REPORT

1,4-Dioxane Alternative Source Evaluation Report

Landsburg Mine Site

Submitted to:

Washington Department of Ecology

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1.0 INTRODUCTION

The Landsburg Mine Site (Site) is a Washington State Model Toxics Control Act (MTCA) listed site, administered by the Washington State Department of Ecology (Ecology). The history of the Site, summary of the remedial investigation (RI), feasibility study (FS) and additional environmental investigations completed at the Site, and the remedial actions selected by Ecology are detailed in the Final Cleanup Action Plan (CAP) (Ecology 2017a). Prior to the start of the selected remedial actions, low concentrations of 1,4-dioxane were detected in three Site groundwater monitoring wells located at the north end of the Site. 1,4-dioxane was not detected in samples collected from any of the other 10 Site wells. A Work Plan (Golder 2018f) was prepared and approved by Ecology, which described the investigation activities proposed to evaluate the nature and extent of the 1,4-dioxane. The investigation activities were intended to help Ecology determine whether mine waste contaminants are the source of the recent detection of 1,4-dioxane, and to evaluate if the 1,4-dioxane detections presented a risk to human health or the environment. The process of identifying the potential source of compounds detected in the Site groundwater monitoring wells is referred to in the CAP as "an alternative source evaluation" (CAP, page 46). This report documents implementation of the Work Plan and presents the results of the 1,4-dioxane alternative source evaluation.

1.1 Pre-Remedial Action Detection of 1,4-Dioxane

Quarterly groundwater monitoring was conducted during the RI starting in 1994, and interim groundwater monitoring was conducted periodically from 1995 to 2003, quarterly in 2004, and semiannually from 2005 to 2018. Following detection of the 1,4-dioxane in the three wells located at the north end of the Site in November 2017, interim groundwater monitoring of the wells on the north end of the Site was increased to quarterly. The interim groundwater monitoring has been conducted to provide continued monitoring of the Site groundwater quality until the approved remedial actions and associated compliance monitoring are started as described in the CAP and Compliance Monitoring Plan (CMP) (Ecology 2017b). The interim groundwater monitoring has included laboratory testing for a comprehensive list of analytes; including: petroleum compounds, volatile (VOC) and semi-volatile organic compounds (SVOC), pesticides, polychlorinated biphenyls (PCBs), and various metals. There were no detections of contaminants that are attributable to mine waste contaminants during the RI or during any of the interim groundwater monitoring events from 1994 to November 2017.

In response to comments received on the draft CAP, Ecology added the compound 1,4-dioxane to the suite of analytes listed in the CMP that will be tested for during protection and confirmation monitoring at the Site. 1,4-Dioxane is recognized for its use as a stabilizer in some solvents and for its use in many household consumer products such as laundry detergents, shampoos and cosmetics. The common use of 1,4-dioxane combined with its chemical property of high solubility and mobility in groundwater has resulted in low level detections of this compound in groundwater throughout the United States (EPA 2017). In recent years, 1,4-dioxane is routinely being added to groundwater testing programs at municipal water systems and at environmental cleanup sites.

Although compliance monitoring will not commence until after the selected remedy is implemented, the Landsburg PLP Group elected to add 1,4-dioxane to the list of test analytes included in the interim groundwater monitoring to be responsive to public comments received. 1,4-Dioxane was the only new compound added to the CMP and starting in November 2017 was added to the interim groundwater monitoring program. All other compounds included in the CMP have been tested for at the Site during the RI and during the interim groundwater monitoring conducted since 2003.

The November 2017 interim groundwater monitoring round included analysis for 1,4-dioxane for the first time. The analytical results for all test analytes during the November 2017 sampling event were consistent with results during the RI and with all the previous interim groundwater monitoring events conducted since 2003 except that 1,4-dioxane was detected in LMW-2 and LMW-4 at concentrations of 2.0 micrograms per liter (µg/L) and 2.3 µg/L, respectively. Since November 2017 was the first time 1,4-dioxane was tested for at the Site, its detection in LMW-2 and LMW-4 does not necessarily indicate a change in groundwater conditions. The compound 1,4-dioxane was not detected in any of the other groundwater monitoring wells or in either of the portal surface water samples, including monitoring well LMW-10 and the north portal, which are located upgradient of LMW-2 and LMW-4.

LMW-2 and LMW-4 were resampled in February 2018 to confirm the November 2017 1,4-dioxane detections. 1,4-Dioxane was detected during the resampling at 2.1 µg/L and 2.3 µg/L in LMW-2 and LMW-4, respectively, similar to the results detected in the November 2017 groundwater monitoring. The Landsburg PLP Group notified Ecology after the November 2017 results were received and validated and after the February 2018 resampling results were received and validated.

1.2 Initial Alternative Source Evaluation

In response to the detection of the 1,4-dioxane in LMW-2 and LMW-4, the Landsburg PLP Group expedited the installation of the four additional groundwater monitoring wells referred to as “sentinel wells” in the CAP. Sentinel wells are groundwater monitoring wells that are located between the waste disposal area and the compliance wells located at the north and south ends of the Site. The wells are referred to as sentinel wells because they will be used as an early warning for impacted groundwater migration. Two of the sentinel wells are located north of where the waste disposal occurred and two are located south of the former waste disposal area. Figure 1 and the cross-section Figure 3 show the locations of the existing monitoring wells and the new sentinel wells.

In March 2018, a sentinel well installation work plan (Golder 2018a) was submitted to Ecology describing the details for installation of the four additional sentinel wells. Ecology approved the work plan, and the two north sentinel wells were installed during March through May 2018. The northern sentinel wells were installed first to provide data to help evaluate the potential source of the 1,4-dioxane detected in LMW-2 and LMW-4. As shown on Figure 3, the new shallow north sentinel well (LMW-12) was screened within the former mine workings from a depth of 15.5 to 25.5 feet below ground surface (ft bgs). The new deeper north sentinel well (LMW-13R) was screened within the former mine workings at a depth of 115 to 140 ft bgs. Existing north sentinel well LMW-10 is screened near the bottom of the coal seam at a depth of 267 to 287 ft bgs. The attached Table 1 summarizes the groundwater monitoring well construction details. LMW-10, LMW-12, and LMW-13R are located upgradient of northern compliance wells LMW-2 and LMW-4 and downgradient of the former waste disposal area, as shown on Figure 3. If the 1,4-dioxane detected in LMW-2 and LMW-4 is a mine waste contaminant it would also be expected to be detected in LMW-12 and LMW-13R, because LMW-12 and LMW-13R are screened within the same depth interval covered by LMW-2 and LMW-4. LMW-10 is screened 50 feet deeper than LMW-4, so 1,4-dioxane would only be detected in LMW-10 if the vertical extent of 1,4-dioxane extended to the depth of the LMW-10 screen interval.

The two new north sentinel wells (LMW-12 and LMW-13R) were included in the May, August, and December 2018 and the March 2019 interim groundwater monitoring events. Full results from these monitoring events were provided to Ecology in groundwater monitoring reports (Golder 2018b,c and 2019a,b). These sampling rounds comprise one year of quarterly sampling completed following the initial detection of 1,4-dioxane in LMW-2 and LMW-4. Table 2 provides a summary of the 1,4-dioxane detections at the Landsburg Mine Site.

The concentrations of 1,4-dioxane detected in LMW-2 and LMW-4 since the initial detection in November 2017 and February 2018 have decreased. Additionally, the concentrations of 1,4-dioxane detected in LMW-12 has not increased and had the lowest detected concentration (1.1 ug/L) during the March 2019 sampling round. 1,4-Dioxane was not detected in LMW-13R or in LMW-10 during any of the sampling rounds. Results of this initial evaluation (using data through May 2018) were presented to Ecology in a technical memorandum (Golder 2018e).

2.0 ADDITIONAL GROUNDWATER INVESTIGATION

2.1 Installation of Groundwater Monitoring Wells North of the Site

On the Site, groundwater within the northern portion of the mine flows horizontally to the north/northeast, along the strike through the highly permeable Rogers seam. North of the Site, groundwater from the Rogers seam discharges to the Cedar River through the glacial sands and gravels that overlie the coal seam and underlie the Cedar River. The Cedar River is located approximately 600 feet north of LMW-2 and LMW-4. Figures 3 and 4 conceptually depict the coal seams, the low permeability Puget Group sandstone and siltstones located on either side of the coal seams, and the recessional outwash sands and gravel deposits beneath the Cedar River. Prior to this Investigation, there were no groundwater wells located between the north end of the Site and the Cedar River. To provide empirical data on the groundwater quality north of the Site, three additional groundwater monitoring wells were installed:

- LMW-20 – Installed along the strike of the Rogers coal seam and screened in the glacial soils overlying the Rogers coal seam. The monitoring well provides data on the concentration of 1,4-dioxane in groundwater discharging from the Rogers coal seam to the glacial soils at a location approximately 400 feet downgradient of LMW-2 and LMW-4, and prior to discharge to the Cedar River.
- LMW-21 – Installed east of LMW-20. LMW-21 provides groundwater quality data at a location that is upgradient of the Rogers seam and within the same glacial soils that LMW-20 and LMW-22 are installed. This upgradient well was installed to evaluate anthropogenic background of 1,4-dioxane in the Cedar River glacial deposits. 1,4-Dioxane use as a stabilizer in chlorinated solvents and in common commercial and household products has resulted in 1,4-dioxane being found in groundwater throughout the United States.
- LMW-22 – Installed west/northwest of LMW-20, between the Rogers coal seam and the closest private wells located to the northwest of the Site. Based on the geology noted in the private Water Well Reports filed with Ecology at the time of drilling, the nearest private wells located northwest of the Site are screened within the glacial soils overlying the bedrock similar to the proposed new Site monitoring wells. Groundwater discharging to the Cedar River glacial deposits from the Rogers coal seam travels north/northeast to the Cedar River. Groundwater elevations from LMW-20, LMW-21 and LMW-22 establish groundwater flow direction within the glacial soils and can be used to evaluate if water discharging from the Rogers seam could migrate towards the private wells. Groundwater samples collected from LMW-22 also provide empirical data on the presence or absence of 1,4-dioxane in groundwater between the Rogers coal seam and the closest private wells.

The wells were drilled and installed from November 27, 2018 to November 29, 2018, in accordance with Golder Technical Guidelines TG-1.2-12 *Monitoring Well Drilling and Installation* and TG-1.2 6 *Soil Description System*. Figures 1 and 4 show the well locations.

The boreholes were drilled by Cascade Environmental, LP (Cascade), a Washington State licensed driller using a roto-sonic drill rig. The boreholes were drilled at a 6-inch diameter cased hole. The roto-sonic drilling method collects continuous cores. A Golder geologist inspected the cores to evaluate the soil lithology, create the borehole log, and evaluate the depth when groundwater was first encountered. Drilling extended in each hole until the targeted depth was reached and the borehole was cleared to permit monitoring well construction. The screen interval of each well was installed within the saturated portions of the glacial deposits that overlie the bedrock. Depth to bedrock varied between 10 to 25 ft bgs. Borehole logs and well construction diagrams are included in Appendix A.

The wells were constructed of 2-inch diameter polyvinyl chloride (PVC) screens and flush-threaded PVC riser casing. The screen length was 10 feet (0.02-inch slot size) for LMW-20 and LMW-22, and 5 feet (0.02-inch slot size) for LMW-21. A shorter screen length was required for LMW-21, because the bedrock was encountered only 15 feet bgs. The screened intervals were gravel packed with coarse (2/12) silica sand. The borehole annulus above each screen section was sealed with a bentonite clay seal to land surface. A protective lockable steel monument was installed for secured access at the well port.

David Evans Associates, a Washington State licensed land surveyor, conducted the geodetic survey after installation. The wells were surveyed for horizontal position (x- and y- coordinates) and elevation (z- coordinate) to the same benchmark established for the other Landsburg Mine Site monitoring wells.

2.2 Sampling and Analysis Results

Groundwater levels for the newly completed and existing monitoring wells were measured using an electric water level tape on December 3, 2018. Water level measurements were obtained in accordance with the procedures detailed in the approved CMP (Ecology 2017b). Water level measurements obtained in December 2018 indicated groundwater at the north end of the Site flows to the north/northeast, towards Cedar River. The groundwater elevations in LMW-20, LMW-21, and LMW-22 confirm that the dominant groundwater flow within the glacial gravels is towards the Cedar River. The groundwater elevation in LMW-20, which is the well installed along the strike of the Rogers coal seam is lower than the groundwater elevations in LMW-22. This confirms that groundwater discharging from the Rogers seam would not flow towards the nearest private wells that are located northwest of the Site. Groundwater discharging from the Rogers seam flows within the glacial gravels towards the Cedar River. Figure 2 depicts the groundwater elevations at the north end of the Site.

The newly completed wells (LMW-20, LMW-21, and LMW-22) were sampled in accordance with the procedures detailed in the approved CMP (Ecology 2017b) on December 6, 2018. The samples were analyzed for 1,4-dioxane by EPA Method 8270D and for VOCs by EPA Method 8260C in accordance with the QAPP.

The December 2018 sampling indicated no VOC analytes or 1,4-dioxane were detected above the reporting limit in the three new wells installed north of the Site. A summary table of the analytical results from LMW-20, LMW-21 and LMW-22 are included in Appendix B. All other Site groundwater wells were also sampled during the December 2018 interim groundwater sampling, and 1,4-dioxane was again only detected in LMW-2, LMW-4 and LMW-12 (Golder 2019a). The concentrations of 1,4-dioxane detected in these wells were generally equal to or less than detected in previous sampling rounds. Table 2 list the concentrations of 1,4-dioxane detected in these wells during each sampling round.

3.0 NATURE AND EXTENT OF 1,4-DIOXANE AT THE SITE

3.1 Characteristics of 1,4-Dioxane

1,4-Dioxane was used as a stabilizer in chlorinated solvents (particularly 1,1,1-trichloroethane [TCA]) starting in the 1970s until its use as a stabilizer was phased out in 1995. 1,4-Dioxane is also present as a by-product (meaning it is not added during production of a product, but instead results from various reactions during the production of the product) of various surfactants, resins, PET plastics, chemical food additives, and other compounds that are used in common commercial and household products. Some common household products like laundry detergents, shampoos, and dish soaps have measured concentrations of 1,4-dioxane exceeding 10,000 micrograms per kilogram (µg/kg) (Mohr 2017). The state of New Hampshire detected 1,4-dioxane in car wash soap at a concentration of 760,000 µg/kg. 1,4-Dioxane is released to the environment at sites where TCA or other commercial products containing 1,4-dioxane were released. 1,4-Dioxane is also released to the environment where consumer products like detergents, soaps and shampoos that contain 1,4-dioxane infiltrate to the soil and potentially to the underlying groundwater through private home owner's septic system drainage fields. Because public wastewater treatment systems are often unable to remove 1,4-dioxane from the treated effluent, discharges of 1,4-dioxane to surface water from public waste water treatment plants commonly occurs (Mohr 2017). The wide-spread use 1,4-dioxane as a stabilizer in TCA and in various consumer and commercial products combined with the release of these products to the environment has resulted in 1,4-dioxane being found in groundwater at sites throughout the United States (EPA 2017).

1,4-Dioxane is a synthetic chemical that is completely miscible in water (i.e. it mixes easily with water). Unlike many organic compounds, 1,4-dioxane does not readily adsorb to carbon that is present in most soils. The high solubility and weak retardation of the compound in soil results in migration of 1,4-dioxane from soil to groundwater. It is relatively resistant to biodegradation in groundwater compared to chlorinated solvents. Its resistance to degradation and high mobility in groundwater often result in 1,4-dioxane migrating in groundwater greater distances from the source area than most other organic compounds.

Based on laboratory studies on animals, the US Department of Health and Human Services (HHS), considers 1,4-dioxane as reasonably anticipated to be a human carcinogen. HHS indicates in the April 2012 Agency for Toxic Substances and Disease Registry (ASTDR), that the effects of 1,4-dioxane on human health depends on how much 1,4-dioxane a person is exposed to and the length of exposure (ASTDR 2012). The ASTDR document indicates that the EPA has determined that exposure to 400 µg/L of 1,4-dioxane in drinking water for 10 days is not expected to cause any adverse effect in a child. The National Academy of Science (NAS) and the US Food and Drug Administration have established a maximum concentration of 10,000 micrograms per kilogram (µg/kg) in food additives, products used in dietary supplements, and cosmetics (ASTDR 2012).

There are currently no drinking water levels established by EPA or in Washington State for 1,4-dioxane. The World Health Organization suggests a 50 µg/L drinking water threshold for 1,4-dioxane, whereas the EPA National Center for Environmental Assessment proposed a health-based advisory level of 3 µg/L in tap water (Water Research Foundation 2014). Under MTCA, Ecology has set a groundwater cleanup level for 1,4-dioxane of 0.438 µg/L. Seventeen other states have established drinking water and groundwater guidelines with acceptable groundwater concentrations ranging from 77 µg/L to 0.25 µg/L. Twelve states have standards that are higher than 3 µg/L for 1,4-dioxane, and six states (including Washington) have cleanup levels for 1,4-dioxane that are lower than 3 µg/L. Groundwater samples collected from the Landsburg Site were analyzed for 1,4-dioxane using EPA Method 8270D with a detection limit of 0.2 µg/L, which is lower than all the drinking water criteria discussed above and lower than the MTCA cleanup level of 0.438 µg/L.

1,4-Dioxane easily breaks down in the atmosphere due to photo-oxidation (EPA 2017). 1,4-dioxane has low aquatic toxicity as it does not bioaccumulate, biomagnify, or bioconcentrate in the food chain (ATSDR 2012; Mohr 2001). There are no surface water cleanup levels established for 1,4-dioxane in Washington state. At the PSC Georgetown Facility in Seattle, Washington, Ecology established a protection of surface water criteria for 1,4-

dioxane, based on human consumption of fish, of 78.5 µg/L (Ecology 2010). The lowest No Observable Effects Concentration (NOEL) for aquatic organisms listed in the EPA EcoTox Database for 1,4-dioxane is 100,000 µg/L (EPA 2018). A MTCA Method B surface water value, calculated using a bioconcentration factor of 0.5 liters per kilogram (Oak Ridge National Laboratory's Risk Assessment Information System [RAIS 2018]) and the oral cancer potency factor listed in Cleanup Levels and Risk Calculation (CLARC) of 0.1 kg-day/mg, results in a MTCA Method B surface water value of 130 µg/L.

3.2 Extent of 1,4-Dioxane at the Site

Low concentrations of 1,4-dioxane are detected in groundwater monitoring wells LMW-2, LMW-4 and LMW-12, all located at the northern end of the Landsburg Site. The northern portal (Portal #2), LMW-10 and LMW-13R are also located at the north end of the Site, but 1,4-dioxane was not detected in any of these locations. 1,4-Dioxane has not been detected in any other Site wells or portal surface water samples. The three new monitoring wells installed north of the Site, including LMW-20 installed directly downgradient of LMW-2 and LMW-4 along the strike of the Rogers coal seam, were tested and did not contain 1,4-dioxane.

In the northern portion of the Site where 1,4-dioxane was detected, the lateral extent of the 1,4-dioxane is limited to the width of the former Rogers seam. The coal seam itself is approximately 10 to 12 feet wide, but the collapsed width of the Rogers mine is about 15 feet. The geology and hydrogeology of the Site are described within the CAP (Ecology 2017a). On the northern end of the Site the coal seam and associated mine workings are oriented nearly vertically. Low permeability sandstone and shale of the Puget Group bedrock are located on the east and west sides of the Rogers coal seam and mine workings. The mined/backfilled Rogers seam is a highly conductive zone for groundwater flow. The fine-grained, vertically bedded Puget Group bedrock strata located to either side of the seam are several orders of magnitude less permeable than the mined-out seam. Groundwater flow within the mine flows horizontally to the north to northeast, along the strike through the highly permeable Rogers seam.

Groundwater beneath the waste disposal area within the former Roger's mine seam flows to the north to northeast along the strike of the Rogers coal seam and within the mine workings. The new sentinel wells LMW-12 and LMW-13R are screened in the Rogers seam, hydrologically downgradient of the former waste disposal area and upgradient of the compliance wells LMW-2 and LMW-4, also screened in the Rogers seam. If the source of the 1,4-dioxane detected in LMW-2 and LMW-4 is the former waste disposal area, one would expect to see higher concentrations of 1,4-dioxane in LMW-12 and detectable concentrations in LMW-13R. 1,4-Dioxane was not detected in LMW-13R during the May, August, December 2018, or the March 2019 interim groundwater monitoring events. The absence of 1,4-dioxane in LMW-13R, which is screened at a depth shallower than LMW-4, is inconsistent with the vertical extent of 1,4-dioxane detected at LMW-2 and LMW-4.

3.3 Evaluation of Current Potential Exposure Pathways

The concentrations of 1,4-dioxane detected in groundwater samples collected from LMW-2, LMW-4 and LMW-12 range from 1.1 to 2.3 µg/L. The highest concentrations were detected during the November 2017 sampling round, which was the first sampling round that included testing for 1,4-dioxane. Concentrations of 1,4-dioxane detected in LMW-2, LMW-4 and LMW-12 since the initial detections have decreased. The maximum concentration detected during quarterly monitoring completed in May, August, and December 2018, and March 2019 was 1.8 ug/L. These concentrations still exceed the Washington State MTCA Method B groundwater cleanup level of 0.438 µg/L but are lower than concentrations considered acceptable for drinking water in most of the other states that have promulgated 1,4-dioxane groundwater cleanup or guidance levels (EPA 2017). Evaluation of the potential consumption of groundwater exposure pathway includes the following:

- There are no drinking water wells located on the Site, and the environmental covenants required under the CAP will prevent future groundwater use from the Site for any non-remedial purpose.
- There are also no groundwater wells located downgradient of the Site between LMW-2/LMW-4 and the Cedar River. The properties north (downgradient) of LMW-2 and LMW-4 are owned by Palmer Coking Coal, King County Parks, Seattle City Lights and Seattle Public Utilities. Installation of private wells is prohibited on the public parcels. The nearest private well is located approximately 1300 feet west of the Rogers coal seam (Figures 1 and 4) and is not along the downgradient groundwater flow path between the Rogers seam and the Cedar River.
- 1,4-Dioxane was not detected in the three new groundwater monitoring wells installed downgradient of the site between LMW-2/LMW-4 and the Cedar River. This indicates that the low-level concentrations of 1,4-dioxane detected in the three northern Site wells attenuates rapidly and does not reach any off-site receptors.

The combination of these factors - prevention of drinking water wells on Site and immediately downgradient of LMW-2 and LMW-4, distance/cross-gradient location of nearest private wells, and the rapid attenuation to non-detectable concentrations downgradient of the Site - indicates that the low-level detection of 1,4-dioxane in LMW-2, LMW-4 and LMW-12 does not present a current or future risk to human health or the environment.

The concentrations of 1,4-dioxane detected in the three Site wells are significantly less than surface water values that are protective of human health from consumption of organisms (130 µg/L calculated MTCA Method B cleanup level) and significantly lower than concentrations for the protection of aquatic Ecological receptors (100,000 µg/L, EPA 2018). Additionally, 1,4-dioxane was not detected in any of the three monitoring wells installed north of the site before the Cedar River, so there is no risk to surface water.

4.0 CONCLUSIONS OF THE ALTERNATIVES SOURCE EVALUATION

The low-level detections of 1,4-dioxane in three Site monitoring wells downgradient of the waste disposal area, indicates that the 1,4-dioxane could possibly be a mine waste contaminant. However, the absence of 1,4-dioxane in LMW-13R, which is downgradient of the waste disposal area and is screened at a depth that is shallower than LMW-4 does not support this possibility. Assessment of the 1,4-dioxane detection indicates the following:

- A full year of quarterly groundwater monitoring has occurred since the initial detection of 1,4-dioxane and overall the concentrations have decreased compared to the initial detection.
- Analyses of groundwater samples collected during quarterly monitoring have not detected any other contaminants that would indicate a release of mine waste contaminants is occurring.
- 1,4-Dioxane was not detected in groundwater samples from the three new groundwater monitoring wells installed downgradient of LMW-2 and LMW-4. Groundwater elevation data from the three new wells confirm that groundwater discharging from the Rogers seam flows towards the Cedar River, and 1,4-dioxane does not reach the Cedar River.
- The horizontal and vertical extent of the 1,4-dioxane have been delineated. The 1,4-dioxane does not present a threat to human health or the environment. There are no current downgradient drinking water

receptors located between the Site and the Cedar River, and installation of private groundwater wells within the area where 1,4-dioxane is detected above MTCA cleanup levels is prohibited.

The Site remedial action, including backfilling and placement of a low-permeability cap over the mine trench area where wastes were disposed, will significantly reduce the infiltration of rainwater and stormwater runoff currently entering the trench. Preventing water from infiltrating through the trench areas where wastes were disposed will inhibit the potential for transport of contaminants to the groundwater within the mine workings. The capping will also substantially reduce the total quantity of water that flows along the mine workings and ultimately discharges to the Cedar River. Short-term groundwater monitoring required by the CAP during the remedial actions and long-term monitoring required under the CAP following completion of the remedial actions will be used to evaluate the changes in groundwater quality and the need for any further assessment or action to ensure the sustained protection of human health and the environment.

Signature Page

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Tables

Table 1: Landsburg Mine Site Groundwater Monitoring Wells Construction Summary

Well ID	Northing	Easting	Installation Date	Date Last Surveyed	Datum	Measuring Point Elevation (ft AMSL)	Measuring Point	Borehole Depth (ft bgs)	Borehole Diameter (inches)	Well Casing Diameter (inches)	Well Materials	Depth to Top of Screen (ft bgs)	Depth to Bottom of Screen (ft bgs)	Screen Slot Size (inches)	Depth to Top of Filter Pack (ft bgs)	Comments
LMW-1	138279.52	1354991.57	1/23/1994	8/14/2018	NAVD88	765.36	Top of PVC Casing	180	8	4	Stainless/PVC	162	177	0.02	158	In area of gangway that connects mine fault off-set
LMW-1A	138323.00	1354997.41	2/7/1994	8/14/2018	NAVD88	763.57	Top of PVC Casing	220	8	2	PVC	129	149	0.02	n/a	Only for water levels
LMW-2	139077.61	1355972.91	2/11/1994	8/14/2018	NAVD88	617.79	Top of PVC Casing	46	8	4	Stainless/PVC	28	38	0.02	25	Shallow north compliance
LMW-3	135192.23	1353220.37	11/22/2004	11/3/2004	NAVD88	656.75	Top of PVC Casing	76	8	4	Stainless/PVC	50	65	0.02	47	Shallow south compliance
LMW-4*	139122.67	1355865.52	2/19/1994	8/14/2018	NAVD88	619.27	Top of PVC Casing	233	8	4	Stainless/PVC	195	210	0.02	210	Deep north compliance
LMW-5	135206.05	1353141.36	12/8/2004	11/3/2004	NAVD88	658.27	Top of PVC Casing	247	8	4	Stainless/PVC	232	242	0.02	232	Deep south compliance
LMW-6	138714.14	1354126.78	1/13/1994	11/3/2004	NAVD88	632.33	Top of PVC Casing	106	8	4	Stainless/PVC	91	106	0.02	83	Frasier Coal Seam
LMW-7*	138055.10	1355483.61	1/10/1994	11/3/2004	NAVD88	771.51	Top of PVC Casing	254	8	4	Stainless/PVC	240	254	0.02	n/a	Landsburg Coal Seam
LMW-8	135074.90	1353229.41	4/7/2004	11/3/2004	NAVD88	646.97	Top of PVC Casing	15	9	2	PVC	7.5	13	0.02	6	Representative of Portal #3 discharge
LMW-9	135727.33	1353324.04	4/14/2004	11/3/2004	NAVD88	743.99	Top of PVC Casing	160	9	2	PVC	149	159	0.02	144	Southern Sentinel Well mid-depth
LMW-10	139054.56	1355787.97	5/11/2004	8/14/2018	NAVD88	618.98	Top of PVC Casing	450	9	4	PVC	267	287	0.02	258	Deep, near bottom of mine, northern end
LMW-11	136159.27	1353317.36	8/24/2005	4/19/2019	NAVD88	802.19	Top of PVC Casing	707	9	4	Stainless/PVC	697	707	0.02	688	Deep, near bottom of mine, south end
LMW-12	138923.92	1355721.80	3/14/2018	8/14/2018	NAVD88	625.35	Top of PVC Casing	30	8	4	PVC	15.5	25.5	0.02	11	North Portal Sentinel Shallow Sentinel Well
LMW-13	138937.17	1355707.45	3/22/2018	8/14/2018	NAVD88	625.62	Top of PVC Casing	150	8	4	PVC	125.5	145.5	0.02	121	Dry Well
LMW-13R	138932.43	1355728.92	5/15/2018	8/14/2018	NAVD88	625.86	Top of PVC Casing	151	8	4	PVC	115	140	0.02	110	North Portal Sentinel Deep Sentinel Well
P-2	135117.60	1353212.70	4/16/2004	11/3/2004	NAVD88	651.37	Top of PVC Casing	70	9	2	PVC	39	44	0.02	**n/a	Temporary piezo into Portal #3
LMW-14*	137188.61	1353967.91	4/15/2019	4/19/2019	NAVD88	805.12	Top of PVC Casing	176	6	2	PVC	156.5	172.3	0.01	152.6	15° Incline. Vertical depths reported
LMW-15	136245.07	1353517.07	11/5/2018	4/19/2019	NAVD88	796.46	Top of PVC Casing	248	6	2	PVC	238	248	0.01	233	South cap effectiveness well
LMW-20	139352.05	1356317.06	11/27/2018	12/26/2018	NAVD88	546.80	Top of PVC Casing	24.5	6	2	PVC	14	24	0.01	11	Cedar River Valley Rogers Seam
LMW-21	139209.99	1356404.12	11/29/2018	12/26/2018	NAVD88	544.09	Top of PVC Casing	15	6	2	PVC	10	15	0.01	7	Cedar River Valley East Well
LMW-22	139493.44	1355909.73	11/28/2018	12/26/2018	NAVD88	542.86	Top of PVC Casing	27.5	6	2	PVC	17	27	0.01	14	Cedar River Valley West Well

Notes:
* LMW-4 and LMW-7 were drilled at a 20° incline; LMW-14 was drilled at 15° incline.
** No filter pack was installed in P-2 due to the open mine shaft at 39 feet to 44 feet. The casing was removed, and the native material collapsed around the well to 15 feet below ground surface.
ft AMSL - feet above mean sea level
ft bgs - feet below ground surface

Table 2: Summary of 1,4-Dioxane Detections in Groundwater since November 2017

ANALYTE	MTCA Level B	UNITS	LMW-2						LMW-4						LMW-12				LMW-13R			
			11/30/2017	2/9/2018	5/24/2018	8/15/2018	12/4/2018	3/5/2019	11/30/2017	2/9/2018	5/24/2018	8/15/2018	12/4/2018	3/5/2019	5/23/2018	8/15/2018	12/4/2018	3/5/2019	5/23/2018	8/15/2018	12/4/2018	3/5/2019
1,4-Dioxane	0.438	ug/L	**2.0**	**2.1**	**1.8**	**1.6**	**1.7**	**1.5**	**2.3**	**2.3**	**1.5**	**1.5**	**1.6**	**1.7**	**1.5**	**1.6**	**1.2**	**1.1**	0.4 U	0.4 U	0.4 U	0.4 U

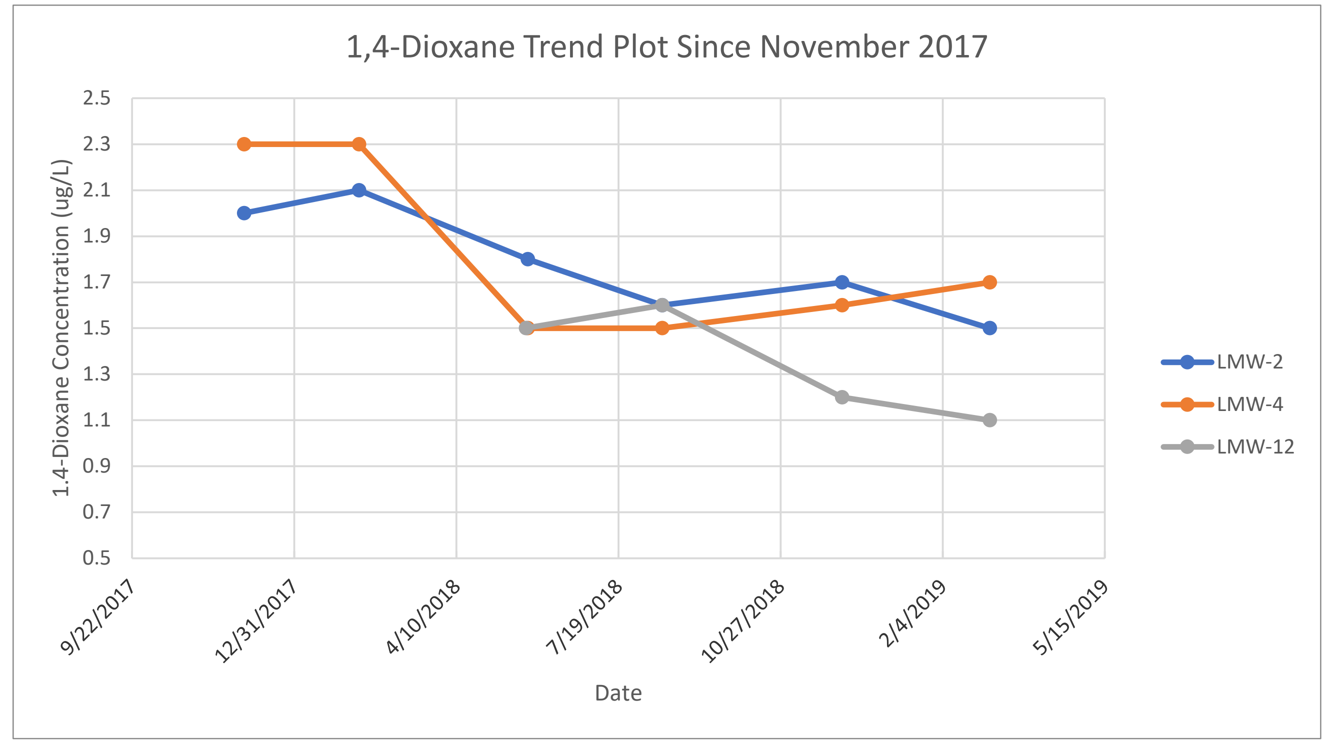
Notes:

U - The analyte was not detected above the level of the method detection limit.

µg/L = micrograms per liter

Most recent Sampling Results

Analyses performed by EPA Method 8270



Figures

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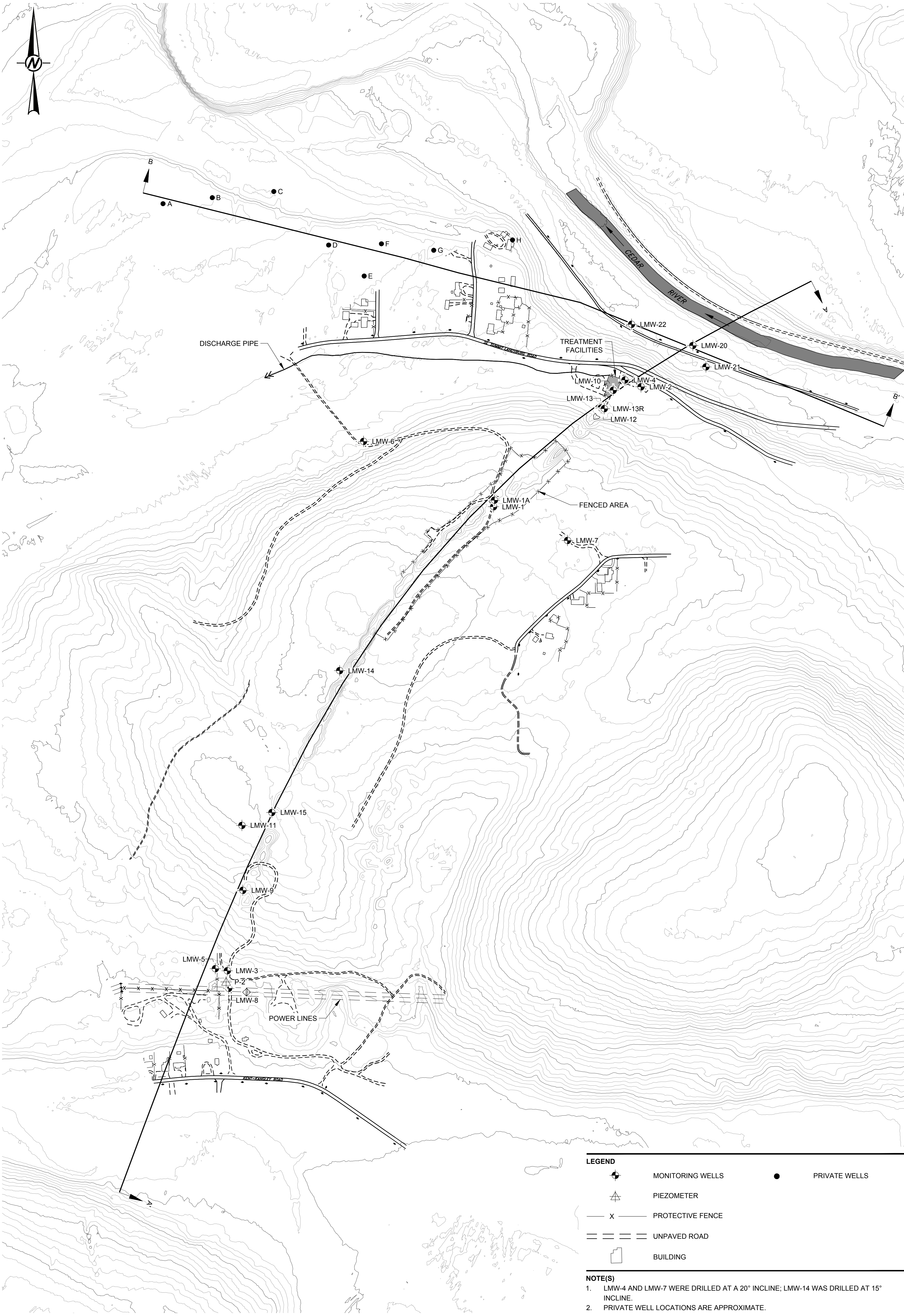


LEGEND

(symbol)	MONITORING WELLS
(symbol)	PRIVATE WELLS
(symbol)	PIEZOMETER
—— X ——	PROTECTIVE FENCE
— — — —	UNPAVED ROAD
(symbol)	BUILDING

NOTE(S)

1. LMW-4 AND LMW-7 WERE DRILLED AT A 20° INCLINE; LMW-14 WAS DRILLED AT 15° INCLINE.
2. PRIVATE WELL LOCATIONS ARE APPROXIMATE.

0 300 600
1" = 300' FEET

CLIENT
LANDSBURG MINE SITE PLP GROUP

PROJECT
LANDSBURG MINE SITE
MTCA REMEDIAL ACTION

CONSULTANT

GOLDER

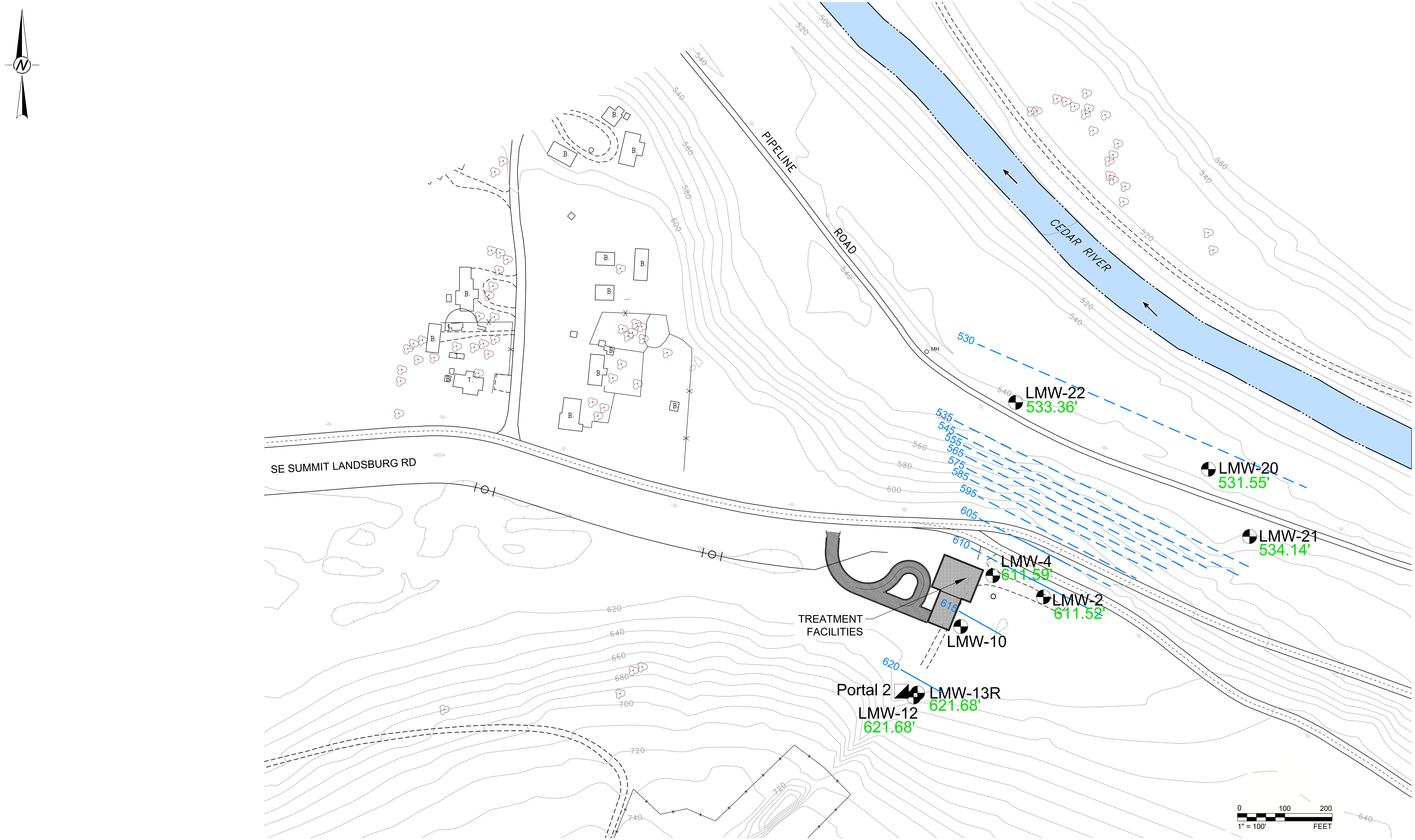
YYYY-MM-DD	2019-04-25
DESIGNED	XXX
PREPARED	XXX
REVIEWED	XXX
APPROVED	XXX

TITLE
SITE MAP

PROJECT NO.	PHASE	REV.	SHEET
9231000005	1019	A	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

0 1 in



LEGEND

MONITORING WELL

615.88' GROUNDWATER ELEVATION (FEET AMSL)

APPROXIMATE GROUNDWATER ELEVATIONS (FEET AMSL)

NOTE(S)

1. LMW - 10 MEASURES A DEEPER FORMATION AND ITS GROUNDWATER ELEVATION WAS NOT USED IN THE DEVELOPMENT OF THE APPROXIMATE GROUNDWATER ELEVATION CONTOURS.
2. GROUNDWATER ELEVATIONS OBTAINED 4/22/2019.

CLIENT
LANDSBURG MINE SITE PLP GROUP

CONSULTANT
GOLDER

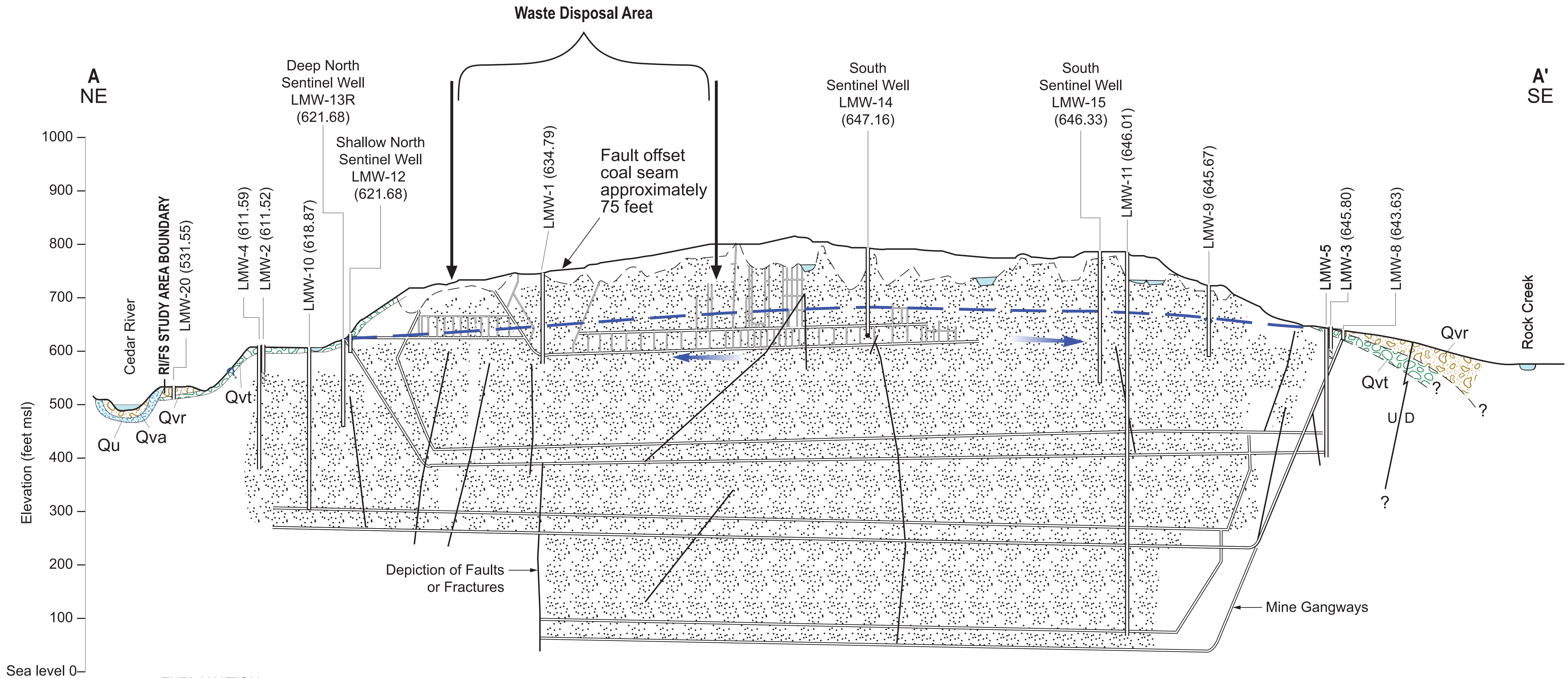
YYYY-MM-DD	2019-04-12
DESIGNED	JX
PREPARED	REDMOND
REVIEWED	JX
APPROVED	GZ

PROJECT
LANDSBURG MINE SITE
MTCA REMEDIAL ACTION

TITLE
GROUNDWATER POTENTIOMETERIC SURFACE

PROJECT NO.	PHASE	REV.	SHEET
9231000005	1250	A	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D



EXPLANATION

Potentiometric surface

Outline of trench bottom

LMW-2 (610.42) Well ID (water level in ft. amsl)

Qvt Till, compact mixture of gravel occasional boulders in clayey silty sand matrix

Sandstone

Surface water feature

Anticipated collapsed zone within mine

Qu Drift, till, fluvial sand and gravel, lacustrine sand, silt, clay and peat

Qvr Recessional outwash, well sorted sand and pebble-cobble

Qva Advanced outwash pebble-cobble gravel may include very fine sand

Monitoring Interval

Groundwater Flow Direction

Sources for the Geology and Mine Information:
J.E. Luzier 1969; surficial geology
State of Washington, Water Well reports
Mine Superintendant's Records
Landsburg Well Logs

NOTE: Vertical to horizontal scale ratio is 2.5:1
Wells are project normal into the strike of the Cross-Section A-A'

Groundwater elevation obtained 4/22/2019

0 500
FEET

CLIENT	PROJECT
LANDSBURG PLP GROUP	LANDSBURG MINE SITE

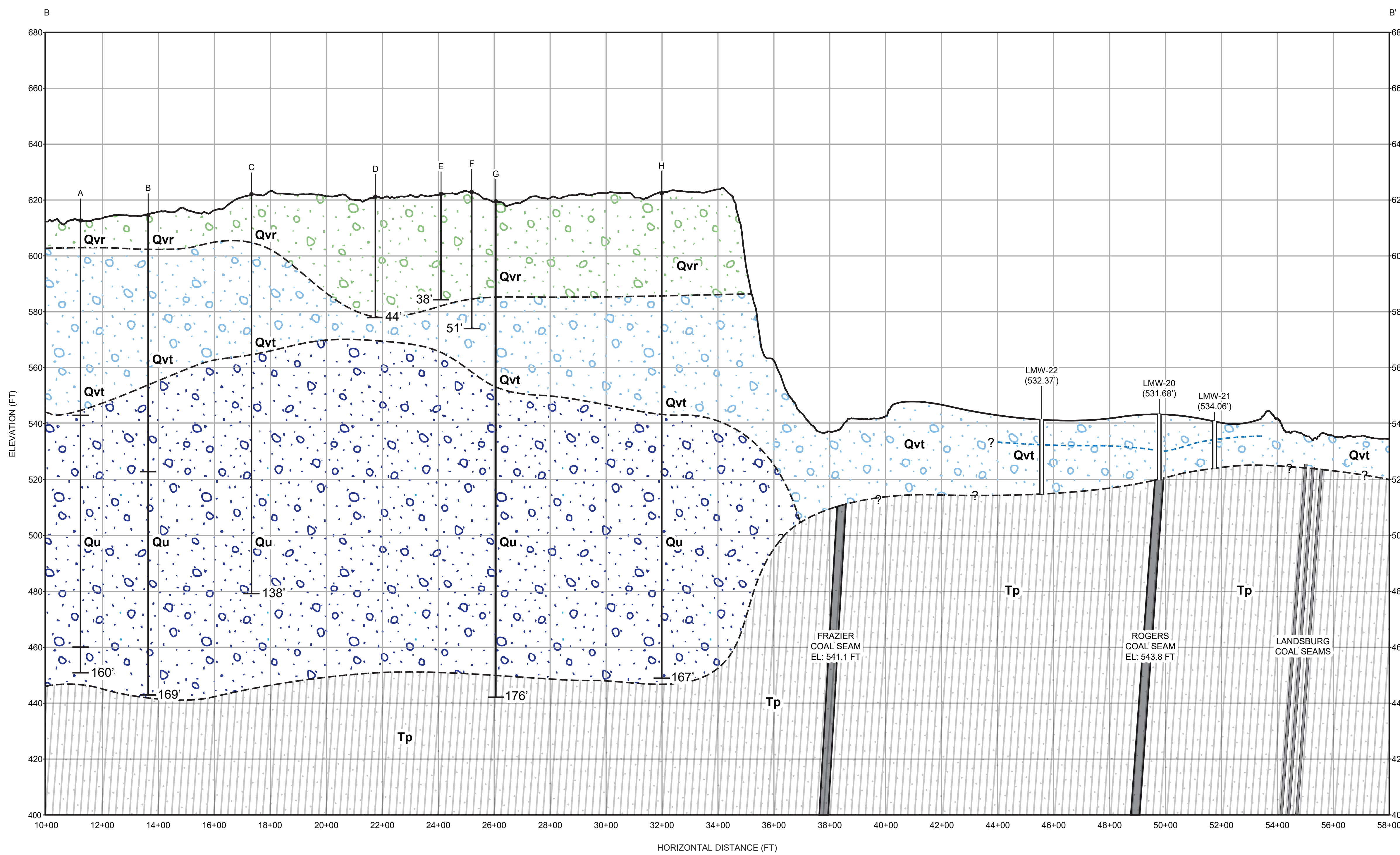
CONSULTANT

GOLDER

YYYY-MM-DD	2019-05-09
PREPARED	REDMOND
DESIGN	
REVIEW	
APPROVED	

TITLE
CROSS-SECTION ALONG STRIKE AT COAL SEAM
CROSS-SECTION A-A'

PROJECT No.	PHASE	FIGURE
923-1000	1200	3



VERTICAL SCALE: 1" = 20' — 0 20 40 FEET

HORIZONTAL SCALE: 1" = 200' — 0 200 400 FEET

EXPLANATION

- Tp (UNDIFFERENTIATED PUGET GROUP) - SANDSTONE INTERBEDDED SHALE AND COAL
- Qu (PRE-VASHON DRIFT) - TILL, FLUVIAL SAND AND GRAVEL, LACUSTRINE SAND, SILT, CLAY, AND PEAT
- Qvt (TILL) - COMPACT MIXTURE OF GRAVEL, OCCASIONAL BOULDERS IN CLAYEY SILTY SAND MATRIX
- Qvr (RECESSIONAL OUTWASH) - WELL SORTED SAND AND PEBBLE-COBBLE
- A — PRIVATE WELL LOCATION AND DEPTH FROM DRILLERS BOREHOLE LOGS
- LMW-20 (531.68') — WELL ID (WATER LEVEL IN FT. AMSL)
- POTENTIOMETRIC SURFACE

NOTE: Groundwater elevation obtained 4/22/2019

Private well locations are approximate

Sources for the Geology and Mine Information:

- J.E. Luzier 1969; surficial geology
- State of Washington, Water Well reports
- Landsburg Well Logs

NOTE:
Wells are projected normal into the strike of the Cross-Section C-C'.
Cross-sections are inferred from limited data and should be considered approximate.

CLIENT	LANDSBURG MINE SITE PLP GROUP	PROJECT	LANDSBURG MINE SITE
CONSULTANT	GOLDER	TITLE	CROSS-SECTION B-B`
YYYY-MM-DD	2019-04-29		
PREPARED	REDMOND		
DESIGN			
REVIEW			
APPROVED			
PROJECT No.	923-1000.005	PHASE	1019
FIGURE	4		

G:\PalmerCokingCoal\Co\LandsburgMine\WA\99_PROJECTS\923100005_RemedialAction\1000_RemedialActionDesign\02_PRODUCTION\INDD\923100_005_1000_004.indd

APPENDIX A

Cedar River Wells Borehole Logs and Well Construction Diagrams

WELL NUMBER LMW-20

GOLDER

CLIENT Landsburg PLP Group
PROJECT NAME Sentinel Well Installation
PROJECT NUMBER 923-1000-005
PROJECT LOCATION Ravensdale, WA
DATE STARTED 11/27/18 **COMPLETED** 11/27/18
GROUND ELEVATION 543.24 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Cascade Environmental
GROUND WATER LEVELS:
DRILLING METHOD Rotosonic
AT TIME OF DRILLING ---
LOGGED BY J.Miller **CHECKED BY** G.Zimmerman
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
0						Steel Riser Cap
0.0	NA	GP		Vacuum Excavated (GP) Alluvium, Large Cobbles 8-12"		Cement
3.5	S1, S2	GM		(GM) Silty GRAVEL with Sand, Coarse Gravel, Large Cobbles, Rounded, Light Brownish Gray, Moist	539.7	Med. Bentonite Chips
7.0	S2, S3	GP-GM		(GP-GM) Poorly Graded GRAVEL and Silt, Fine to Coarse, Subrounded, some Coarse Sand, Brown, Moist	536.2	
12.0	S3	GP		(GP) Poorly Graded Silty GRAVEL, Fine to Coarse, Brownish Gray, Moist	531.2	
14.0	S3, S4	GP-GM		(GP-GM) Poorly Graded GRAVEL and Silt, Fine to Coarse, some Large Cobbles, Rounded, Brown, Wet -Sandy Lense	529.2	10/20 Colorado Silica Sand 2" Sch. 40 PVC 0.010 Slot
20.0	S5	GP		(GP) Poorly Graded GRAVEL, Fine to Coarse, some Fine to Coarse Sand, Rounded, Brown, Wet	523.2	
24.0				SILTSTONE, Hard, Gray, Dry	519.2	
24.5					518.7	Well End Cap

Bottom of borehole at 24.5 feet.

WELL NUMBER LMW-21

GOLDER

CLIENT Landsburg PLP Group

PROJECT NAME Sentinel Well Installation

PROJECT NUMBER 923-1000-005

PROJECT LOCATION Ravensdale, WA

DATE STARTED 11/29/18 **COMPLETED** 11/29/18

GROUND ELEVATION 540.54 ft **HOLE SIZE** 6 inches

DRILLING CONTRACTOR Cascade Environmental

GROUND WATER LEVELS:

DRILLING METHOD Rotosonic

AT TIME OF DRILLING ---

LOGGED BY J.Miller **CHECKED BY** G.Zimmerman

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0	NA			Vacuum Excavated (GM) Alluvium, Silty GRAVEL, Rounded	
3.0		GM		(GM) Silty GRAVEL, Coarse, Large Rounded Cobbles, Brown, Moist	537.5
5.0	S1	SM		(SM) Silty SAND with some Gravel, Fine, Rounded Clasts, Gray to Brown, Dry	535.5
8.5		GP		(GP) Sandy GRAVEL with some Silt, Fine to Coarse, Rounded, Yellowish Brown, Moist to Wet	532.0
10	S2				
12.0	S3			Silty SANDSTONE, Fine Laminations, Hard, Fresh, Light Gray	528.5
15.0					525.5

Bottom of borehole at 15.0 feet.

WELL DIAGRAM

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 4/4/19 13:18 - C:\USERS\JCMILLER\DESKTOP\LANDSBURG.GPJ

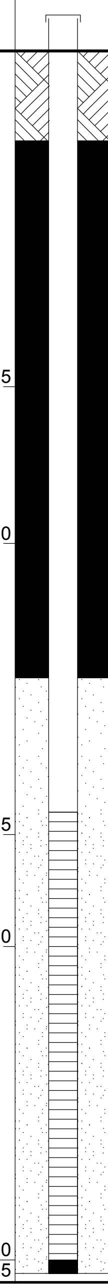
GOLDER

WELL NUMBER LMW-22

CLIENT Landsburg PLP Group
PROJECT NAME Sentinel Well Installation
PROJECT NUMBER 923-1000-005
PROJECT LOCATION Ravensdale, WA
DATE STARTED 11/28/18 **COMPLETED** 11/28/18
GROUND ELEVATION 540 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Cascade Environmental
GROUND WATER LEVELS:
DRILLING METHOD Rotosonic
AT TIME OF DRILLING ---
LOGGED BY J.Miller **CHECKED BY** G.Zimmerman
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	MATERIAL DESCRIPTION	Elevation
0	NA		Vacuum Excavated (GP) Alluvium, Large Cobbles, with sand and silt	
7.5			- Large Cobble 10"	532.5
7.5	S1	GP	(GP) Sandy GRAVEL, Fine to Coarse, some Silt, Rounded, Moist	532.5
11.0	S2, S3	GP-GM	(GP-GM) GRAVEL and SILT, Large Cobbles, Gray/Brown Mottling, Moist - Large Clast	529.0
17.5	S3	ML	(ML) Sandy SILT with Gravel, some Large Cobbles, Gray, Wet	522.5
20.0	S4, S5, S6	GM	(GM) Silty GRAVEL, Dense, Gray, Wet -Large Boulder 1.5-ft, Mafic, Igneous	520.0
27.0			SILTSTONE, Hard, Weathered, Light Gray, Dry	513.0
27.5			Bottom of borehole at 27.5 feet.	512.5

WELL DIAGRAM



APPENDIX B

Summary of Cedar River Wells Laboratory Analytical Results

December 2018 Cedar River WellsGroundwater Analytical Results

ANALYTE	UNITS	LMW-20		LMW-21		LMW-22	
		12/6/2018		12/6/2018		12/6/2018	
Field Parameter							
pH	stnd	6.61		7.53		7.19	
Conductivity	uS/cm	194.0		270.6		294.7	
Dissolved Oxygen	mg/L	3.99		0.99		0.59	
Temperature	^{o}C	9.3		9.6		10.2	
E_h	Rel mV	63.8		-207.5		-234.9	
Turbidity	NTU	0.79		26.9		6.74	
Semi-Volatile Organic Compounds (SVOCs)							
1,4-Dioxane[1]	ug/L	0.2	U	0.2	U	0.2	U
Volatile Organic Compounds (VOCs)							
Acetone	ug/L	2.19	J	2.72	J	5	U
Acrolein	ug/L	2.5	U	2.5	U	2.5	U
Acrylonitrile	ug/L	1	U	1	U	1	U
Benzene	ug/L	0.2	U	0.08	J	0.2	U
Bromobenzene	ug/L	0.2	U	0.2	U	0.2	U
Bromochloromethane	ug/L	0.2	U	0.2	U	0.2	U
Dichlorobromomethane	ug/L	0.2	U	0.2	U	0.2	U
Bromoethane	ug/L	0.2	U	0.2	U	0.2	U
Bromoform	ug/L	0.2	U	0.2	U	0.2	U
Bromomethane	ug/L	1	U	1	U	1	U
methyl ethyl ketone	ug/L	5	U	5	U	5	U
n-Butylbenzene	ug/L	0.2	U	0.2	U	0.2	U
Sec-Butylbenzene	ug/L	0.2	U	0.2	U	0.2	U
tert-butylbenzene	ug/L	0.2	U	0.2	U	0.2	U
Carbon Disulfide	ug/L	0.1	U	0.1	U	0.1	U
Carbon Tetrachloride	ug/L	0.2	U	0.2	U	0.2	U
Chlorobenzene	ug/L	0.2	U	0.2	U	0.2	U
Chloroethane	ug/L	0.2	U	0.2	U	0.2	U
2-Chloroethyl vinyl ether	ug/L	0.5	U	0.5	U	0.5	U
Chloroform	ug/L	0.2	U	0.2	U	0.2	U
Chloromethane	ug/L	0.5	U	0.23	J	0.5	U
2-Chlorotoluene	ug/L	0.1	U	0.1	U	0.1	U
4-Chlorotoluene	ug/L	0.2	U	0.2	U	0.2	U
Dichlorodifluoromethane	ug/L	0.2	U	0.2	U	0.2	U
1,2-Dibromo-3-Chloropropane	ug/L	0.5	U	0.5	U	0.5	U
Ethylene Dibromide	ug/L	0.1	U	0.1	U	0.1	U
Dibromomethane	ug/L	0.2	U	0.2	U	0.2	U
1,2-Dichlorobenzene	ug/L	0.2	U	0.2	U	0.2	U
1,3-Dichlorobenzene	ug/L	0.2	U	0.2	U	0.2	U
1,4-Dichlorobenzene	ug/L	0.2	U	0.2	U	0.2	U
Trans-1,4-Dichloro-2-butene	ug/L	1	U	1	U	1	U
1,1-Dichloroethane	ug/L	0.2	U	0.2	U	0.2	U
1,2-Dichloroethane	ug/L	0.2	U	0.2	U	0.2	U
1,1-Dichloroethene	ug/L	0.2	U	0.2	U	0.2	U
Cis-1,2-Dichloroethene	ug/L	0.2	U	0.2	U	0.2	U
Trans-1,2-Dichloroethene	ug/L	0.2	U	0.2	U	0.2	U
1,2-Dichloropropane	ug/L	0.2	U	0.2	U	0.2	U

December 2018 Cedar River WellsGroundwater Analytical Results

ANALYTE	UNITS	LMW-20		LMW-21		LMW-22	
1,3-Dichloropropane	ug/L	0.1	U	0.1	U	0.1	U
2,2-Dichloropropane	ug/L	0.1	U	0.1	U	0.1	U
1,1-Dichloropropene	ug/L	0.1	U	0.1	U	0.1	U
Cis-1,3-Dichloropropene	ug/L	0.2	U	0.2	U	0.2	U
Trans-1,3-Dichloropropene	ug/L	0.2	U	0.2	U	0.2	U
Ethylbenzene	ug/L	0.2	U	0.2	U	0.2	U
Hexachlorobutadiene	ug/L	0.2	U	0.2	U	0.2	U
2-Hexanone	ug/L	5	U	5	U	5	U
Iodomethane	ug/L	0.5	U	0.5	U	0.5	U
Isopropyl Benzene	ug/L	0.2	U	0.2	U	0.2	U
4-Isopropyl Toluene	ug/L	0.2	U	0.2	U	0.2	U
Methylene Chloride	ug/L	1	U	1	U	1	U
Methyl isobutyl ketone	ug/L	2.5	U	2.5	U	2.5	U
Naphthalene	ug/L	0.5	U	0.5	U	0.5	U
n-Propylbenzene	ug/L	0.2	U	0.2	U	0.2	U
Styrene	ug/L	0.2	U	0.2	U	0.2	U
1,2,3-Trichlorobenzene	ug/L	0.2	U	0.2	U	0.2	U
1,2,4-Trichlorobenzene	ug/L	0.5	U	0.5	U	0.5	U
1,1,1,2-Tetrachloroethane	ug/L	0.2	U	0.2	U	0.2	U
1,1,2,2-Tetrachloroethane	ug/L	0.1	U	0.1	U	0.1	U
Tetrachloroethene	ug/L	0.2	U	0.2	U	0.2	U
Toluene	ug/L	0.2	U	0.09	J	0.2	U
1,1,1-Trichloroethane	ug/L	0.2	U	0.2	U	0.2	U
1,1,2-Trichloroethane	ug/L	0.2	U	0.2	U	0.2	U
Trichloroethene	ug/L	0.2	U	0.2	U	0.2	U
CFC-11	ug/L	0.2	U	0.2	U	0.2	U
CFC-113	ug/L	0.2	U	0.2	U	0.2	U
1,2,3-Trichloropropane	ug/L	0.2	U	0.2	U	0.2	U
1,2,4-Trimethylbenzene	ug/L	0.2	U	0.2	U	0.2	U
1,3,5-Trimethylbenzene	ug/L	0.2	U	0.2	U	0.2	U
Vinyl Acetate	ug/L	0.2	U	0.2	U	0.2	U
Vinyl Chloride	ug/L	0.1	U	0.1	U	0.1	U
m, p-Xylene	ug/L	0.4	U	0.4	U	0.4	U
o-Xylene	ug/L	0.2	U	0.2	U	0.2	U
Total Xylenes	ug/L	0.6	U	0.6	U	0.6	U

Notes:
U - Analyte was not detected above the MDL. The Reporting Limit (RL) is listed.
J - Analyte was detected above the Method Detection Limit (MDL) but below the RL.
[1] - The MDL is listed for the non-detected 1,4-Dioxane results .