 4

Groundwater – Surface Water Interaction at SG-2
Vertellus Specialties
Provo, Utah

Date	SG-2	MW-35		TW-3		MW-5		PZ-9	
	Water Surface		Delta		Delta		Delta		Delta
2/2/2009	4493.64	4494.05	0.41	4493.9	0.26	4494.08	0.44	4494.68	1.04
4/8/2009	4493.92	4494.09	0.17	4494.01	0.09	4494.15	0.23	4494.58	0.66
6/11/2009	4494.08	4494.29	0.21	4494.04	-0.04	4494.21	0.13	4494.39	0.31
6/18/2009	4494.34	4494.32	-0.02	4492.37	-1.97	4494.49	0.15	4494.33	-0.01
7/14/2009	4494.32	4493.99	-0.33	4494.09	-0.23	4494	-0.32	4494.2	-0.12
8/14/2009	4494.66	4494.51	-0.15	4494.62	-0.04	4494.7	0.04	4493.79	-0.87
10/1/2009	4494.5	4494.33	-0.17	4494.47	-0.03	4494.54	0.04	4493.71	-0.79
12/17/2009	4494.78	4494.9	0.12	4494.74	-0.04	4494.95	0.17	4495.18	0.4
1/28/2010	4493.98	4494.21	0.23	4493.92	-0.06	4494.29	0.31	4495	1.02
1/10/2011	4494.45	4494.46	0.01	4494.12	-0.33	4494.38	-0.07	4494.24	-0.21