Attachment D

2013 Groundwater Data Evaluation

Department of Natural Resources and Parks

Solid Waste Division

CEDAR HILLS REGIONAL LANDFILL 2013 GROUNDWATER DATA EVALUATION

APRIL 2014

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EXECUTIVE SUMMARY

This 2013 Groundwater Data Evaluation Annual Report summarizes groundwater data collected in 2013 and presents significant findings supported by the evaluation of this data.

Groundwater at the Cedar Hills Regional Landfill (CHRLF) occurs both in a regional aquifer and in perched zones. The regional aquifer flows through advance outwash and deeper deposits and is separated from the base of waste placement areas by more than 200 feet of unsaturated sands and gravels. Perched groundwater occurs in onsite till, ice-contact deposits and recessional outwash. No laterally or vertically extensive perched zones have been identified; leaving the regional aquifer beneath the landfill as the earliest target hydraulic pathway for groundwater contaminant detection.

REGIONAL AQUIFER

The regional aquifer beneath CHRLF is entirely recharged by precipitation. A local recharge area is located immediately south of the landfill within the Queen City Farms (QCF) property, and is centered north of the Main Gravel Pit Lake. In general, groundwater flow in the regional aquifer is radial from the recharge area. Beneath the landfill, regional flow is to the north in the south and central portions of the landfill site. Flow direction in the northern part of the site turns northeasterly as recharge from the McDonald Creek drainage affects flow patterns. Regional Aquifer flow is physically separated from the Cedar River and likely discharges to Issaquah Creek. There is no significant seasonal variation in horizontal groundwater flow paths. Horizontal gradients are influenced by infiltrating precipitation in the recharge area. Vertical hydraulic gradients are demonstrated by head differences in adjacent wells screened at different depths and related to hydraulic conductivity of the aquifer materials. A flow path analysis has been completed for the site and indicates a complex flow regime in the landfill vicinity

A monitoring network is in place consisting of 45 monitoring and production wells. Monitoring network wells are located to characterize groundwater flow and to obtain representative samples for water quality characterization. Downgradient flow converges into a high transmissivity zone which provides excellent monitoring coverage for all flow paths within the potential source area.

An extensive list of chemical analytes and field parameters are analyzed and the results are evaluated by a variety of graphical and statistical methods. The groundwater data analyses presented in this report describe onsite groundwater elevations, flow direction and velocity; and summarizes the evaluation of groundwater quality to determine if chemical concentrations have changed over time or differ between well locations. This report determines if these findings are indicative of impacts to groundwater quality by surface activities.

Upgradient groundwater quality, especially in wells nearest the southern recharge zone, is profoundly affected by conditions and activities that have occurred on the adjoining QCF property. Upgradient groundwater quality manifests a high degree of spatial variation and temporal trends, which are expected given recharge area site history which has included a variety of land uses, investigations and remediation.

As flow continues into areas beneath the landfill footprint changes are discernible as groundwater encounters and equilibrates to different oxidation-reduction conditions, soil gas/groundwater interface conditions and solvent/solute interactions. Flow paths under the footprint and immediately downgradient of waste cells are influenced by landfill gas (LFG) in the unsaturated strata. Flow paths in the north landfill area (aligned along MW-66, MW-74, MW-75 and MW-91) are notably higher in chloride concentrations. The data are consistent with an input from onsite, overlying infrastructure in the north end. Concentrations have declined since maximum levels reached in 2008-2010.

Downgradient groundwater quality also manifests a high degree of spatial variation and temporal trends. Much as recharge effects are dampened with distance from the source, the concentrations of many analytes are attenuated by processes such as dispersion dilution, sorption, and degradation as groundwater flows beneath the landfill. The highest concentrations of certain analytes occur in upgradient wells. Groundwater quality in the regional aquifer leaving the site remains consistent with historical data.

These data indicate that CHRLF acts as an attenuation zone for upgradient impacts, allowing a reduction in the concentration of chlorinated volatile organic compounds (CVOCs).

The regional aquifer is the first continuously saturated zone beneath the landfill and serves as the earliest path for detection monitoring. Recent water quality evaluations of QCF groundwater are available in the *2010 Expanded Hydrogeology Assessment Queen City Farms King County, Washington*, (December 2010) and *Report Evaluation of Remedial Action 10-Year Review Queen City Farms King County, Washington* (2008).

PERCHED ZONES

Perched groundwater occurs in onsite till, ice-contact deposits and recessional outwash. No laterally or vertically extensive perched zones have been identified. Recharge is by precipitation with possible hydraulic continuity to surface streams.

Impacts from past landfilling practices have previously been recognized in several perched zone wells. Site improvements and engineered facilities have been effective in reducing contaminant concentrations attributable to past practices. Declining or stable long term trends for many contaminants are apparent in these wells. The influence of landfill gas on groundwater quality continues in east side perched groundwater. Additional investigations are in planning to evaluate residual impacts and make recommendations. Recent findings are available in the Technical Memoranda *Results of Groundwater Sampling and Fate and Transport Analysis South Solid Waste Area Perched Zone Assessment*, April 2010, and the *East Main Hill Perched Zones*, October 2010.

CEDAR HILLS REGIONAL LANDFILL
2013
GROUNDWATER DATA EVALUATION

1.0 INTRODUCTION

This Cedar Hills Regional Landfill (CHRLF) 2013 Groundwater Data Evaluation report evaluates groundwater monitoring data collected during the past calendar year and summarizes the significant findings supported by these evaluations. This report evaluates water quality in the regional aquifer, which is the first continuously saturated zone beneath the landfill and provides the earliest path for detection monitoring. Water quality in the perched water-bearing zones at CHRLF is also evaluated.

Chapter 2 contains a brief description of the geologic and hydrogeologic conditions at CHRLF. For a complete discussion of site conditions, the development of the hydrogeological model and monitoring network, see the *Cedar Hills Regional Landfill Sitewide Hydrogeologic Report*, March 2004. Additional findings from subsequent investigations can be found in*Cedar Hills Regional Landfill Site Wide Hydrogeologic Report Addendum*, December 2013.

Chapter 3 discusses the methods used to evaluate and analyze the groundwater data, and Chapter 4 presents the results of these evaluations. Conclusions based on the analyses results are included in Chapter 5.

Groundwater monitoring has been conducted at the CHRLF since 1983. A large quantity of data has been developed for the site as a result of the monitoring program. The groundwater monitoring program and this annual data evaluation are in accordance with the King County Board of Health Solid Waste Regulations (Title 10, Rules and Regulations No. 03-06) and “Criteria for Municipal Solid Waste Landfills” (Chapter173-351 WAC).

2.0 GEOLOGY AND HYDROGEOLOGY

In order to effectively analyze water quality data collected at CHRLF, it is important to have a clear understanding of the regional and site geology and hydrogeology, and to understand groundwater occurrence and flow beneath the Cedar Hills site. Figure 2-1 displays the location of CHRLF in a regional context and Figure 2-2 indicates the environmental monitoring locations for groundwater, surface water and landfill gas migration detection. Figures 2-3 and 2-4 provide cross sectional views of the major hydogeologic features of the landfill site. A detailed discussion of site geology and hydrogeology is beyond the scope of this report, but may be found in the *Cedar Hills Regional Landfill Site wide Hydrogeologic Report*, March 2004 and the *Phase I Investigations Groundwater Monitoring Well System Enhancements Technical Memorandum*, October 2007. Geologic evaluations of the CHRLF site have identified a complex history of sediments deposited by rivers, lakes and glaciers over volcanic and sedimentary bedrock. Sediments beneath the site consist of generally fine grained sands and silts, in some areas part of a prehistoric lake deposit. In the northern portion, the sediments are continuous with coarse sands and gravels, suggesting removal by erosion of the finer sediments and replacement by river channel deposits. These sediments are overlain by a thick blanket of sands and gravels deposited during Vashon era glacial advance. The advance outwash is capped by a complex group of deposits overridden by or deposited from the glacial ice (till, contact deposits and recessional outwash).

Groundwater occurs both as a regional aquifer and in perched zones. The regional aquifer flows through advance outwash and deeper deposits and is separated from the base of waste placement areas by more than 200 feet of unsaturated sands and gravels. Perched groundwater occurs in onsite till, ice-contact deposits and recessional outwash. No laterally or vertically extensive perched zones have been identified; therefore, the regional aquifer beneath the landfill is the earliest target hydraulic pathway for groundwater contaminant detection. The regional aquifer potentiometric surface lies at approximately 350 feet MSL at the south property line and at approximately 285 feet MSL at the north east.

The regional aquifer beneath CHRLF is entirely recharged by precipitation. A dominant local recharge area is located immediately south of the landfill within the QCF property, centered north of the Main Gravel Pit Lake. In general, groundwater flow in the regional aquifer is radial from the recharge area. Beneath the landfill, regional flow is to the north in the south and central portions of the landfill site. Flow direction in the northern part of the site turns northeasterly as recharge from the McDonald Creek drainage comes into effect. Flow then converges into a high transmissivity channel and likely discharges to Issaquah Creek. There is no significant seasonal variation in horizontal groundwater flow paths; horizontal gradients are influenced by infiltrating precipitation in the recharge area. Vertical hydraulic gradients in the southern area are demonstrated by head differences in adjacent wells screened at different depths. Flow determinations and a Regional Aquifer Potentiometric Surface Map are prepared quarterly by a licensed Hydrogeologist.

2.1 LOCAL PERCHED WATER BEARING ZONES

A number of local water bearing zones have been identified in the Vashon-aged units around the Cedar Hills site. Table 2-1 lists onsite wells, and gives construction dates and locational information. The perched zones are divided into three groups for discussion and presentation purposes. The North and West perched zones are monitored by five wells and include areas along the west and north buffers and infrastructure north of landfilled areas. The East Main Hill perched zone is monitored by 10 wells and extends along the eastern edge of the landfill adjacent to unlined areas. The South Solid Waste Area (SSWA) perched zone has nine well completions encompassing the non-contiguous South Solid Waste Area and extending into CHRLF's south buffer area, abutting Queen City Farms (QCF). Though water levels are obtained from multiple wells in each zone, lateral or vertical continuity between wells in a zone cannot be assumed.

Recent investigations focused on the SSWA perched zone and the East Main Hill perched zone. The SSWA is monitored by well MW-101 (water levels and water quality), MW-25, MW-41S, MW-41D, MW-45, MW-79, MW-96, MW-97 and MW-105 (water levels only). Findings from this investigation are presented in the Technical Memorandum *Results of Groundwater Sampling and Fate and Transport Analysis South Solid Waste Area Perched Zone Assessment,* April 2010. The East Main Hill perched zones are monitored by wells MW-30A, MW-47, MW-62 MW-63, and MW-EB6 (water level and water quality); and wells MW-48 and MW-50, MW-102, MW-103 and MW-104 (water levels only), Recent investigation findings for this zone are presented in the *East Main Hill Perched Zones Technical Memorandum*, October 2010.

2.2 REGIONAL AQUIFER

The regional aquifer, contained within the pre-Vashon stratigraphic units, has been identified as the shallowest laterally extensive water bearing zone encountered beneath the landfill; and is therefore the earliest target hydraulic pathway for groundwater contaminant detection. A monitoring network is in place consisting of 42 monitoring and three production wells where water level measurements are obtained. Thirty-nine monitoring wells are also sampled and analyzed for water quality. Table 2-1 lists all wells, construction dates and locational information for onsite wells.

The *Cedar Hills Regional Landfill Regional Aquifer Technical Memorandum*, March 2011, is a follow up to the *Groundwater Monitoring Well System Enhancements Phase I* investigation and provides an extensive groundwater flow path analysis of horizontal and vertical gradients, delineates detection zones for regional wells and recommends refinements to the groundwater monitoring network. An addendum to the site-wide hydrogeological report has been prepared that incorporates findings and recommendations of the recent investigations. To support ongoing monitoring and incorporate modifications, an updated sampling and analysis plan, *Environmental Monitoring Sampling and Analysis Plan for Cedar Hills Regional Landfill* will be implemented in 2014.

The piezometric surface contour maps (Appendix I) indicate a north and northeasterly flow direction in the regional aquifer. Interpolation and contouring methodology are the methodology developed for the *Technical Memorandum Phase I Investigations Groundwater Monitoring Well System Enhancements,* October 2007. Quarterly monitoring of groundwater elevations has shown very little seasonal or annual variability in regional groundwater flow and velocity. For 2013, the average horizontal flow velocities for the regional aquifer have been calculated to range from 0.013 ft/day in the south landfill area, to 2.05 ft/day in the central area and 1.83 ft/day in the north area.

3.0 DATA COLLECTION AND EVALUATION

Environmental samples are collected and analyzed in accordance with the *Quality Assurance Project Plan for Environmental Monitoring at King County Solid Waste Facilities* (QAPP) (1999) and the *Environmental Monitoring Sampling and Analysis Plan for Cedar Hills Regional Landfill* (2002) (SAP). These documents contain procedures to ensure that environmental data meet desired objectives for quality, consistency and documentation.

Groundwater quality is evaluated by comparison of analysis results to regulatory standards, geochemical analysis and statistical evaluation. Following is a brief description of each. King County Solid Waste Division monitors groundwater in accordance with Chapter 173-351 WAC.

Data collected include field parameters and laboratory analysis results. These data are evaluated by a variety of graphical and statistical methods. The groundwater evaluation presented herein describes onsite groundwater elevations, flow direction and velocity.

Groundwater chemical data are evaluated to determine if chemical concentrations have changed over time or differ between well locations. Groundwater evaluation serves to determine evidence of impacts to groundwater quality by surface activities.

3.1 DATA REVIEW

Throughout the groundwater monitoring program conducted by KCSWD, numerous Quality Assurance/Quality Control (QA/QC) samples have been collected and analyzed as an ongoing part of meeting data quality objectives. These samples include field and trip blanks, field duplicates and split samples for inter-laboratory comparison. Laboratory data was reviewed as outlined in the QAPP for compliance with Data Quality Objectives (DQOs) and Quality Assurance/Quality Control (QA/QC).

Field data collection QA/QC is ensured by adherence to standardized procedures of instrument calibration and data acquisition as outlined in the SAP. The laboratory data review is conducted by county staff with the initial responsibility for the correctness and completeness of the data. The reviewer will evaluate the quality of the work based on guidelines established in the QAPP to ensure that:

- Appropriate procedures have been followed.
- Laboratory deliverables are correct and complete.
- Analyses are completed within holding times.
- QC sample and laboratory blank results are within appropriate QC limits.
- Documentation is complete.

Data qualifiers may be assigned to the data based on the QA review. The qualified data will then be made available for data evaluation and interpretation. A compilation of water quality data for groundwater, surface water and leachate are presented in Appendix IV.

3.2 GROUNDWATER ELEVATION AND FLOW

Groundwater potentiometric surface maps and flow velocity calculations are presented in Appendix I. Hydrographs of water levels and precipitation over time are presented in Appendix II. Wells are grouped by detection zones as described in *Regional Landfill Regional Aquifer Technical Memorandum* and by groundwater elevation on the hydrographs.

Flow determinations are calculated quarterly by a Licensed Hydrogeologist and following the model presented in the Hydrogeologic Report and subsequent investigation.

3.3 GROUNDWATER ANALYTICAL DATA

The outcome of the sampling, analysis and data review processes are data that meet the requirements for use in evaluating groundwater quality and can be used as a basis for decision making. Statistical and graphical methods are then applied to answer questions of comparison.

Descriptive statistics are calculated and tabulated to provide a snapshot of data set distributional parameters. These include the number of analyses, number of detections, minimum, maximum, mean, standard deviation and median. Although both means and medians are reported in the summary tables, medians are used in the text because they tend to be a more reliable measure of central tendency in the case of non-normal distributions, particularly when there are outliers, as is the case here.

Using the Shapiro-Wilk test for normality, data sets are tested for approximation to a normal distribution, to determine which statistical procedures, described below in sections 3.5 and 3.6, may be appropriately applied.

3.4 GROUNDWATER QUALITY STANDARDS

Water quality monitoring results are compared to Washington State Groundwater Quality Criteria, Chapter 173-200 WAC. Changes to Criteria for Municipal Solid Waste Landfills Chapter 173-351 WAC effective December 9, 2012 added total metals analysis along with dissolved metals analysis for eight sampling periods in order to establish background data sets for total metals. Subsequent evaluations will use only the total metals faction for Criteria evaluations. Both total and dissolved metals factions were analyzed for the final three quarters of 2013. Standards are compared to actual analytical values, not mean or median values. All exceedances are determined by the standards that were in effect at the time of the sampling and are summarized in Tables 4-1a and 4-1b. These tables include primary standard exceedances, those where concentrations are greater than the criteria for analytes having health consequences, and exceedances of secondary criteria, non-mandatory guidelines regarding aesthetic (taste, odor, or color) or cosmetic (tooth or skin discoloration) effects.

3.5 TREND TESTING

Testing for trend is one of our primary means of evaluating water quality data over time. The statistical test used is the Mann-Kendall test for trend. This test is well suited for environmental data (Gibbons 1994) as it makes no distributional assumptions (non-parametric); and allows irregularly spaced (temporally) samples. Values below detection limits are allowed in the calculation, a condition which is frequently encountered in groundwater monitoring. The test yields the probability (p values) that a temporal trend is due to chance. Low p-values indicate low probability of a trend existing solely due to chance, therefore significant evidence of a trend exists. Values of less than 0.05 indicate statistical significance.

This test has been applied to data sets for parameters of value for evaluating water quality or that are indicative of impacts from anthropogenic sources. Naturally occurring trace level constituents with low detection frequencies are not trend tested.

The test is conducted on two data sets from each well; a short term data set consisting of the most recent two years of data, generally eight data points for quarterly monitoring, and a long term data set consisting of up to 50 results prior to the recent data set (data collected in 2011 and older for this report).

To yield meaningful results, trend results must be interpreted carefully in cases where frequency of detection is low or in cases where reporting limits have changed or analytical resolution has changed over the period of record. Trend test are conducted on an annual basis and results are tabulated in the Statistical Summary Tables (Table 4-3a and 4-3b). Statistically significant decreasing trends are denoted by “D” in the table, statistically significant increasing trends by “I”. Absence of a trend and non-significant trends are indicated in the table as “—“.

3.6 PREDICTION LIMITS

The Prediction Limit used in this evaluation is an intrawell statistical test that compares an analytical result to a computed limit value. The limit value is derived from past analytical results from the same well, considered to be representative background data. A value outside of this limiting value is considered evidence that the result is not drawn from the same sample population distribution. Population here refers to the set of potential measurements or values, including not only cases actually observed but those that are potentially observable. The prediction limits generated in this report are based on a 5% false positive rate (type I error) and depend on the background distribution. For each parameter tested, an appropriate background data set is chosen. Limits are recalculated each year with the incorporation of the previous year’s data into the dataset. The updated limits are used to define the range of expected values for future samples. The data set is tested for normality by application of the Shapiro-Wilk Test for Normality. If the data set fails the test for normality, several transformations of the data are tested. When normal or transformed normal data sets are determined, a parametric prediction limit is calculated and future results compared to this value. When all transformations fail the test for normality, a non-parametric method is applied and future results are compared to this limit.

This test is performed on a quarterly basis, Prediction Limit Exceedances of Chapter 173-351 WAC Appendix I constituents are presented in Table 4-4.

3.7 TIME-CONCENTRATION PLOTS

Time plots are generated for parameters with high detection frequencies and relevance to groundwater quality evaluation. The plots contain data from a number of wells grouped by detection zone and flow gradient location. The intent is to give the reader a visual synopsis of relevant and extensive interrelated data, rather than a graphical compilation of analytical results. All non-detections (ND) are displayed on graphs as one-half the limit of detection. All plots are scaled the same, to include the entire range of values measured and to provide a consistent context from plot to plot. Each plot shows analyte concentrations for the period 2003-2013. Since water quality data were typically collected quarterly, the plots are useful for showing temporal changes due to seasonality as well as long-term increasing or decreasing trends and a visual comparison of relative concentration magnitudes for wells in similar spatial and gradient location. Time-Concentration plots for selected parameters are included in Appendix II.

3.8 TRILINEAR DIAGRAMS

Geochemical data is presented on trilinear diagrams. Major cations and anions are plotted on individual triangles as percentages of total milliequivalents per liter (meq/L). These diagrams illustrate differences in major ion chemistry between groundwater samples and can be used to categorize water composition into identifiable groups known as hydrochemical facies. Used here, hydrochemical facies refers to distinct chemical compositions of groundwater solute concentrations contained in an aquifer. In general, a groundwater will have a dominant cation or cation pair and a dominant anion or anion pair. For our purposes, the four dominant possibilities are: calcium/magnesium or sodium/potassium for cations and chloride/sulfate or bicarbonate for anions. These facies reflect distinct compositions of cation and anion concentrations such that the value of the diagram lies in the ability to recognize relationships that exist among individual samples. Trilinear Diagrams are included with ionic balance calculations in Appendix III.

4.0 GROUNDWATER QUALITY EVALUATION

This section contains an overall description of water quality and an examination of contamination issues supported by the data. As perched zones have been identified to be neither laterally or vertically extensive and as such do not provide an opportunity for regional aquifer background characterization nor site-wide detection of waste placement areas; the regional aquifer beneath the landfill is the earliest target hydraulic pathway for groundwater contaminant detection.

Water quality, both upgradient and downgradient, is notable for its variability spatially and over time. This variability is only reasonable considering the history of activities and flow regime in place. Wells comprising the monitoring network serve to provide background characterization and downgradient performance monitoring.

The objective of the monitoring program is to utilize a system consisting of a sufficient number of wells installed at appropriate locations and depths to yield representative ground water samples from those hydrostratigraphic units which have been identified as the earlier target hydraulic pathways. The system provides data capable of providing early warning detection of any groundwater contamination and facilitates decision making that insures protection of human health and the environment.

4.1 REGIONAL AQUIFER GROUNDWATER ELEVATION AND FLOW

The primary recharge area for the regional aquifer is immediately across the south property line. Flow is radial from this center such that the flow across the south property line is oriented S to N. As flow moves northward under the property footprint, it remains predominantly to the north. As the flow approaches the north third of the landfill property, recharge from the McDonald Creek drainage affects flow patterns and flow direction changes to the NE where flow lines converge and the gradient increases. This convergent effect influences regional flow in such a way that concentrates flow into a relatively narrow corridor roughly between wells MW-66 on the NW and MW-67 on the SE. See Figure 4-1.

For the purposes of this review wells are grouped according to gradient and position in the flow regime relative to waste placement and other infrastructure. Upgradient conditions are characterized by south upgradient wells, located along the southern property border; northwest upgradient wells, influenced by the McDonald Creek drainage and northeast upgradient wells, monitoring flow paths appear to originate east if the landfill site and discharge to the convergent flow feeding the Issaquah Creek drainage.

Wells monitoring flows originating outside the landfill footprint and bypassing all landfill facilities are termed crossgradient. There are wells sampled on the east and west of the landfill where these conditions exist.

Flows downgradient of waste cells are monitored by two wells on the west side and six wells located in the convergent flow corridor. Additional flows are monitored by wells placed downgradient of north end facilities (conveyances or pump stations) but not of waste cells.

Finally, two other groups of wells provide data: wells interior to the landfill footprint and wells placed to monitor flow paths vertically beneath facilities or other areas of interest. Table 2-1 lists well groups and Figure 4-2 shows locations.

Response to seasonal rainfall is greatest at the southern wells nearest local recharge and expresses little apparent time delay. Wells along the south property line can exhibit seasonal elevation changes in excess of eight feet and are highest in the spring, immediately following the wettest months of the water year. Seasonal lows generally occur in the fall, at the end of the driest portion of the water year. For example, MW-76, MW-82 and MW-94, wells nearest to the recharge location and screened at the water table have seasonal changes of five to seven feet on average.

Wells placed further from recharge sources experience much less fluctuation with all downgradient water table wells having an average interseasonal range of one foot or less.

Hydrographs of groundwater elevations versus time appear in Appendix II in which seasonal changes in groundwater elevation are plotted along with cumulative annual precipitation. All regional well elevations are plotted along with April – March annual rainfall totals and top of screen elevations. Apparent on this plot are the correlation of seasonal recharge with depth to the water table and proximity to the recharge area. Also apparent are longer, multi-year effects of rainfall total and groundwater elevation. Recent years have experienced higher than average annual rainfall and water levels in regional wells have reached the highest static water levels since the late 1990s. Wells completed in the regional aquifer are screened in pre-Vashon deposits consisting of lacusterine or fluvial sands and silts, alluvial gravels, fluvial gravels and fluvial sands and silts.

4.2 REGIONAL AQUIFER WATER QUALITY

Groundwater in the regional aquifer manifests a high degree of spatial variation and temporal trends. This variability is expected given recharge area site conditions as described. Also contributing to data variability are long term cyclical occurrences, data collection period, time intervals in data sets and analytical variability and sensitivity. Together, these conditions make the establishment of a single benchmark “background water quality” an unusable concept.

Groundwater quality, especially in wells nearest the south recharge zone, is profoundly affected by conditions and activities that have occurred over the past fifty years on the adjoining 320-acre QCF property. In general chronological order these activities included: a pig farming operation that brought MSW in for use as feed; a business that disposed of hazardous waste in excavated pits; a general aviation airport; a solvent reprocessing and recovery operation; a gravel mine with excavation extending down to a level near the water table of the regional aquifer (Gravel Pit

Lake); and an MSW composting facility. The QCF property is listed on the National Priorities List for contaminated sites under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund) and has undergone site remediation efforts that included extensive excavation, stabilization and barrier wall construction. Groundwater quality in south upgradient CHRLF wells is impacted by chlorinated volatile organic compounds (CVOCs) from the QCF site. Presence of these contaminants and their migration is well documented in *Report Evaluation of Remedial Action 10-Year Review Queen City Farms King County, Washington*, 2008 and the *Expanded Hydrogeology Assessment Queen City Farms King County, Washington*, 2010.

Constituents associated with QCF releases are tetrachloroethene (PCE), trichloroethene (TCE) *cis* 1,2-dichloroethene (1,2-DCE) and vinyl chloride (VC).

As flow continues into areas beneath the landfill footprint changes are discernible as groundwater encounters and equilibrates to different oxidation-reduction conditions, soil gas/groundwater interface conditions and solvent/solute interactions. Attenuation processes also act to continue to degrade and disperse CVOCs from the QCF releases.

LFG Determined Conditions

Important consideration in wells screened at the water table located in flow paths under the footprint and immediately downgradient of waste cells (wells designated as interior, vertical to facilities, northwest downgradient and downgradient) is the influence of landfill gas (LFG) in the unsaturated strata. The presence of LFG significantly raises the partial pressure of carbon dioxide (CO_2) in the unsaturated zone and alters conditions that lead to measurable differences in water quality. Among these are redox sensitive constituents (iron, manganese, arsenic and nitrogen species), carbonate system equilibria (alkalinity and buffering capacity), and dissolution/precipitation processes in which most metal cations participate.

Groundwater under the influence of LFG is best characterized by changes in alkalinity as CO_2 dissolves creating carbonic acid (H_2CO_3), which then brings mineral cations into solution and stabilizes as bicarbonate ion (HCO_3^-). Calcium and magnesium are the primary cations solubilized. Analytically, this process increases specific conductance, total dissolved solids (TDS), total alkalinity metal cations (calcium, magnesium, barium) and associated anions (sulfate).

Viewing the series of time/concentration plots for alkalinity demonstrates this process. Upgradient wells south, northwest and northeast all have alkalinity values generally less than 100 mg/L $CaCO_3$. As flow reaches interior, vertical and downgradient wells values between 100 and 200 mg/L are more common, along with similar increases in calcium, magnesium and barium conductance and TDS.

Following flow further through the site, conditions change as the presence of LFG beyond the landfill footprint is diminished and therefore the partial pressure of CO_2 decreases, the kinetics of the system change and conditions revert to alkalinities below 100 mg/L and concentrations of other similarly mobilized analytes similar to upgradient conditions.

Other Parameters

Time/concentration plots are included for additional regularly detected water quality indicator parameters. These include chloride, nitrate, sulfate, iron, manganese, potassium, sodium, arsenic, barium. Infrequently detected in regional aquifer wells is dichlorodifluoromethane, which is believed to have been inadvertently introduced into MW-24 by a pressurized water level measuring device in the 1990s and which is a minor constituent of landfill gas.

Of these parameters iron, manganese, arsenic, sulfate and nitrate are sensitive to redox conditions and may be mobilized into or depleted from groundwater flow depending on local redox conditions. Native soils can serve as a source material for iron manganese, arsenic and sulfate.

Chloride, potassium and sodium are conservative indicators that do not readily participate in redox, sorption or biological processes and therefore are indicative of an external input to the system.

As with the changes along the flow paths described tor alkalinity and associated parameters, a similar analysis for chloride can be made. Most regional wells in all flow regimes have chloride concentrations generally below 8 mg/L. Exceptions to these levels are notably higher concentrations in the flow paths aligned along MW-66, MW74, MW-75 and MW-91 in the north landfill area and a recent increase in south upgradient wells MW-76, MW-83 and MW-94. Similar patterns are followed by sodium and potassium in these wells.

The data indicate these observations are consistent with a chloride input from onsite, overlying infrastructure in the north end for the downgradient wells; and by recent land use alterations and site activities offsite on the south end for wells MW-76, MW-83 and MW-94.

Flows further downgradient onsite have concentrations again below 8 mg/L, reflecting regional aquifer flow mixing and attenuation processes.

4.2.1 Water Quality Exceedances

Water quality exceedances are tabulated in Table 4-1a. Data are compared to Washington State Ground Water Criteria (GWC) (WAC 173-200-040). The secondary standards provide a measure of the aesthetic condition (taste, odor and color) and do not present a risk to human health.

Analytes exceeding primary standards in the regional aquifer are arsenic and the chlorinated volatile organic compounds (CVOCs) trichloroethene (TCE) and vinyl chloride (VC).

Arsenic occurs naturally in native soils and can be mobilized in groundwater by depressed redox and affected by pH conditions and ions available to form complexes or adsorption sites.

Arsenic was detected in eight wells in 2012 when only dissolved factions were analyzed. In 2013 dissolved Arsenic was detected in nine regional wells but total arsenic was detected in 20 regional wells. The dissolved detections are consistent with previous results and SWD believes the total arsenic results are wholly related to the methodology change rather than a change in water quality. All detections exceeded the state GWC of 0.00005 mg/L. No dissolved results exceeded the 0.010 mg/l Federal Drinking water Standard and total arsenic exceeded the standard for six results in two wells.

TCE exceeded criteria in three wells (MW-76, MW-82 and MW-94), vinyl chloride in one well (MW-65). Trichloroethene is also consistently detected in wells MW-78 and MW-83 at concentrations below the criteria. Federal drinking water MCL was exceeded in wells MW-76 and MW-82. *Cis*-1,2-dichloroethene (*cis*-1-2DCE) is detected regularly in wells MW-24, MW-56, MW-59 and MW-76, all concentrations well below the GWC. Tetrachloroethene (PCE) is regularly detected in MW-76 at levels below the GWC.

All CVOCs detected in 2013 are in south upgradient wells and known to be compounds disposed of at QCF or degradation products of those compounds.

Secondary standards exceeded include pH, iron and manganese. The lower pH standard of 6.5 was exceeded in MW-76 and MW-78 in 2012. Natural groundwaters in the region tend to be slightly acidic, and can be influenced by surface activities and proximity to recharge by rainfall as rainfall in equilibrium with the atmosphere has a pH of ~5.5. .

Iron and manganese, like arsenic, are naturally occurring and mobilization is controlled by similar processes: redox, pH and sorption. The occurrence and concentrations of iron and manganese vary greatly over short distances. Maximum iron and manganese concentrations between individual upgradient wells vary over three orders of magnitude inferring changing redox conditions vertically and horizontally in the regional aquifer. Iron or manganese above the secondary criteria value occurs in all zones of the regional aquifer.

4.2.2 Trends

Trend test results are tabulated in the Statistical Summary of Groundwater Quality Table 4-2a.

By regulation, a finding of statistical significance is determined for analytes listed in Appendix I of Chapter 173-351 WAC. The trend test is conducted for two time periods: short term including the past two years of monitoring data and long term covering the 50 previous data points. The long term test covers data generated from mid-1998 on, so wells with a longer period of monitoring have truncated data sets.

Appendix I parameters found to have significant trends are as follows:

Appendix I Parameter	Time	Long Term Increase	Long Term Decrease	Short Term Increase	Short Term Decrease
		Upgradient and Crossgradient			
Nitrate as N		MW-56, MW-73, MW-84	MW-60, MW-76 MW-83, MW-99,	MW-65, MW-83, MW-81	MW-56, MW-73
Arsenic, dissolved			MW-99, MW-93		
Barium, dissolved		MW-93	MW-24, MW-57, MW-58A, MW-59, MW-60, MW-65, MW-94, MW-21, M3-73, MW-81, MW-99, MW-95		MW-56, MW-60
cis 1,2-Dichloroethene		MW-24, MW-59	MW-56, MW-76	MW-56, MW-59	
Tetrachloroethene			MW-76		
Trichloroethene			MW-76, MW-82, MW-83, MW-94		MW-82
Vinyl Chloride, ug/L			MW-65		
		Interior, Vertical and Downgradient			
Nitrate as N		MW-77, MW-64, MW-66, MW-80, MW-86, MW-88, MW-91	MW-70, MW-78, MW-67,	MW-78, MW-100, MW-88, MW-89, MW-90	MW-77, MW-67,
Arsenic, dissolved		MW-69, MW-88	MW-64, MW-74, MW-75, MW-80, MW-89, MW-91	MW-68	MW-64, MW-89
Barium, dissolved		MW-66, MW-67, MW-74, MW-80, MW-85, MW-87	MW-70, MW-77, MW-78, MW-100, MW-72, MW-75, MW-86, MW-88, MW-89, MW-43	MW-85	MW-77
Dichlorodifluoromethane			MW-77		
Trichloroethene		MW-78			

Decreasing trends of CVOCs are present in most south upgradient wells where QCF impacts have been recognized. Increasing trends of TCE are present in MW-24 and MW-78 and *cis*-1,2 DCE in well MW-59 where further migration and plume spread of parent compounds and degradation products are evident.

Data sets from regional wells are tested for trends using Appendix II water quality indicators such as specific conductance, total dissolved solids (TDS), and dissolved cationic (i.e. calcium, magnesium, potassium, sodium) and anionic species (i.e. bicarbonate, chloride and sulfate) that have sufficient detections to give meaningful results.

Appendix II parameter trend test results indicate variable water quality over time in all wells regardless of placement in the flow net (see Figure 4.1 and Table 4-2a). The character of these flows are representative of groundwater as it flows to Cedar Hills and provides a reference to determine changes that may take place along any of many flow paths between an upgradient well and further downgradient wells.

Interpretation of trends in Appendix II parameters

Section 4.2 discussed measurable differences attributable to conditions existing on the landfill site. Evidence of LFG/groundwater interaction is apparent in trend analysis of these parameters. There is a strong indication of LFG influence on wells MW-67, MW-68, MW-69 and MW-74 and MW-80 by trends in associated parameters alkalinity, conductance, TDS, calcium and magnesium. Barium frequently tracks with calcium and magnesium do to chemical similarities (Group IIA in the Periodic Table of the Elements). These wells are in flow paths vertical to key facilities, west side downgradient, and downgradient. Indication of LFG influence is also supported by data presented in the Statistical Summary for these wells and analytes and by the time/concentration plots, graphically presenting relative concentrations over time. Additionally, as a part of King County's response to landfill gas migration, discussed in section 8.2 of the annual report, LFG has been extracted from the unsaturated zone above the regional aquifer water table along the west side of the landfill since early 2012. The capture zone of these wells is likely to be where interaction with groundwater is likely to occur. These extraction points lie very near the flow paths and capture zones for west side downgradient wells MW-69 and MW-72.

An analogous evaluation of trends, flow and time plots can be made for chloride distribution. Long term increasing trend are observed in wells in each group, indicating widespread variability and changing conditions in recharge zones. In the south upgradient zone, trends and time/concentration plots for wells MW-76, MW-83 and MW-94 stand out. These trend results support the conclusions presented in Section 4.2.

Downgradient wells MW-74, MW-75 MW-85 and MW-87 display long term chloride trends that support the conclusion of an onsite contribution.

4.2.3 Prediction Limits

While trend testing detects a significant change in relative concentration over time by defining a direction and probability, prediction limit results provide a way of determining if future measurements are inconsistent with an established background. It sets a criterion, a limit value, such that any measurement in a future sample that exceeds that value will be considered to have been drawn from a different population. In order for a prediction limit test to be useful to test for different sample populations between wells, it is assumed that a benchmark background data set can be determined. As discussed with trend testing, a suitable background data set is unavailable. Data drawn from a variable population to construct an interwell prediction limit can lead to erroneous conclusions, indicating contamination by the landfill where there is none, or worse, failing to indicate contamination if it were present. By using an intrawell prediction limit, testing future results from a well against its own background, we can avoid the uncertainty and erroneous conclusions brought in by spatial variation, and we can also determine the existence of a change in water quality at any given monitoring well for the time interval.

The prediction limit concept is useful for evaluating parameters with high detection frequencies to detect water quality changes in discrete time intervals. A test can be done on a sample or sequence of samples (four samples collected in a year) to determine divergence from the underlying population.

By regulation, a finding of statistical significance is determined for analytes listed in Appendix I of Chapter 173-351 WAC. Table 4-3 lists intrawell prediction limit exceedances in these analytes. Parameter, well, sample date, analytical result and limit values for 2012 are included.

Prediction limit exceedances in regional wells include *cis*-1,2-dichloroethene in MW-59, following a long term increasing trend likely representing plume spread from QCF. Barium exceeded the intra-well limit in MW-83, but the concentrations are similar to other south upgradient wells. Nitrate in MW-66 exceeded the limit, also after a long term increasing trend and is less than half the concentration present in MW-73 which is upgradient to MW-66 and along a similar flow path.

The existence of upgradient prediction limit exceedances confirms that there is dynamic, unstable water quality in the regional aquifer flowing to the landfill. The prediction limit statistical test assumes a static, unchanging background dataset to compute expected future values. When this assumption does not hold, as is the case here, it increases the likelihood that exceedances of the computed limit will be found, even when these exceedances are not related to activities attributable to Cedar Hills.

In the case where upgradient water quality is unstable, prediction limits become useful as a tool to determine changing upgradient conditions with quantifiable certainty.

4.3 PERCHED GROUNDWATER

Perched groundwater occurs in onsite glacial till, ice-contact deposits and recessional outwash. No laterally or vertically extensive perched zones have been identified. For purposes of presentation and discussion, perched zones are divided into three groups; North and West Perched Zones; East Perched Zone (EPZ); and South Solid Waste Area Perched Zone (SSWA Perched Zone).

Impacts to the EPZ and SSWA by historical site activities have been recognized over the years. Several investigations have been undertaken to clarify interactions between engineered facilities, surface water and perched groundwater, and to further define perched zone extent.

Available data indicate that all onsite perched zones are separated from the regional aquifer by unsaturated deposits ranging from 100 to 300 feet. No laterally or vertically extensive perched zones have been identified leaving the regional aquifer beneath the landfill as the earliest target hydraulic pathway for groundwater contaminant detection. For this reason the regional aquifer, rather than any perched groundwater, is the target hydraulic pathway for detection monitoring.

Sampling and analysis of groundwater in the perched zones allows changes in water quality from site activities to be assessed.

Table 2-1 lists perched wells, construction dates and locational information.

4.3.1 Groundwater Elevation and Flow

Depth to water and seasonal precipitation response plot is located in Appendix II. Flow direction and velocity are not determined due to the discontinuous nature of perched zones. current understanding of groundwater occurrence and flow are presented in the *East Main Hill Perched Zones Technical Memorandum*, published in 2010 for the east perched zones and in *Results of Groundwater Sampling and Fate and Transport Analysis South Solid Waste Area Perched Zone Assessment,* April 2010, for the SSWA zones.

4.3.2 Water Quality Exceedances

Perched zones water quality exceedances for 2013 appear in Table 4-1b. Water quality exceedances in perched wells are consistent with previous data. In the North and West zone wells, arsenic occurs in MW-27A at concentrations above the GWC and federal drinking water MCL for both total and dissolved factions. Secondary standards are exceeded for pH (wells MW-28 and MW-29), iron (MW-55) and manganese (MW-27A and MW-55).

In the EPZ, primary state GWC standards were exceeded for arsenic in MW-47 and MW-EB6 for both total and dissolved factions, all below the federal MCL; 1,1-dichloroethane (MW-30A and MW-62); and vinyl chloride in well, MW-47, exceeding state criteria but below the federal

MCL. Secondary standards were exceeded for pH in MW-30A, MW-62 and MW-EB6, for TDS in MW-47, for iron in MW-47and MW-EB6; and for manganese in MW-47 and MW-EB6.

In the SSWA perched zone, MW-101 arsenic exceeded the primary federal drinking water MCL for both total and dissolved factions in one sample and the GWC in all samples. Vinyl chloride exceeded the federal drinking water in all samples. Iron and manganese exceeded the secondary standard in MW-101.

As previously discussed, arsenic occurs naturally in native soils and can be mobilized in groundwater by depressed redox and affected by pH conditions and ions available to form complexes or adsorption sites. The physical and spatial properties of the perched zones enhance the likelihood of exposure to one or more of these mechanisms. Although arsenic can be found in leachate, the probability of leachate as a source of arsenic in groundwater samples is unlikely considering processes such as dilution and sorption that would reduce the contribution from leachate. It is likely that arsenic detected in site wells is mobilized from native soils by redox or pH changes which can be brought about by landfill associated processes.

The frequency and variety and concentration of VOC exceedances in the EPZ and SSWA wells have declined over time. Primary standards have been exceeded by seven VOCs at some point during the monitoring history of the perched zone wells. Presently only two compounds, 1,1-dichloroethane and vinyl chloride have exceeded standards.

Iron and manganese, like arsenic, are naturally occurring and are mobilized by similar processes, redox, pH and sorption. Iron and manganese exceedances occur in both impacted and unimpacted perched wells.

4.3.3 Trends

Trend test results are tabulated in the Statistical Summary of Perched Groundwater Quality Table 4-3b. North and West perched zone wells display few trends short term. In long term data, MW-27A shows significant decreasing trend pH, iron and barium. MW-28 tests significantly decreasing trend in most parameters and an increase in chloride, though all data in are within the historical range. MW-29 shows no long term increasesand, as with MW-28, all data in are within the historical ranges. MW-55 displays long term increasing trends in conductance, alkalinity, TDS, sulfate, iron, manganese, calcium and magnesium. Though concentrations remain similar to or below other north and west perched wells, these trends indicate the possible influence of LFG, as MW-55 is located in the vicinity of LFG migration and control efforts started in 2012. Regional aquifer well MW-69 is better positioned to monitor changes due to LFG migration in the higher transmissive deposits targeted fo LFG extraction.

East perched zone wells MW-30A and MW-47 show long term increasing trends in multiple parameters associated with the presence of LFG, conductance, TDS, alkalinity, calcium and magnesium. MW-30A also displays long term increases for chloride, potassium and sodium, though all these remain at concentrations within the historical range.

CVOCs, also in MW-30A and MW-47 show long term decreases with the exception of dichlorofluoromethane and *cis* 1,2-DCE in MW-47 which show a long term increases yet remain within the historical range. MW-62 shows long term decreasing trends for most parameters. Short term trends are generally not statistically significant in any east perched zone wells.

Monitoring well MW-EB6 is seasonally dry and often dewaters during purging and sampling. For these reasons, getting representative samples is difficult and the data are highly variable. Even so, trend testing results in long term decreases in conductance, iron, manganese, calcium, magnesium, potassium, arsenic, barium and toluene. Ammonia tests increasing long term. Short term shows increasing trends for Ammonia and sulfate and decreasing potassium.

The South Solid Waste Area perched zone is monitored for water quality by MW-101. Several other SSWA zone wells have been sampled occasionally during ongoing investigation and have not produced sufficient data for trend testing. MW-101 yields short term declining short term trends for pH, conductance, alkalinity, manganese, calcium, potassium, arsenic, barium and vinyl chloride. Long term, there are declining trends for conductance, nitrate, sodium and barium. There are no increasing trends in MW-101.

Short term trends can be influenced by more recent site activities, especially in perched zone wells with high response to seasonal precipitation. Analytical variation can also contribute statistically to trend detection.

4.3.4 Prediction Limits

Perched zone data were tested for intrawell prediction limit exceedances for Appendix I analytes where adequate data are available. In 2012, no exceedances of intrawell prediction limits were detected in any perched wells.

5.0 SUMMARY AND CONCLUSIONS

5.1 REGIONAL AQUIFER

The regional aquifer is the first continuously saturated zone beneath the landfill and serves as the earliest path for detection monitoring. Groundwater flowing onto the CHRLF site is highly variable both spatially and temporally

Recharge of the regional aquifer beneath CHRLF is predominately by rainfall. Primary recharge areas are the McDonald Creek Drainage to the northwest and Gravel Pit Lake centered on the QCF property to the south of the landfill. QCF has been the site of many activities including solid and hazardous waste disposal, solvent reprocessing and recovery; gravel mining; and a composting operation. The property is on the National Priorities List for hazardous waste sites and has gone through remediation efforts including excavation, stabilization and barrier wall construction. These past activities and current conditions affect and define upgradient groundwater quality for CHRLF. Groundwater flow from the recharge area is radial and is monitored by extensive networks of wells at both QCF and CHRLF.

Groundwater data are evaluated according to gradient and position of the well in the flow regime relative to waste placement and other infrastructure. Upgradient conditions are characterized by south upgradient wells, located along the southern property border; northwest upgradient wells, influenced by the McDonald Creek drainage and northeast upgradient wells, monitoring flow paths appear to originate east if the landfill site and discharge to the convergent flow feeding the Issaquah Creek drainage.

Wells monitoring flows originating outside the landfill footprint and bypassing all landfill facilities are termed crossgradient. There are wells sampled on the east and west of the landfill where these conditions exist.

Flows downgradient of waste cells are monitored by two wells on the west side and six wells located in the convergent flow corridor. Additional flows are monitored by wells placed downgradient of north end facilities (conveyances or pump stations) but not of waste cells.

Two other groups of wells provide data: wells interior to the landfill footprint and wells placed to monitor flow paths vertically beneath facilities or other areas of interest.

Upgradient water quality to CHRLF exhibits wide spatial and temporal variation. Contamination of the regional groundwater by CVOCs on the QCF site is well documented, as is migration across the property line and under CHRLF.

The CVOCs TCE, PCE and *cis*-1,2-dichloroethene are detected regularly in several upgradient wells. TCE was present in five upgradient wells, exceeding primary drinking water standards in two. Vinyl chloride is regularly detected in one upgradient well and is likely related to degradation of the PVC monitoring well construction materials. Overall, primary groundwater criteria were exceeded in some upgradient wells for TCE, vinyl chloride and arsenic. Some wells exceeded secondary standards for iron, manganese and occasionally the lower standard for field pH.

As flow moves northward under the property footprint, it remains predominantly to the north until recharge from the McDonald Creek drainage affects flow patterns resulting in northeasterly to the Issaquah creek basin.

Water quality changes are discernible as groundwater encounters and equilibrates to different oxidation-reduction conditions, soil gas/groundwater interface conditions and solvent/solute interactions. Flow paths under the footprint and immediately downgradient of waste cells are influenced by (LFG) in the unsaturated strata.

Flow paths aligned along MW-66, MW74, MW-75 and MW-91 in the north landfill area have chloride concentrations elevated relative to other regional wells consistent with an input from onsite, overlying infrastructure in the north end.

As the flow approaches the north third of the landfill property recharge from the McDonald Creek drainage comes into effect and flow direction changes to the NE where flow lines converge and the gradient increases. This convergent effect influences regional flow in such a way that concentrates flow into a relatively narrow corridor

A small crescent of wells in the northeast corner of the CHRLF property monitors regional aquifer flow along preferential flow paths downgradient to MSW placement. Landfill activities have raised chloride concentrations in wells MW-66, MW-74, MW-75 and MW-85. Peak concentrations have declined in MW-74 and levels in wells further along the high transmissivity flow path downgradient reach near background levels.

Downgradient ground water quality has been compared to groundwater criteria exceeded primary standards for arsenic and secondary standards for iron, manganese and pH. The CVOCs TCE, PCE and *cis*-1,2 DCE are undetected in downgradient wells. These data indicate that CHRLF is acting as an attenuation zone for upgradient QCF impacts, allowing a reduction in the concentration of VOCs, iron and manganese.

Groundwater analysis indicates the effects of interaction with carbon dioxide from landfill gas migration. This influence is detectable in regional aquifer wells screened near the water table in predominately the central portion of the landfill site. Effects noted are increased alkalinity calcium and magnesium relative to deeper screened wells. Other redox sensitive can be mobilized as well.

Additional findings related to regional aquifer flow analysis and monitoring well detection zones can be found in the *Cedar Hills Regional Landfill Regional Aquifer Technical Memorandum*, March 2011. An addendum to the site-wide hydrogeological report has been prepared and an updated sampling and analysis *Environmental Monitoring Sampling and Analysis Plan for Cedar Hills Regional Landfill* will be implemented in 2014.

5.2 PERCHED ZONES

Perched groundwater occurs in onsite till, ice-contact deposits and recessional outwash. No laterally or vertically extensive perched zones have been identified at CHRLF. Recharge of perched groundwater is by precipitation with possible hydraulic continuity to surface streams.

It is recognized that perched zones are separated from the regional aquifer, are not laterally or vertically extensive and that the regional aquifer beneath the landfill as the earliest target hydraulic pathway for groundwater contaminant detection.

Impacts from historical landfilling methods have previously been recognized in several perched zone wells. Site improvements and engineered facilities have moderated some impacts to water quality as evidenced by the long term declines for many contaminant concentrations in these wells. The influence of landfill gas on groundwater quality continues in east side perched groundwater.

Recent investigations that pertain to perched zone conditions have been completed. The Technical Memoranda *Results of Groundwater Sampling and Fate and Transport Analysis South Solid Waste Area Perched Zone Assessment*, April 2010, and the *East Main Hill Perched Zones*, October 2010 evaluate occurrence and conditions in the Main Hill and South Solid Waste Area perched zones.

These memoranda include an evaluation of the gas-to-groundwater pathway for contaminant migration and further define extent and flow paths of groundwater in the East Main Hill perched zone, and in the South Solid Waste Area perched zone, confirmation of the local extent and the fate and transport of vinyl chloride.

Secondly, efforts to date to evaluate the integrity and effectiveness of engineered facilities in closed, unlined landfill areas can be found in the *Cedar Hills Regional Landfill Environmental Management Facility Evaluation And Modifications For Closed Landfill Areas, 2007 Summary Report*, 2008.

Results and conclusions from these investigations are presented in the *Cedar Hills Regional Landfill Site Wide Hydrogeologic Report Addendum*, December 2013..

6.0 REFERENCES

Aspect Consulting, 2003, Cedar Hills Regional Landfill Hydrogeologic Investigation Report Area 6 Development Project.

Aspect Consulting, 2007, Cedar Hills Regional Landfill Technical Memorandum Phase I Investigations Groundwater Monitoring Well System Enhancements.

Aspect Consulting, 2010, Cedar Hills Regional Landfill Technical Memorandum Groundwater Sampling and Fate and Transport Analysis South Solid Waste Area Perched Zone Assessment

Aspect Consulting, 2010, Cedar Hills Regional Landfill East Main Hill Perched Zones Technical Memorandum

Aspect Consulting, 2013, Cedar Hills Regional Landfill Site Wide Hydrogeologic Report Addendum

CH2M HILL and UES, 2004a, Cedar Hills Regional Landfill Site-Wide Hydrogeologic Report.

CH2M HILL and UES, 2004b, Cedar Hills Regional Landfill Evaluation of the Perched Saturated Zone Adjacent to the South Solid Waste Area.

CH2M HILL and UES, 2004c, Cedar Hills Regional Landfill Evaluation of Perched Saturated Zones Adjacent to the Unlined Portions of the Main Hill.

CH2M HILL and UES, 2004d, Cedar Hills Regional Landfill, Regional Aquifer Hydraulic Parameter Testing Report.

Deutsch, William J. (1997) Groundwater Geochemistry, Lewis Publishers, New York,

EcoChem Inc., (October, 2009) 2008 Annual Monitoring Data Report Queen City Farms King County, Washington.

Freeze, R.A., and J.A. Cherry 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Geomatrix Consultants, Inc. 2008. Cedar Hills Regional Landfill Environmental Management Facility Evaluation And Modifications For Closed Landfill Areas, 2007 Summary Report.

Gibbons, Robert D. (1994) Statistical Methods for Groundwater Monitoring, John Wiley and Sons, New York,

King County Solid Waste Division, 1999, Quality Assurance Project Plan for Environmental Monitoring For King County Solid Waste Facilities (QAPP).

King County Solid Waste Division, 2001, Environmental Monitoring Sampling and Analysis Plan For Cedar Hills Regional Landfill (SAP).

Landau Associates, 2008, Report Evaluation of Remedial Action 10-Year Review Queen City Farms King County, Washington

Landau Associates, 2010, Expanded Hydrogeology Assessment Queen City Farms King County, Washington

Sweet-Edwards/EMCON, 1990, Contract Documents for the Construction of the Cedar Hills Regional Landfill SSWA Closure.

URS, 2005, Cedar Hills Regional Landfill Plan of Operation, April 2005 (Revised October 2005).

Washington State Department of Ecology, 1994, Natural Background Soils Metals Concentrations in Washington State, October.

Washington State Department of Ecology, 1995, Guidance on Sampling and Data Analysis Methods, 1995.

TABLES

TABLE 2-1
SUMMARY OF CEDAR HILLS REGIONAL LANDFILL GROUNDWATER WELLS

Well Number	Date Constructed	Aquifer	Zone[1]	Purpose[2]	Ground Surface Elevation	Top of Well Casing Elevation	Total Well Depth	Screened Interval Depth		Screened Interval Elevation		Coordinates Northing	Coordinates Easting
MW-24	6/1/1983	Regional	US	WL/WQ	473.8	475.99	193.0	187	192	286.8	281.8	167767.76	1702441.65
MW-54	9/26/1986	Regional	US	WL	579.3	580.43	360.0	329	351	250.3	228.3	168435.53	1702154.28
MW-56	10/12/1988	Regional	US	WL/WQ	479.2	480.33	170.5	156	166	323.2	313.2	167214.82	1698980.77
MW-57	8/22/1988	Regional	US	WL/WQ	455.7	456.64	145.5	129	144	326.7	311.7	167201.99	1699993.32
MW-58A	9/26/1988	Regional	US	WL/WQ	478.6	479.27	220.5	208.5	218.5	270.1	260.1	167207.16	1699006.59
MW-59	8/16/1988	Regional	US	WL/WQ	455.6	457.13	185.5	170.5	180.5	285.1	275.1	167193.44	1699983.91
MW-60	9/13/1991	Regional	US	WL/WQ	564.8	567.15	266.4	230	239	334.8	325.8	167873.2	1701154.47
MW-65	3/29/1993	Regional	US	WL/WQ	543.2	545.83	236.9	225.5	234.3	317.7	308.9	167146.55	1701602.10
MW-76	10/25/1999	Regional	US	WL/WQ	489.8	491.71	155.9	138.7	148.2	351.1	341.6	167193.13	1700376.23
MW-82	11/2/2000	Regional	US	WL/WQ	472.8	474.85	139.5	123.9	133.4	348.9	339.4	167725.31	1699553.72
MW-83	10/27/2000	Regional	US	WL/WQ	494.5	496.81	160.0	144.3	153.8	350.2	340.7	167212.27	1697939.89
MW-94	7/2/2002	Regional	US	WL/WQ	493.2	495.51	168.0	136	144.7	357.2	348.5	167210.22	1698674.21
MW-21	5/17/1983	Regional	UNW	WL/WQ	418.2	420.66	180.0	155	163	263.2	255.2	173876.38	1697901.86
MW-73	7/3/1999	Regional	UNW	WL/WQ	484.3	485.70	218.0	196.2	205.5	288.1	278.8	174995.59	1698954.95
MW-84	10/20/2000	Regional	UNW	WL/WQ	528.7	530.80	250.5	236.2	245.7	292.5	283.0	173894.54	1698602.89
MW-81	10/3/2002	Regional	UNE	WL/WQ	492.2	493.66	199.0	183	192	309.2	300.2	172113.99	1702568.87
MW-99	8/30/2002	Regional	UNE	WL/WQ	491.8	493.64	287.0	270	279	221.8	212.8	172098.73	1702556.06
MW-93	6/24/2002	Regional	CG	WL/WQ	630.2	632.15	350.0	310.3	320.1	319.9	310.1	169851.24	1702259.35
MW-95	7/22/2002	Regional	CG	WL/WQ	568.6	571.54	311.0	254	262.7	314.6	305.9	169426.92	1697265.32
MW-106	2/19/2009	Regional	CG	WL	473.0	475.47	270.0	193	203	280.0	270.0	173461.69	1702536.99
MW-70	5/11/1993	Regional	I	WL/WQ	527.9	530.57	221.5	205.1	218.8	322.8	309.1	168699.89	1698412.97
MW-77	10/12/1999	Regional	I	WL/WQ	550.5	552.67	251.5	230	239.5	320.5	311.0	168999.71	1700007.63
MW-78	10/8/1999	Regional	I	WL/WQ	535.3	537.35	229.5	213	225.5	322.3	309.8	169027.58	1698881.94
MW-100	8/26/2002	Regional	I	WL/WQ	618.4	620.32	124.7	299.3	309.3	319.1	309.1	169610.46	1700791.72
MW-22	5/25/1983	Regional	V	WL	515.0	517.09	284.0	279	283.8	236.0	231.2	173088.17	1701844.34
MW-64	3/22/1993	Regional	V	WL/WQ	594.3	596.55	276.3	260.3	274.1	334.0	320.2	168772.19	1701980.27
MW-66	4/5/1993	Regional	V	WL/WQ	528.6	531.28	250.7	234.2	248	294.4	280.6	174250.32	1699750.19
MW-67	4/28/1993	Regional	V	WL/WQ	514.1	516.43	232.4	216.3	230.1	297.8	284.0	172610.65	1701776.69
MW-68	4/15/1993	Regional	V	WL/WQ	644.8	647.07	354.6	333.5	352.5	311.3	292.3	170609.35	1701917.32
MW-69	4/23/1993	Regional	DW	WL/WQ	651.0	653.69	368.8	357.4	371	293.6	280.0	172400.20	1698061.86
MW-72	8/7/1998	Regional	DW	WL/WQ	669.8	671.87	389.0	366.2	375.8	303.6	294.0	170987.71	1698229.92
MW-74	11/1/2000	Regional	DG	WL/WQ	529.2	531.26	270.0	239.3	248.8	289.9	280.4	173813.79	1700386.85
MW-75	9/24/1999	Regional	DG	WL/WQ	529.8	532.40	287.0	258.7	268.8	271.1	261.0	173432.42	1701059.70
MW-80	2/27/2001	Regional	DG	WL/WQ	528.5	530.41	270.0	249.3	258.8	279.2	269.7	172964.99	1701309.78
MW-85	12/1/2000	Regional	DG	WL/WQ	529.8	531.76	270.0	247.2	256.7	282.6	273.1	173694.52	1701828.95
MW-87	11/21/2000	Regional	DG	WL/WQ	535.2	537.31	272.5	251.5	260.8	283.7	274.4	173493.76	1700670.27
MW-91	10/26/2001	Regional	DG	WL/WQ	529.7	532.02	331.0	268.9	289	260.8	240.7	173423.94	1701023.09
MW-86	12/12/2000	Regional	DNF	WL/WQ	533.9	536.04	282.0	250.5	259.3	283.4	274.6	174917.90	1701331.25
MW-88	9/13/2001	Regional	DNF	WL/WQ	511.2	513.68	248.5	229.7	239	281.5	272.2	174303.06	1701807.87
MW-89	11/12/2001	Regional	DNF	WL/WQ	510.7	512.82	328.0	281.5	290.8	229.2	219.9	174319.44	1701799.57
MW-90	8/14/2002	Regional	DNF	WL/WQ	500.2	502.22	300.0	265	274	235.2	226.2	174300.67	1702203.13
MW-43	4/30/1985	Regional	DNF	WL/WQ	544.6	547.06	325.0	299	309	245.6	235.6	174327.14	1701274.23
WS-ATC-1	2/7/1972	Regional	--	WL	624.9	625.51	535.0	325	340	299.9	284.9	169823.34	1702268.95
WS-NPW-1	8/221990	Regional	--	WL	644.6	646.33	382.0	365.7	375.7	278.9	268.9	171138.99	1701906.96
WS-NPW-3	6/51990	Regional	--	WL	644.3	645.81	376.0	359.4	367.4	284.9	276.9	170663.28	1701922.88

TABLE 2-1
SUMMARY OF CEDAR HILLS REGIONAL LANDFILL GROUNDWATER WELLS

Well Number	Date Constructed	Aquifer	Zone[1]	Purpose[2]	Ground Surface Elevation	Top of Well Casing Elevation	Total Well Depth	Screened Interval Depth		Screened Interval Elevation		Coordinates Northing	Coordinates Easting
MW-30A	9/6/1989	Perched	EPZ	WL/WQ	567.7	568.43	40.0	25	35	542.7	532.7	172345.48	1701628.59
MW-47	6/31/1985	Perched	EPZ	WL/WQ	633.6	634.60	50.0	23.5	43.5	610.1	590.1	171365.53	1701898.69
MW-48	5/24/1985	Perched	EPZ	WL	593.6	594.49	63.0	37	47	556.6	546.6	168758.73	1701985.17
MW-50	6/3/1985	Perched	EPZ	WL	636.2	637.02	39.5	27.5	37.5	608.7	598.7	170276.14	1701873.92
MW-62	2/1/1990	Perched	EPZ	WL/WQ	555.3	556.21	65.5	44	54	511.3	501.3	172397.77	1701719.18
MW-63	2/12/1990	Perched	EPZ	WL	513.8	515.88	22.0	12	17	501.8	496.8	172580.25	1701786.72
MW-102	1/27/2009	Perched	EPZ	WL	549.7	552.48	50	35	50	515.2	500.2	172313.75	1701858.76
MW-103	1/28/2009	Perched	EPZ	WL	636.8	639.08	40.00	25	35	611.8	601.8	170473.99	1702210.55
MW-104	1/29/2009	Perched	EPZ	WL	626.9	629.68	35.00	22	32	604.9	594.9	171153.34	1702169.14
MW-EB6	11/28/1990	Perched	EPZ	WL/WQ	587.9	589.61	50.0	20	30	567.9	557.9	171862.72	1702049.75
MW-27A	10/3/1985	Perched	NW	WL/WQ	583.2	584.23	80.0	59	69	524.2	514.2	169817.29	1697470.72
MW-28	6/21/1983	Perched	NW	WL/WQ	526.2	527.75	39.0	27	37	499.2	489.2	174231.84	1699966.20
MW-29	6/23/1983	Perched	NW	WL/WQ	531.7	532.92	60.0	17	27	514.7	504.7	173552.23	1700926.39
MW-55	10/2/1986	Perched	NW	WL/WQ	651.1	652.29	67.0	37.5	47.5	613.6	603.6	172364.53	1698110.11
MW-98	3/9/2001	Perched	NW	WL	501.6	503.73	22.5	10.7	20	490.9	481.6	174810.64	1699245.65
MW-25	6/3/1983	Perched	SSWA	WL	473.2	474.41	43.0	18	38	455.2	435.2	167760.97	1699580.14
MW-41S	7/12/1983	Perched	SSWA	WL	460.7	462.44	51.0	8	18	452.7	442.7	167171.51	1700100.82
MW-41D	7/12/1983	Perched	SSWA	WL	460.7	462.32	51.0	30	50	430.7	410.7	167171.51	1700100.82
MW-45	5/17/1985	Perched	SSWA	WL	487.7	488.40	64.0	31	41	447.6	457.6	167907.28	1699058.03
MW-79	11/5/1999	Perched	SSWA	WL	456.9	459.17	56.0	40.5	50	416.4	406.9	167175.91	1699495.56
MW-96	12/18/2001	Perched	SSWA	WL	545.4	547.74	102.9	88.8	97.5	456.6	447.9	168667.73	1699434.47
MW-97	9/5/2001	Perched	SSWA	WL	562.5	564.54	124.7	101	110	461.5	452.5	168380.87	1700636.96
MW-101	6/2/2006	Perched	SSWA	WL/WQ	472.1	474.72	57.50	44	54	428.1	418.1	167791.40	1699364
MW-105	1/30/2009	Perched	SSWA	WL	518.7	521.23	30.00	18	28	500.7	490.7	167697.49	1698320.49

Notes

[1]Position of the well screen in the regional aquifer flow path analysis relative to waste placement and site utilities. .

Zone Designations
US = Upgradient South Site Wells
UNW = Upgradient Northwest
UNE = Upgradient Northeast
CG = Cross Gradient
DW = Westside Downgradient
V = Vertical Key Facilites
I = Interior
DNF = Downgradient of North End Facilities outside Refuse Cells
DG = Downgradient Groundwater Flow

[2]WL = Water Level WQ = Water Quality

TABLE 4-1a

CEDAR HILLS REGIONAL LANDFILL

2013 SUMMARY OF GROUNDWATER QUALITY CRITERIA EXCEEDANCES REGIONAL AQUIFER

			Arsenic	Trichloro-ethene	Vinyl Chloride	pH (Field)	Iron	Manganese
			Primary Criteria			**Secondary Criteria**		
Well ID	Sample Date	Sample ID	0.0005 mg/L	3 ug/L	0.02 ug/L	< 6.5, > 8.5	0.3 mg/L	0.05 mg/L
Upgradient Wells								
MW-24	1/3/13	W24-130103-					3.28	0.119
MW-24	4/8/13	W24-130408-					3.45	0.129
MW-24	7/2/13	W24-130702-					3.53	0.140
MW-24	10/17/13	W24-131017-					2.79	0.100
MW-56	1/24/13	W56-130124-						0.064
MW-56	4/8/13	W56-130408-	0.0025 (T)					0.303
MW-56	7/3/13	W56-130703-	0.0024 S (T)					0.132 S
MW-56	10/3/13	W56-131003-						0.142
MW-57	1/17/13	W57-130117-					8.67	0.248
MW-57	4/9/13	W57-130409-					9.16	0.274
MW-57	7/3/13	W57-130703-	0.0024 S (T)				8.58 S	0.262 S
MW-57	10/9/13	W57-131009-					7.7	0.229
MW-58A	1/18/13	W58A130118-					1.01	0.337
MW-59	1/25/13	W59-130125-					4.41	0.0968 D
MW-59	4/16/13	W59-130416-					4.57	0.102
MW-59	7/2/13	W59-130702-					4.57	0.115
MW-59	10/9/13	W59-131009-					3.78	0.095
MW-60	7/3/13	W60-130703-	0.0016 S (T)					
MW-65	1/18/13	W65-130118-			0.043		4.4	0.20
MW-65	4/23/13	W65-130423-			0.037		4.6	0.196
MW-65	7/8/13	W65-130708-			0.040		5.1	0.208
MW-65	10/15/13	W65-131015-			0.038		4.0	0.194
MW-73	1/22/13	W73-130122-				6.19		
MW-73	4/25/13	W73-130425-				6.11		
MW-73	10/16/13	W73-131016-				6.12		
MW-76	1/25/13	W76-130125-		9.02		6.27		
MW-76	5/1/13	W76-130501-		8.11		6.26		
MW-76	7/15/13	W76-130715-		6.69		6.5		
MW-76	10/31/13	W76-131031-		8.07		6.27		
MW-78	4/26/13	W78-130426-				6.33		
MW-78	10/25/13	W78-131025-				6.36		
MW-82	1/23/13	W82-130123-		5.60				
MW-82	4/22/13	W82-130422-		5.51				
MW-82	7/23/13	W82-130723-		5.63				
MW-21	1/8/13	W21-130108-					1.87	0.075
MW-21	4/8/13	W21-130408-					2.81	0.0753
MW-21	7/2/13	W21-130702-					1.68	0.0922
MW-21	10/22/13	W21-131022-	0.0011 (T)				1.74	0.076
MW-99	1/11/13	W99-130111-	0.00204 (D)					0.0815
MW-99	4/12/13	W99-130412-	0.0023 (T)					0.0879
MW-99	7/19/13	W99-130719-	0.0022 (T)					0.0764 D
MW-99	10/22/13	W99-131022-	0.0022 (T)					0.0701

TABLE 4-1a

CEDAR HILLS REGIONAL LANDFILL

2013 SUMMARY OF GROUNDWATER QUALITY CRITERIA EXCEEDANCES REGIONAL AQUIFER

			Arsenic	Trichloro-ethene	Vinyl Chloride	pH (Field)	Iron	Manganese
			Primary Criteria			**Secondary Criteria**		
Well ID	Sample Date	Sample ID	0.0005 mg/L	3 ug/L	0.02 ug/L	< 6.5, > 8.5	0.3 mg/L	0.05 mg/L
Crossgradient and Interior Wells								
MW-93	1/16/13	W93-130116-	0.00139 (D)					0.249
MW-93	4/30/13	W93-130430-	0.0013 (T)					0.251
MW-93	7/9/13	W93-130709-	0.0013 (T)					0.293
MW-93	10/29/13	W93-131029-	0.0014 (T)					0.288
MW-95	1/17/13	W95-130117-						0.133
MW-95	5/1/13	W95-130501-						0.187
MW-95	7/9/13	W95-130709-	0.001 (T)					0.147
MW-95	10/24/13	W95-131024-						0.138
MW-78	7/3/13	W78-130703-	0.0015 S (T)					
MW-100	1/14/13	W100130114-					1.3	0.226
MW-100	4/30/13	W100130430-	0.0019 (T)				3.65	0.237
MW-100	7/9/13	W100130709-	0.0012 (T)				1.55	0.257
MW-100	10/17/13	W100131017-	0.0020 (T)				1.71	0.233
Wells Vertical to Key Facilities								
MW-64	1/16/13	W64-130116-						0.061
MW-64	4/10/13	W64-130410-	0.0017 (T)					
MW-64	7/31/13	W64-130731-	0.0020 (T)					
MW-64	10/7/13	W64-131007-	0.0039 (T)					
MW-67	1/3/13	W67-130103-						0.080
MW-67	4/23/13	W67-130423-						0.128
MW-67	7/12/13	W67-130712-						0.128
MW-67	10/15/13	W67-131015-						0.081
MW-68	1/15/13	W68-130115-	0.0018 (D)				0.99	0.227
MW-68	4/10/13	W68-130410-	0.016 (T)				3.98	0.254
MW-68	7/12/13	W68-130712-	0.0493 (T)				1.07	0.276
MW-68	10/18/13	W68-131018-	0.0328 (T)				0.73	0.236

TABLE 4-1a

CEDAR HILLS REGIONAL LANDFILL

2013 SUMMARY OF GROUNDWATER QUALITY CRITERIA EXCEEDANCES REGIONAL AQUIFER

			Arsenic	Trichloro-ethene	Vinyl Chloride	pH (Field)	Iron	Manganese
			Primary Criteria			**Secondary Criteria**		
Well ID	Sample Date	Sample ID	0.0005 mg/L	3 ug/L	0.02 ug/L	< 6.5, > 8.5	0.3 mg/L	0.05 mg/L
Downgradient Wells								
MW-69	1/8/13	W69-130108-	0.0025 (D)				1.3	0.20
MW-69	4/19/13	W69-130419-	0.0028 (T)				1.5	0.215
MW-69	7/19/13	W69-130719-	0.0039 (T)				1.04	0.212 D
MW-69	10/17/13	W69-131017-	0.0028 (T)				0.95	0.202
MW-72	1/28/13	W72-130128-					2.3	0.302
MW-72	4/22/13	W72-130422-					2.79	0.311
MW-72	7/22/13	W72-130722-					2.2	0.297 D
MW-72	10/10/13	W72-131010-					1.59	0.276
MW-75	1/11/13	W75-130111-					1.77	0.13
MW-75	4/12/13	W75-130412-					1.82	0.130
MW-75	7/18/13	W75-130718-					1.53	0.124 D
MW-75	10/24/13	W75-131024-					1.74	0.159
MW-80	1/29/13	W80-130129-	0.00334 (D)				1.260	0.22 D
MW-80	4/26/13	W80-130426-	0.0081 (T)				3.500	0.255
MW-80	7/18/13	W80-130718-	0.0046 (T)				1.600	0.249 D
MW-80	10/31/13	W80-131031-	0.0058 (T)				1.44	0.268
MW-86	1/24/13	W86-130124-					0.497	
MW-86	4/29/13	W86-130429-	0.0010 (T)				0.619	
MW-86	7/22/13	W86-130722-	0.0020 (T)					
MW-86	10/29/13	W86-131029-	0.0011 (T)				0.345	
MW-87	1/11/13	W87-130111-					3.3	0.365
MW-87	4/12/13	W87-130412-	0.0051 (T)				7.4	0.38
MW-87	7/19/13	W87-130719-	0.0016 (T)				3.46	0.387 D
MW-87	10/22/13	W87-131022-	0.0018 (T)				3.88	0.336
MW-88	1/28/13	W88-130128-	0.001 (D)					
MW-88	4/29/13	W88-130429-	0.0010 (T)					
MW-88	7/17/13	W88-130717-	0.0010 (T)					
MW-88	10/28/13	W88-131028-	0.0010 (T)					
MW-89	1/10/13	W89-130110-	0.0012 (D)				0.86	0.25
MW-89	4/19/13	W89-130419-	0.0030 (T)				1.80	0.268
MW-89	8/1/13	W89-130801-	0.0025 (T)				0.867	0.209 D
MW-89	10/28/13	W89-131028-	0.0037 (T)				0.785	0.254
MW-90	1/30/13	W90-130130-					1.3	0.265 D
MW-90	4/8/13	W90-130408-					3.00	0.279
MW-90	7/22/13	W90-130722-					1.04	0.25 D
MW-90	10/18/13	W90-131018-					0.95	0.239
MW-91	1/22/13	W91-130122-	0.00407 (D)				3.8	0.305
MW-91	4/9/13	W91-130409-	0.0369 (T)				43.20	0.824
MW-91	7/8/13	W91-130708-	0.0442 (T)				2.50	0.375
MW-91	10/28/13	W91-131028-	0.0408 (T)				2.36	0.358
MW-43	1/15/13	W43-130115-					0.91	0.214
MW-43	4/18/13	W43-130418-					1.44	0.234
MW-43	7/2/13	W43-130702-					1.01	0.255
MW-43	10/17/13	W43-131017-					0.411 H	0.199

Note: D = Dissolved Metals Faction, T = Total Metals Faction

TABLE 4-1b

CEDAR HILLS REGIONAL LANDFILL

2013 SUMMARY OF GROUNDWATER QUALITY CRITERIA EXCEEDANCES PERCHED ZONES

			Arsenic	1,1-Dichloro-ethane	Vinyl Chloride	pH (Field)	TDS	Iron	Manganese
			Primary Criteria			**Secondary Criteria**			
Well ID	Sample Date	Sample ID	0.0005	1 ug/L	0.02 ug/L	< 6.5, > 8.5	500	0.3	0.05
North and West Perched Wells									
MW-27A	01/08/13	W27A130108-	0.0155 (D)						0.066
MW-27A	04/10/13	W27A130410-	0.0113 (T)						
MW-27A	07/17/13	W27A130717-	0.0149 (T)						
MW-27A	10/08/13	W27A131008-	0.0156 (T)						0.0523
MW-28	01/14/13	W28-130114-				5.7			
MW-28	04/15/13	W28-130415-				5.5			
MW-28	07/16/13	W28-130716-				5.9			
MW-28	10/18/13	W28-131018-				6.0			
MW-29	01/10/13	W29-130110-				6.3			
MW-29	04/11/13	W29-130411-				6.4			
MW-29	07/16/13	W29-130716-	0.0028 (T)			6.5			
MW-55	01/08/13	W55-130108-							0.154
MW-55	04/09/13	W55-130409-							0.168
MW-55	07/15/13	W55-130715-							0.162
MW-55	10/08/13	W55-131008-						0.3	0.144
East Perched Zone Wells									
MW-30A	01/29/13	W30A130129-		1.57		6.3			
MW-30A	04/15/13	W30A130415-		1.90		6.1			
MW-30A	07/16/13	W30A130716-		1.94		6.4			
MW-30A	10/14/13	W30A131014-		2.33		6.3			
MW-47	01/10/13	W47-130110-			5.86		690	0.7	1.66
MW-47	04/19/13	W47-130419-	0.0020 (T)		5.01		676	3.3	2.47 D
MW-47	07/16/13	W47-130716-			4.98		719		1.83 D
MW-47	10/28/13	W47-131028-			5.11		678	0.336	1.96
MW-62	04/11/13	W62-130411-		1.65		6.5			
MW-EB6	01/14/13	WB6-130114-	0.0042 (D)			5.9		6.9	0.416
MW-EB6	04/15/13	WB6-130415-	0.0017 (T)			5.7		7.1	0.356 D
MW-EB6	11/20/13	WB6-131120-	0.0012 (T)			5.4		0.9	0.479
South Solid Waste Area Wells									
MW-101	01/28/13	W101130128-	0.0044 (D)		0.282				1.31 D
MW-101	04/24/13	W101130424-	0.0048 (T)		0.412			0.3	1.25
MW-101	07/18/13	W101130718-	0.0104 (T)		0.553			1.5	1.49 D
MW-101	10/22/13	W101131022-	0.0028 (T)		0.381			0.7	0.902 D

Note: D = Dissolved Metals Faction, T = Total Metals Faction

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-24		MW-56		MW-57		MW-58A		MW-59		MW-60		MW-65		MW-76		MW-82		MW-83		MW-94	
											Upgradient South											
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH, (Field) Standard Units																						
No. of Analyses	77	8	76	8	75	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	38	8
No. of Detections	77	8	76	8	75	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	37	8
Maximum	9.06	7.2	8.4	7.2	7.6	6.9	9.0	7.6	8.7	7.1	7.5	7.1	8.2	7.2	7.0	6.7	7.7	7.1	7.6	7.0	7.5	7.1
Minimum	5.94	7.1	5.9	6.8	6.3	6.6	6.0	7.4	5.9	6.8	6.2	6.7	6.4	6.7	6.2	6.3	6.5	6.7	6.7	6.8	0.0	6.8
Mean	7.064	7.1	7.1	7.0	6.9	6.8	7.5	7.5	7.1	7.0	7.1	7.0	7.1	6.9	6.5	6.4	6.9	6.9	7.1	6.9	6.9	6.9
Standard Deviation	0.359	0.05	0.34	0.12	0.26	0.11	0.34	0.08	0.34	0.11	0.21	0.14	0.34	0.17	0.18	0.15	0.19	0.14	0.20	0.07	1.17	0.09
Median	7.01	7.1	7.1	7.0	6.9	6.8	7.5	7.5	7.1	7.0	7.1	7.0	7.1	6.9	6.6	6.3	6.9	6.9	7.1	6.9	7.0	6.9
Specific Conductance, (Field) micromhos/cm																						
No. of Analyses	77	8	75	8	75	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	77	8	75	8	75	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
Maximum	303	185	255	165	300	230	313	205	250	185	500	210	175	175	330	200	277	265	338	355	397	310
Minimum	103	165	108	120	133	180	115	150	111	150	130	150	88	140	108	160	150	195	100	200	115	230
Mean	193	177	160	149	229	203	174	180	170	170	234	176	140	149	150	175	185	229	167	280	148	269
Standard Deviation	39	8	34	15	32	16	33	22	17	13	99	24	13	12	32	16	24	28	39	44	44	29
Median	187	178	150	155	228	203	170	190	170	170	198	170	140	145	145	170	183	230	160	280	140	275
Total Dissolved Solids, mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	46	8	39	8
No. of Detections	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	46	8	39	8
Maximum	200.0	119	151	118	1100	169	157	126	250	119	300	127	170	111	140	153	210	183	204	238	220	194
Minimum	74.0	93	56	90	92	129	75	111	27	98	31	93	60	96	60	102	97	137	42	143	77	161
Mean	116.7	108	97	102	158	150	110	121	104	112	149	117	89	103	97	129	129	161	111	190	102	181
Standard Deviation	22.04	9	19	10	112	13	18	7	24	7	59	11	16	4	17	16	21	21	29	39	25	13
Median	112.0	109	97	101	146	151	110	126	100	115	130	120	90	103	96	131	124	170	110	180	94	184
Alkalinity, total (CaCO3), mg/L																						
No. of Analyses	68	8	67	8	67	8	67	5	67	8	67	8	67	8	49	8	46	7	47	8	39	8
No. of Detections	68	8	67	8	67	8	67	5	67	8	67	8	67	8	49	8	46	7	47	8	39	8
Maximum	110	65	86	57	110	88	112	77	110	65	260	86	76	54	66	68	101	122	144	145	150	120
Minimum	3	59	44	47	72	64	55	73	54	57	60	69	42	50	38	53	38	86	50	95	44	97
Mean	74	63	59	52	89	79	72	75	66	62	102	79	52	53	47	60	79	108	66	114	55	108
Standard Deviation	17	2	9	4	10	9	9	1	7	2	42	6	4	1	6	5	10	15	20	15	18	7
Median	74	63	56	53	90	79	73	75	65	62	90	82	52	53	46	58	78	113	62	112	51	108
Ammonia as N, mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	61	8	25	0	59	8	72	5	25	2	10	2	27	4	6	0	6	0	7	0	9	0
Maximum	0.4	0.0	0.2	ND	0.2	0.0	0.3	0.1	0.0	0.0	0.1	0.2	0.1	0.0	0.2	ND	0.1	ND	0.3	ND	0.9	ND
Minimum	ND	0.0	ND	ND	ND	0.0	ND	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	0.0	0.0	0.0	ID	0.0	0.0	0.1	0.1	0.0	ID	0.0	ID	0.0	0.0	0.0	ID	0.0	ID	0.0	ID	0.0	ID
Standard Deviation	0.05	0.01	0.02	ID	0.02	0.00	0.04	0.00	0.01	ID	0.03	ID	0.01	0.01	0.03	ID	0.02	ID	0.05	ID	0.14	ID
Median	0.04	0.04	0.01	ID	0.03	0.03	0.06	0.07	0.01	ID	0.01	ID	0.02	0.01	0.01	ID	0.01	ID	0.01	ID	0.02	ID
Chloride, mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	77	8	76	8	75	8	76	5	76	8	76	8	73	8	49	8	46	7	47	8	39	8
Maximum	7.8	4.0	5.0	4.3	8.5	6.1	9.3	4.1	6.3	4.6	5.0	19.0	7.0	4.6	8.0	14.2	10.0	6.4	24.8	30.6	25.8	21.3
Minimum	3.0	3.4	2.0	3.9	ND	4.5	3.0	3.4	2.9	3.9	2.5	1.5	ND	3.9	2.0	4.8	4.0	4.5	3.0	11.6	3.0	17.4
Mean	4.2	3.7	3.4	4.1	5.1	5.5	4.6	3.8	3.9	4.2	3.4	4.6	4.3	4.2	4.7	11.2	6.1	5.8	5.7	20.9	4.8	19.2
Standard Deviation	1.0	0.2	0.7	0.2	1.3	0.5	1.4	0.3	1.0	0.2	0.6	5.8	1.1	0.2	1.1	2.9	1.5	0.7	4.5	7.2	4.4	1.4
Median	4.0	3.6	3.5	4.0	5.0	5.7	4.0	3.7	3.8	4.2	3.1	2.8	4.0	4.1	4.5	11.5	6.0	6.0	4.4	20.2	3.6	19.3

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-21		MW-73		MW-84		MW-81		MW-99		MW-93		MW-95	
	Upgradient Northwest						Upgradient Northeast				Cross Gradient			
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH, (Field) Standard Units														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	74	8	49	8	48	8	48	8	37	8	40	8	41	8
Maximum	9.4	7.9	7.5	7.2	7.3	7.1	7.7	7.5	8.1	8.0	7.9	7.3	7.6	7.5
Minimum	5.9	7.1	0.3	6.1	6.5	6.8	6.9	7.0	7.4	7.8	6.8	7.1	7.1	7.2
Mean	7.4	7.5	6.8	6.6	7.0	6.9	7.2	7.2	7.7	7.9	7.3	7.2	7.4	7.4
Standard Deviation	0.45	0.28	0.98	0.44	0.19	0.10	0.18	0.19	0.18	0.09	0.17	0.05	0.13	0.10
Median	7.4	7.6	7.0	6.8	7.0	7.0	7.3	7.1	7.7	7.9	7.3	7.2	7.4	7.4
Specific Conductance, (Field) microm														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	74	8	49	8	48	8	48	8	37	8	40	8	41	8
Maximum	162	135	170	150	155	160	141	140	150	135	391	365	225	215
Minimum	65	100	99	98	86	130	77	100	78	100	120	270	124	170
Mean	109	117	148	128	137	146	117	121	119	127	253	339	195	193
Standard Deviation	13	12	14	21	13	10	12	16	11	12	51	34	20	19
Median	110	115	150	135	140	145	120	120	115	130	240	350	195	195
Total Dissolved Solids, mg/L														
No. of Analyses	82	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	74	8	49	8	47	8	48	8	37	8	40	8	41	8
Maximum	140	84	1100	104	130	110	140	96	210	93	650	268	150	140
Minimum	25	72	61	69	ND	77	56	78	36	82	130	232	107	124
Mean	69	76	120	90	86	98	87	88	86	89	187	246	128	132
Standard Deviation	16	4	144	13	18	11	14	7	30	4	85	11	12	6
Median	68	75	100	95	90	102	86	90	82	90	165	246	129	133
Alkalinity, total (CaCO3), mg/L														
No. of Analyses	65	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	65	8	49	8	48	8	48	8	37	8	40	8	41	8
Maximum	62	56	78	55	120	61	66	52	100	53	110	119	100	87
Minimum	38	49	42	33	46	54	41	43	46	49	64	102	78	77
Mean	47	52	60	46	59	59	48	49	54	52	95	113	88	85
Standard Deviation	5	2	7	10	10	2	5	3	8	1	8	5	6	3
Median	46	53	58	50	58	60	47	49	52	52	95	114	86	86
Ammonia as N, mg/L														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	26	3	6	1	4	1	6	0	25	8	30	8	20	8
Maximum	0.2	0.0	0.2	0.0	0.1	0.0	0.1	ND	0.1	0.1	0.2	0.1	0.2	0.0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	ND	0.0	ND	0.0
Mean	0.0	0.0	0.0	ID	0.0	ID	0.0	ID	0.0	0.1	0.0	0.1	0.0	0.0
Standard Deviation	0.03	0.01	0.03	ID	0.02	ID	0.02	ID	0.02	0.01	0.03	0.01	0.04	0.00
Median	0.01	0.01	0.01	ID	0.01	ID	0.01	ID	0.04	0.07	0.04	0.06	0.02	0.03
Chloride, mg/L														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	73	8	48	8	47	8	48	8	37	8	40	8	41	8
Maximum	4.0	7.6	3.9	3.6	5.7	4.2	5.0	3.8	3.6	3.4	8.0	3.2	6.1	6.3
Minimum	ND	2.7	ND	0.9	ND	3.7	2.0	2.7	2.0	2.9	1.6	2.7	3.8	4.8
Mean	2.6	3.7	2.9	2.6	3.2	3.9	2.4	3.3	2.8	3.1	3.1	2.8	4.6	5.3
Standard Deviation	0.5	1.8	0.6	0.9	0.6	0.2	0.5	0.4	0.5	0.1	0.9	0.2	0.7	0.5
Median	2.8	2.8	3.0	2.8	3.0	3.8	2.2	3.3	2.9	3.1	3.0	2.8	4.4	5.1

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-24		MW-56		MW-57		MW-58A		MW-59		MW-60		MW-65		MW-76		MW-82		MW-83		MW-94	
											Upgradient South											
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Nitrate as N, mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	19	0	58	7	20	4	8	0	14	1	70	8	10	1	49	8	46	7	46	8	38	8
Maximum	1.0	ND	1.6	1.5	1.0	0.1	1.1	ND	1.0	0.0	4.9	1.3	0.1	0.0	2.1	1.2	1.5	0.9	1.8	0.8	1.5	1.4
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	0.5	0.3	0.6	0.6	ND	0.1	ND	0.1
Mean	0.0	ID	0.3	0.4	0.0	0.0	0.0	ID	0.0	ID	1.7	1.2	0.0	ID	1.4	0.7	1.0	0.7	0.6	0.5	1.0	0.9
Standard Deviation	0.15	ID	0.32	0.58	0.12	0.02	0.13	ID	0.12	ID	0.86	0.06	0.02	ID	0.37	0.29	0.19	0.12	0.32	0.26	0.31	0.40
Median	0.00	ID	0.23	0.17	0.00	0.01	0.00	ID	0.00	ID	1.80	1.21	0.00	ID	1.30	0.60	0.91	0.70	0.60	0.41	1.00	0.96
Sulfate, mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	77	8	76	8	76	8	76	5	76	8	76	8	73	8	48	8	46	7	47	8	39	8
Maximum	39	17	24	21	22	19	25	17	23	19	13	8	20	17	25	25	18	18	63	11	20	7
Minimum	9	16	12	13	2	17	9	15	14	17	6	7	ND	15	ND	11	12	13	6	7	2	4
Mean	16	16	18	18	18	18	15	16	17	18	7	7	15	17	17	17	14	16	16	10	13	6
Standard Deviation	4	0	3	2	2	0	4	1	2	1	2	0	3	1	4	5	2	2	8	2	4	1
Median	17	16	17	19	18	18	16	16	17	18	7	7	15	17	18	17	14	17	15	11	13	6
Iron, dissolved mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	77	8	74	6	76	8	76	5	76	8	69	7	74	8	37	0	34	0	35	0	30	0
Maximum	8.8	3.5	4.7	0.0	11.0	10.0	8.5	1.1	7.5	4.6	0.4	0.1	8.4	5.1	8.8	ND	0.2	ND	0.1	ND	0.3	ND
Minimum	1.7	2.8	ND	ND	6.6	7.7	0.8	1.0	3.1	3.8	ND	ND	0.4	4.0	ND	ND	ND	ND	ND	ND	ND	ND
Mean	4.6	3.2	0.6	0.0	8.5	8.7	1.2	1.0	4.4	4.1	0.1	0.0	3.5	4.4	0.2	ID	0.1	ID	0.0	ID	0.0	ID
Standard Deviation	1.36	0.23	0.62	0.01	0.93	0.70	0.87	0.05	0.51	0.28	0.07	0.02	1.05	0.37	1.25	ID	0.05	ID	0.03	ID	0.05	ID
Median	4.3	3.2	0.5	0.0	8.6	8.6	1.1	1.0	4.3	4.1	0.1	0.0	3.8	4.4	0.0	ID	0.1	ID	0.0	ID	0.0	ID
Manganese, dissolved mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	77	8	76	8	76	8	75	5	76	8	43	4	74	8	7	0	5	0	24	4	10	0
Maximum	0.684	0.140	0.330	0.142	0.471	0.295	0.490	0.375	0.350	0.115	0.028	0.002	0.382	0.208	0.067	ND	0.002	ND	0.069	0.008	0.035	ND
Minimum	0.1	0.1	0.1	0.1	0.2	0.2	ND	0.3	0.1	0.1	ND	ND	0.1	0.2	ND	ND	ND	ND	ND	ND	ND	ND
Mean	0.28	0.12	0.18	0.09	0.32	0.26	0.34	0.35	0.11	0.10	0.00	0.00	0.21	0.19	0.00	ID	0.00	ID	0.00	0.00	0.00	ID
Standard Deviation	0.14	0.01	0.07	0.03	0.06	0.02	0.07	0.03	0.03	0.01	0.01	0.00	0.03	0.01	0.01	ID	0.00	ID	0.01	0.00	0.01	ID
Median	0.24	0.11	0.20	0.08	0.31	0.26	0.34	0.36	0.11	0.10	0.00	0.00	0.21	0.19	0.00	ID	0.00	ID	0.00	0.00	0.00	ID
Calcium, dissolved mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
Maximum	25	15	28	16	27	18	27	19	23	15	59	19	14	13	17	20	24	26	35	41	40	31
Minimum	11.0	12.2	11	13.9	15	15	11	15.4	12	12	12	15.2	9	11	8.8	12	9.1	16.8	11	23	11	25
Mean	16.5	13.2	16.4	15.2	19.6	16.6	17	17.0	14.3	13.4	26.5	17.2	11.4	12	12.9	17.5	17.3	21.6	17.2	31.1	14.6	26.9
Standard Deviation	3.7	1.0	4.5	0.8	3.0	0.9	3.1	1.5	1.6	0.9	13.5	1.5	1.1	0.5	1.9	2.8	2.7	2.9	4.6	6.6	4.7	2.0
Median	15.4	13.0	14	15	19	16.7	17	16.5	14	13	20.5	17.3	11.3	12.0	13	18.7	18	21.5	16	29.4	14	26.7
Magnesium, dissolved mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
Maximum	15.0	10.1	11.3	8	14.6	10.0	12.4	9	13.0	10	25	9	7.9	8.0	8	8.9	13.5	15.6	14	18	16	15
Minimum	6.7	8.0	4.6	5.0	7.7	7.8	6.2	7.8	7.1	7.8	6.4	7.4	4.7	6.7	4.0	5.1	5.0	9.5	4.7	10	4.6	11.0
Mean	9.9	8.8	7.1	6.4	10.6	9.2	8.4	8.6	8.4	8.2	12.0	8.2	6.4	7.3	5.7	7.7	9.9	12.9	7.0	13.1	6.1	12.3
Standard Deviation	2.0	0.7	1.6	1.0	1.6	0.9	1.4	0.6	0.9	0.6	5.8	0.6	0.6	0.5	0.9	1.3	1.5	2.0	1.9	2.6	1.8	1.3
Median	9.7	8.7	6.7	6	10.0	9.6	8	8.7	8.3	8.0	9.6	8.2	7	7.3	5.6	8.2	10.0	12.6	6.5	12	6	12.1

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-21		MW-73		MW-84		MW-81		MW-99		MW-93		MW-95	
	Upgradient Northwest						Upgradient Northeast				Cross Gradient			
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Nitrate as N, mg/L														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	12	0	49	8	48	8	48	8	32	8	14	8	4	0
Maximum	1.9	ND	2.1	1.8	1.4	0.6	1.8	1.7	0.5	0.2	1.2	0.1	0.1	ND
Minimum	ND	ND	0.4	0.5	0.1	0.4	0.5	1.5	ND	0.0	ND	0.0	ND	ND
Mean	0.0	ID	1.2	1.4	0.4	0.5	1.6	1.6	0.1	0.1	0.1	0.0	0.0	ID
Standard Deviation	0.22	ID	0.55	0.46	0.26	0.08	0.23	0.07	0.15	0.06	0.19	0.01	0.01	ID
Median	0.00	ID	1.10	1.59	0.45	0.58	1.60	1.62	0.07	0.04	0.00	0.01	0.00	ID
Sulfate, mg/L														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	74	8	48	8	48	8	47	8	37	8	40	8	41	8
Maximum	9	6	24	9	18	13	11	9	18	8	101	83	28	18
Minimum	2	5	ND	6	10	11	ND	7	6	7	1	71	14	16
Mean	6	5	13	8	12	12	8	8	8	8	43	76	18	16
Standard Deviation	1	0	4	1	1	1	2	0	2	0	23	4	3	1
Median	6	5	12	9	12	13	8	8	7	8	39	77	16	17
Iron, dissolved mg/L														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	74	8	37	0	36	0	35	0	37	8	27	0	30	0
Maximum	3.7	1.9	0.12	ND	0.48	ND	0.14	ND	0.22	0.04	0.25	ND	0.19	ND
Minimum	1.30	1.6	ND	ND	ND	ND	ND	ND	0.0	0.0	ND	ND	ND	ND
Mean	2.2	1.7	0.0	ID	0.0	ID	0.0	ID	0.0	0.0	0.1	ID	0.1	ID
Standard Deviation	0.47	0.08	0.03	ID	0.07	ID	0.02	ID	0.03	0.01	0.05	ID	0.05	ID
Median	2.1	1.7	0.0	ID	0.0	ID	0.0	ID	0.0	0.0	0.1	ID	0.1	ID
Manganese, dissolved mg/L														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	74	8	8	1	47	6	8	4	37	8	40	8	41	8
Maximum	0.093	0.092	0.012	0.001	0.037	0.006	0.006	0.001	0.150	0.086	0.369	0.293	0.240	0.147
Minimum	0.03	0.07	ND	ND	ND	ND	ND	ND	0.0	0.1	0.1	0.2	0.1	0.1
Mean	0.07	0.07	0.00	ID	0.00	0.00	0.00	0.00	0.06	0.07	0.25	0.26	0.14	0.13
Standard Deviation	0.02	0.01	0.00	ID	0.01	0.00	0.00	0.00	0.03	0.01	0.04	0.03	0.04	0.01
Median	0.07	0.07	0.00	ID	0.00	0.00	0.00	0.00	0.05	0.07	0.24	0.25	0.14	0.14
Calcium, dissolved mg/L														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	74	8	49	8	48	8	48	8	37	8	40	8	41	8
Maximum	14	11	19	13	15	12	12	11	10	10	37	39	23	21
Minimum	7	9	12	10.4	8.8	9	8	11	7	8	20.0	29	10.0	17
Mean	8.7	9.9	14.2	11.7	10.7	10.7	10.2	10.9	8.5	9.1	26	35	19.5	19.1
Standard Deviation	1.0	0.6	1.6	0.9	1.0	0.9	1.1	0.2	0.7	0.5	4.6	3.4	2.1	1.2
Median	9	10.1	14	11.9	11	11	10	11	8.6	9.2	25	35	19	18.8
Magnesium, dissolved mg/L														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	74	8	49	8	48	8	48	8	37	8	40	8	41	8
Maximum	8	6	16	6.4	9.7	9.4	7	6	4.5	5	17.6	19.9	12	11.0
Minimum	3.9	4.9	4.6	3.0	4.4	7.3	5	5	3.0	3.7	9.7	15.4	6.8	8.2
Mean	5	5.6	7.0	4.9	7.9	8.3	5	5.8	4	4.2	13.1	17.8	10.0	10.0
Standard Deviation	0.7	0.5	1.6	1.6	0.8	0.7	0.5	0.3	0.4	0.3	2.5	1.4	0.9	0.9
Median	5	5.7	6.8	5.4	7.9	8.2	5	5.9	3.8	4.1	12.9	17.9	10.0	10.3

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-24		MW-56		MW-57		MW-58A		MW-59		MW-60		MW-65		MW-76		MW-82		MW-83		MW-94	
											Upgradient South											
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Potassium, dissolved mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	77	8	76	8	76	8	76	5	76	8	76	8	73	8	49	8	46	7	47	8	39	8
Maximum	1.6	0.929	2.4	1.24	3.4	1.03	1.6	1.03	3.3	1.19	2.3	1.42	1.2	1.1	1.3	1.52	1.77	1.75	2.49	2.82	2.53	2.32
Minimum	0.7	0.8	0.8	0.8	0.7	0.8	0.6	0.9	0.6	0.9	0.9	1.0	ND	0.8	0.9	1.0	0.7	1.4	1.4	1.8	1.1	1.9
Mean	1.0	0.9	1.3	1.0	1.0	0.9	1.0	1.0	1.0	1.0	1.3	1.1	0.9	0.9	1.1	1.2	1.4	1.6	1.7	2.2	1.4	2.1
Standard Deviation	0.2	0.0	0.4	0.1	0.4	0.1	0.1	0.0	0.3	0.1	0.4	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.4	0.2	0.1
Median	0.9	0.8	1.2	1.0	0.9	0.9	1.0	1.0	1.0	1.0	1.2	1.1	0.9	0.9	1.1	1.215	1.4	1.6	1.7	2.1	1.4	2.0
Sodium, dissolved mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
Maximum	7.42	6.11	6.61	5.5	22	7.15	7.8	5.7	7.6	6	14	6.73	7.74	5.65	9.2	8.04	6.77	7.53	6.98	8.42	8.52	7.62
Minimum	4.78	5.03	4	4.46	5.3	5.77	4.3	4.97	4.73	4.92	4.7	5.06	4.5	4.89	6	5.72	4.9	5.54	4.7	6.12	4.3	6.22
Mean	6.0	5.5	5.0	4.9	7.0	6.5	5.5	5.5	5.6	5.3	6.8	5.7	5.2	5.3	7.4	7.3	5.8	6.6	5.5	7.2	5.1	6.9
Standard Deviation	0.7	0.4	0.6	0.3	1.9	0.6	0.7	0.3	0.5	0.4	2.0	0.5	0.4	0.3	0.7	0.8	0.5	0.6	0.6	0.7	0.7	0.5
Median	5.7	5.5	4.9	4.9	6.8	6.7	5.3	5.7	5.6	5.2	6.0	5.7	5.1	5.4	7.3	7.4	5.7	6.7	5.4	7.3	5.0	7.0
Arsenic, dissolved mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	9	0	3	0	9	0	1	0	2	0	1	0	17	0	0	0	0	0	1	0	0	0
Maximum	0.002	ND	0.002	ND	0.003	ND	0.001	ND	0.001	ND	0.001	ND	0.002	ND	ND	ND	ND	ND	0.001	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	0.001	ID	0.001	ID	0.001	ID	ID	ID	ID	ID	ID	ID	0.001	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	0.000	ID	0.000	ID	0.0004	ID	ID	ID	ID	ID	ID	ID	0.000	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.001	ID	0.001	ID	0.001	ID	ID	ID	ID	ID	ID	ID	0.001	ID	ID	ID	ID	ID	ID	ID	ID	ID
Barium, dissolved mg/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	76	8	76	8	74	8	74	5	75	8	76	8	74	8	49	8	17	2	47	8	39	8
Maximum	0.008	0.002	0.018	0.004	0.011	0.002	0.018	0.005	0.005	0.003	0.017	0.003	0.015	0.007	0.12	0.003	0.004	0.001	0.006	0.007	0.017	0.004
Minimum	ND	0.002	0.002	0.003	ND	0.001	ND	0.004	ND	0.003	0.003	0.003	0.004	0.007	0.002	0.002	ND	ND	0.002	0.003	0.001	0.002
Mean	0.002	0.002	0.004	0.004	0.003	0.002	0.005	0.004	0.004	0.003	0.006	0.003	0.008	0.007	0.005	0.003	0.001	ID	0.003	0.005	0.005	0.002
Standard Deviation	0.001	0.000	0.002	0.000	0.001	0.000	0.002	0.000	0.001	0.000	0.004	0.000	0.002	0.000	0.017	0.000	0.001	ID	0.001	0.001	0.004	0.001
Median	0.002	0.002	0.004	0.004	0.002	0.002	0.005	0.004	0.004	0.003	0.004	0.003	0.008	0.007	0.003	0.003	5E-04	ID	0.003	0.004	0.004	0.002
Dichlorodifluoromethane, ug/L																						
No. of Analyses	68	8	67	8	67	8	67	5	67	8	67	8	67	8	48	8	45	7	46	8	38	8
No. of Detections	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	2.18	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	5.83	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.1	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
cis 1,2-Dichloroethene, ug/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	16	7	72	8	0	0	0	0	12	8	0	0	0	0	46	8	0	0	0	0	0	0
Maximum	0.39	0.34	1.8	1.24	ND	ND	ND	ND	0.666	0.857	ND	ND	ND	ND	3.1	1.01	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	0.522	ND	ND	ND	ND	ND	0.454	ND	ND	ND	ND	ND	0.429	ND	ND	ND	ND	ND	ND
Mean	0.14	0.26	1.08	0.91	ID	ID	ID	ID	0.1	0.7	ID	ID	ID	ID	1.391	1.938	ID	ID	ID	ID	ID	ID
Standard Deviation	0.07	0.07	0.33	0.24	ID	ID	ID	ID	0.1	0.1	ID	ID	ID	ID	0.710	0.888	ID	ID	ID	ID	ID	ID
Median	0.1	0.265	1.1	0.92	ID	ID	ID	ID	0.1	0.67	ID	ID	ID	ID	1.30	2.00	ID	ID	ID	ID	ID	ID

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-21		MW-73		MW-84		MW-81		MW-99		MW-93		MW-95	
	Upgradient Northwest						Upgradient Northeast				Cross Gradient			
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Potassium, dissolved mg/L														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	74	8	49	8	48	8	48	8	37	8	40	8	41	8
Maximum	1.6	1.14	1.6	0.832	1.3	1.15	0.86	0.762	1.2	0.859	1.9	1.88	1.4	1.38
Minimum	0.6	0.9	0.7	0.7	0.8	0.9	0.6	0.7	0.7	0.8	1.1	1.4	0.9	1.1
Mean	1.0	1.0	0.9	0.8	1.0	1.0	0.7	0.7	0.9	0.8	1.3	1.6	1.2	1.2
Standard Deviation	0.2	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.2	0.1	0.1	0.1
Median	0.9	1.0	0.8	0.8	0.955	0.964	0.7	0.7	0.9	0.8	1.3	1.6	1.2	1.1
Sodium, dissolved mg/L														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	74	8	49	8	48	8	48	8	37	8	40	8	41	8
Maximum	7.2	6.1	7.8	5.59	6.7	6.09	7.5	5.82	16	10.2	9.4	9.68	7.8	6.12
Minimum	4.4	4.63	3.8	2.41	4.5	4.79	4.6	5.03	8.42	8	6.2	7.69	5.25	4.8
Mean	4.9	5.4	5.9	4.5	5.6	5.6	5.6	5.5	10.7	9.2	7.7	9.0	6.1	5.7
Standard Deviation	0.4	0.5	0.7	1.3	0.5	0.4	0.6	0.2	2.0	0.7	0.9	0.7	0.6	0.4
Median	4.8	5.5	6.0	5.2	5.5	5.7	5.6	5.5	9.9	9.3	7.6	9.1	6.0	5.8
Arsenic, dissolved mg/L														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	24	0	1	0	0	0	10	0	37	8	39	8	5	1
Maximum	0.002	ND	0.001	ND	ND	ND	0.002	ND	0.007	0.002	0.002	0.002	0.001	0.001
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.002	ND	0.001	ND	ND
Mean	0.001	ID	ID	ID	ID	ID	0.001	ID	0.004	0.002	0.002	0.001	0.001	ID
Standard Deviation	0.000	ID	ID	ID	ID	ID	0.000	ID	0.001	0.000	0.000	0.000	0.000	ID
Median	0.001	ID	ID	ID	ID	ID	0.001	ID	0.004	0.002	0.002	0.001	0.001	ID
Barium, dissolved mg/L														
No. of Analyses	74	8	49	8	48	8	48	8	37	8	40	8	41	8
No. of Detections	73	8	49	8	48	8	48	8	37	8	39	8	41	8
Maximum	0.008	0.003	0.007	0.003	0.017	0.004	0.008	0.003	0.013	0.003	0.009	0.009	0.007	0.004
Minimum	ND	0.003	0.002	0.002	0.003	0.003	0.002	0.003	0.002	0.002	ND	0.007	0.003	0.003
Mean	0.004	0.003	0.003	0.002	0.004	0.003	0.004	0.003	0.004	0.003	0.007	0.008	0.004	0.003
Standard Deviation	0.001	0.000	0.001	0.000	0.002	0.000	0.001	0.000	0.003	0.000	0.001	0.001	0.001	0.000
Median	0.004	0.003	0.003	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.007	0.009	0.004	0.003
Dichlorodifluoromethane, ug/L														
No. of Analyses	65	8	48	8	48	8	47	8	123	12	39	8	41	8
No. of Detections	14	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	0.8	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	2.0	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.1	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
cis 1,2-Dichloroethene, ug/L														
No. of Analyses	74	8	49	8	48	8	48	8	123	12	40	8	41	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-24		MW-56		MW-57		MW-58A		MW-59		MW-60		MW-65		MW-76		MW-82		MW-83		MW-94	
											Upgradient South											
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Tetrachloroethene, ug/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	8	1	0	0	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.89	0.457	0.31	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.34	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.54	0.60	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.12	0.10	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.53	0.59	ID	ID	ID	ID	ID	ID
Trichloroethene, ug/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	0	0	0	0	1	0	0	0	1	0	0	0	0	0	49	8	45	7	47	8	39	8
Maximum	ND	ND	ND	ND	1.2	ND	ND	ND	0.45	ND	ND	ND	ND	ND	17	11.5	11	5.63	3.8	2.09	5.4	3.26
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.69	6.69	ND	4.14	0.504	1.26	1.03	2.12
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	11.96	13.88	7.29	0.10	2.08	9.23	3.33	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	2.21	2.17	1.87	0.00	0.62	1.11	1.11	0.00
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	11.20	13.50	7.25	0.1	2	9.5	3.7	0.1
Vinyl Chloride, ug/L																						
No. of Analyses	77	8	76	8	76	8	76	5	76	8	76	8	74	8	49	8	46	7	47	8	39	8
No. of Detections	1	0	0	0	0	0	0	0	0	0	0	0	60	8	0	0	0	0	0	0	1	0
Maximum	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.18	0.044	ND	ND	ND	ND	ND	ND	0.02	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.037	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0	0	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0	0	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.078	0.01	ID	ID	ID	ID	ID	ID	ID	ID

NOTES: * Well location groupings are relative to the flow paths of the Aquifer and the placement of Solid Waste.
ND = Not Detected

Table 4-2a
Statistical Summary of Regional Aquifer Groundwater Data

Well Location	MW-21		MW-73		MW-84		MW-81		MW-99		MW-93		MW-95	
	Upgradient Northwest						Upgradient Northeast				Cross Gradient			
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Tetrachloroethene, ug/L														
No. of Analyses	74	8	49	8	48	8	48	8	123	12	40	8	41	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Trichloroethene, ug/L														
No. of Analyses	74	8	49	8	48	8	48	8	123	12	40	8	41	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Vinyl Chloride, ug/L														
No. of Analyses	74	8	49	8	48	8	48	8	123	12	40	8	41	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID

NOTES: * Well location groupings are relative to the flow paths of the Aquifer and the placement of Solid Waste.
ND = Not Detected

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-70		MW-77		MW-78		MW-100		MW-64		MW-66		MW-67		MW-68		MW-69		MW-72	
	Interior								Vertical to Key Facilities								Westside Downgradient			
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH, (Field) Standard Units																				
No. of Analyses	75	8	48	8	45	8	41	8	74	7	73	8	74	8	66	8	73	7	53	8
No. of Detections	75	8	48	8	45	8	41	8	74	7	73	8	74	8	66	8	73	7	53	8
Maximum	8	7.6	7.3	7.1	7.3	6.7	7.1	6.9	8.1	7.2	8.8	7.1	8.5	7.3	8.7	7.2	8.2	7.6	7.5	7.2
Minimum	6.8	7.2	6.7	6.7	6.3	6.3	6.6	6.7	6.2	6.8	6.4	6.7	6.5	6.9	6.2	6.9	6.7	7.2	6.8	6.8
Mean	7.4	7.4	7.0	7.0	6.8	6.5	6.8	6.8	7.2	7.1	7.2	7.0	7.2	7.1	7.3	7.1	7.4	7.5	7.2	7.0
Standard Deviation	0.25	0.13	0.11	0.13	0.23	0.16	0.15	0.08	0.34	0.1	0.39	0.14	0.36	0.10	0.39	0.08	0.27	0.15	0.16	0.12
Median	7.5	7.3	7.0	7.0	6.8	6.5	6.9	6.9	7.2	7.1	7.2	7.0	7.2	7.1	7.3	7.1	7.4	7.5	7.3	7.1
Specific Conductance, (Field) micromhos/cm																				
No. of Analyses	75	8	48	8	45	8	41	5	74	7	73	8	74	8	66	8	74	7	53	8
No. of Detections	75	8	48	8	45	8	41	5	76	8	76	8	74	8	66	8	74	7	53	8
Maximum	280	205	330	255	220	175	360	205	250	185	500	210	308	305	357	295	320	275	340	265
Minimum	122	160	200	170	114	100	152	150	111	150	130	150	138	240	140	220	85	210	166	230
Mean	178	175	260	214	178	147	287	180	170	170	234	176	203	286	243	258	209	232	266	244
Standard Deviation	23	16	27	31	20	23	39	22	17	13	99	24	28	26	56	23	58	21	31	12
Median	175	175	260	210	180	145	292	190	170	170	198	170	204	298	243	263	220	230	255	245
Total Dissolved Solids, mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	72	8	74	8	65	8	74	7	54	8
No. of Detections	75	8	48	8	46	8	41	5	76	8	76	8	74	8	65	8	74	7	54	8
Maximum	160.0	138	200	164	180	134	250	126	250	119	300	127	185	211	270	180	210	175	220	200
Minimum	46.0	115	80	139	96	108	130	111	27	98	31	93	65	190	74	159	40	112	130	161
Mean	110.4	128	160	148	125	121	178	121	104	112	149	117	135	200	154	172	133	160	174	189
Standard Deviation	18.30	8	21	9	16	9	27	7	24	7	59	11	25	7	40	7	37	22	24	13
Median	110.0	126	160	146	120	123	180	126	100	115	130	120	130	200	150	174	130	167	166	194
Alkalinity, total (CaCO3), mg/L																				
No. of Analyses	68	8	48	8	46	8	41	5	67	7	66	8	67	8	59	8	67	7	54	8
No. of Detections	68	8	48	8	46	8	41	5	67	8	67	8	67	8	59	8	67	7	54	8
Maximum	100	84	180	117	94	70	160	77	110	65	260	86	112	125	160	136	130	131	130	117
Minimum	63	74	120	92	67	64	95	73	54	57	60	69	54	115	46	121	56	121	26	107
Mean	77	80	136	106	79	67	131	75	66	62	102	79	81	120	119	130	101	126	110	114
Standard Deviation	7	3	14	9	7	2	13	1	7	2	42	6	12	4	36	4	23	4	13	3
Median	76	80	130	107	79	68	130	75	65	62	90	82	79	120	130	131	110	126	110	115
Ammonia as N, mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	73	8	74	8	66	8	73	7	54	8
No. of Detections	20	0	7	0	9	0	8	5	25	2	10	2	9	0	42	7	32	7	26	8
Maximum	0.31	ND	0.05	ND	0.05	ND	0.09	0.07	0.04	0.01	0.07	0.21	0.49	ND	0.17	0.02	0.07	0.02	0.12	0.02
Minimum	ND	ND	ND	ND	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	ND	0.01
Mean	0.02	ID	0.02	ID	0.01	ID	0.02	0.07	0.01	ID	0.01	ID	0.02	ID	0.02	0.01	0.02	0.01	0.02	0.02
Standard Deviation	0.07	ID	0.04	ID	0.01	ID	0.02	0.00	0.01	ID	0.03	ID	0.06	ID	0.02	0.00	0.03	0.00	0.02	0.00
Median	0.01	ID	0.01	ID	0.01	ID	0.02	0.07	0.01	ID	0.01	ID	0.01	ID	0.02	0.01	0.01	0.01	0.02	0.01
Chloride, mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	73	8	74	8	66	8	74	7	54	8
No. of Detections	75	8	48	8	46	8	41	5	76	8	76	8	74	8	66	8	73	7	54	8
Maximum	7.0	7.7	5.1	5.1	6.1	9.3	5.9	4.1	6.3	4.6	5.0	19.0	9.0	5.1	6.8	3.1	5.0	4.8	4.3	8.0
Minimum	2.0	3.7	3.0	4.4	3.4	3.8	2.4	3.4	2.9	3.9	2.5	1.5	3.5	4.4	2.0	2.6	ND	3.8	2.0	3.5
Mean	3.3	4.7	4.0	4.8	4.7	5.9	3.2	3.8	3.9	4.2	3.4	4.6	5.2	4.8	3.1	2.8	3.1	4.3	3.6	4.9
Standard Deviation	0.7	1.3	0.5	0.2	0.6	1.8	0.6	0.3	1.0	0.2	0.6	5.8	1.4	0.3	0.7	0.2	0.9	0.3	0.5	1.6
Median	3.3	4.1	4.0	4.8	5.0	5.7	3.0	3.7	3.8	4.2	3.1	2.8	4.7	4.9	3.0	2.8	3.2	4.2	3.9	4.3

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-74		MW-75		MW-80		MW-85		MW-87		MW-91		MW-86		MW-88		MW-89		MW-90		MW-43	
	Downgradient												Downgradient of Northhend Facilities									
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH, (Field) Standard Units																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
Maximum	7.2	7.5	7.7	7.1	7.7	7.3	7.4	7.3	7.2	7.0	7.5	7.1	7.7	7.2	7.7	7.4	7.7	7.4	7.7	7.4	8.9	7.5
Minimum	6.7	7.0	6.7	6.8	7.0	6.9	6.7	6.9	6.7	6.8	6.8	6.8	6.6	6.7	6.8	6.6	7.0	7.2	7.0	6.9	5.8	7.2
Mean	7.0	7.1	7.1	7.0	7.2	7.1	7.1	7.1	6.9	6.9	7.1	7.0	7.0	6.9	7.2	7.1	7.3	7.3	7.3	7.2	7.4	7.3
Standard Deviation	0.12	0.16	0.19	0.12	0.20	0.15	0.15	0.14	0.12	0.07	0.15	0.13	0.19	0.18	0.19	0.26	0.16	0.06	0.18	0.14	0.39	0.13
Median	7.0	7.1	7.1	7.0	7.1	7.2	7.1	7.1	6.9	6.9	7.1	7.1	6.9	6.8	7.2	7.2	7.3	7.3	7.3	7.2	7.4	7.4
Specific Conductance, (Field) microm																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
Maximum	467	390	315	260	279	285	266	275	431	430	271	280	220	180	133	135	220	200	212	205	190	175
Minimum	253	350	180	230	176	210	158	200	270	380	175	210	106	140	79	100	110	160	126	160	99	140
Mean	346	369	254	244	227	257	201	236	336	408	235	234	170	157	111	115	171	183	174	171	155	154
Standard Deviation	55	12	32	9	32	28	22	26	34	16	22	28	15	17	8	14	17	15	14	15	15	12
Median	345	370	255	240	210	270	200	225	340	408	238	225	170	155	110	110	170	183	170	170	155	150
Total Dissolved Solids, mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	47	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	48	8	49	8	11	8	46	8	47	8	42	8	46	8	46	8	46	8	41	8	76	8
Maximum	266	326	260	216	237	212	163	175	306	322	806	204	150	114	96	90	150	129	145	142	130	122
Minimum	140	245	90	176	143	163	100	150	160	287	110	171	58	102	40	72	65	120	82	114	68	111
Mean	216	285	167	194	169	180	132	166	239	309	169	179	107	107	75	82	110	124	116	132	101	118
Standard Deviation	32	24	28	12	26	14	16	8	29	14	103	11	14	4	11	6	16	3	15	9	14	4
Median	210	289	170	193	166	178	130	167	230	316	152	176	109	107	77	84	110	123	120	134	100	118
Alkalinity, total (CaCO3), mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	67	8
No. of Detections	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	67	8
Maximum	190	218	110	98	87	92	94	98	157	89	128	92	82	65	58	53	82	76	76	70	77	71
Minimum	97	185	74	89	74	78	65	84	47	81	68	81	50	59	48	47	67	68	52	65	31	64
Mean	134	204	91	96	81	87	82	94	91	87	87	86	68	63	52	52	74	74	67	68	70	69
Standard Deviation	24	10	7	3	4	5	7	4	12	2	8	4	5	2	2	2	4	3	5	2	6	2
Median	130	206	92	97	81	89	84	94	91	87	86	86	68	64	52	53	73	75	68	68	70	69
Ammonia as N, mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	10	0	11	3	5	3	5	1	20	7	17	8	6	0	5	0	27	8	16	8	41	8
Maximum	0.53	ND	0.06	0.13	0.01	0.01	0.18	0.02	0.16	0.02	0.06	0.05	0.13	ND	0.11	ND	0.12	0.02	0.06	0.02	0.13	0.03
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	ND	0.01	ND	0.01	ND	0.02
Mean	0.03	ID	0.01	0.02	0.01	0.01	0.02	ID	0.02	0.01	0.02	0.03	0.01	ID	0.01	ID	0.02	0.02	0.02	0.02	0.02	0.02
Standard Deviation	0.08	ID	0.01	0.04	0.00	0.00	0.03	ID	0.02	0.00	0.01	0.01	0.02	ID	0.02	ID	0.02	0.00	0.01	0.00	0.02	0.00
Median	0.01	ID	0.02	0.01	0.01	0.01	0.01	ID	0.02	0.01	0.02	0.03	0.01	ID	0.01	ID	0.02	0.02	0.02	0.02	0.02	0.02
Chloride, mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	47	8	49	8	11	8	46	8	48	8	42	8	46	8	44	8	46	8	41	8	75	8
Maximum	35.0	25.0	8.5	8.9	5.5	5.8	10.0	7.5	4.7	6.0	9.0	8.4	7.6	4.8	2.9	3.4	5.2	7.0	3.9	4.9	3.3	3.9
Minimum	ND	20.5	3.3	7.7	4.6	4.6	4.0	6.8	2.0	4.5	2.0	7.3	3.1	4.0	ND	2.2	2.0	3.7	2.0	3.7	ND	3.0
Mean	23.2	23.1	6.6	8.3	5.1	5.1	5.5	7.3	3.0	5.4	7.4	7.8	4.9	4.3	2.2	2.5	2.6	4.2	2.8	4.0	2.0	3.6
Standard Deviation	7.6	1.4	1.7	0.4	0.3	0.4	1.0	0.2	1.0	0.5	1.1	0.3	1.0	0.3	0.5	0.4	0.8	1.1	0.7	0.4	0.5	0.3
Median	23.8	23.0	7.3	8.3	5.1	5.0	5.4	7.3	3.0	5.4	7.6	7.8	5.0	4.2	2.2	2.4	2.4	3.8	2.8	3.9	2.0	3.7

Table 4-2a
Statistical Summary of Regional Aquifer Groundwater Data

Well Location	MW-70		MW-77		MW-78		MW-100		MW-64		MW-66		MW-67		MW-68		MW-69		MW-72	
	Interior								Vertical to Key Facilities								Westside Downgradient			
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Nitrate as N, mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	73	8	74	8	66	8	74	7	54	8
No. of Detections	63	8	47	8	46	8	4	0	14	1	70	8	74	8	11	1	12	0	12	1
Maximum	0.2	0.1	1.6	0.9	2.0	1.2	0.3	ND	1.0	0.0	4.9	1.3	3.6	0.6	0.7	0.0	0.3	ND	1.0	0.0
Minimum	ND	0.03	ND	0.83	0.60	0.77	ND	ND	ND	ND	ND	1.12	0.53	0.43	ND	ND	ND	ND	ND	ND
Mean	0.07	0.04	0.59	0.87	1.28	0.96	0.02	ID	0.02	ID	1.73	1.21	1.06	0.50	0.02	ID	0.01	ID	0.03	ID
Standard Deviation	0.05	0.01	0.31	0.02	0.27	0.14	0.06	ID	0.12	ID	0.86	0.06	0.53	0.05	0.09	ID	0.04	ID	0.14	ID
Median	0.05	0.04	0.48	0.88	1.30	0.93	0.00	ID	0.00	ID	1.80	1.21	0.92	0.50	0.00	ID	0.00	ID	0.00	ID
Sulfate, mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	73	8	74	8	66	8	74	7	54	8
No. of Detections	75	8	48	8	46	8	41	5	76	8	76	8	74	8	66	8	73	7	54	8
Maximum	22	38	14	9	13	8	110	17	23	19	13	8	36	41	70	19	42	15	72	39
Minimum	10	14	8	8	7	7	16	15	14	17	6	7	18	17	10	16	ND	13	18	29
Mean	16	19	10	8	9	8	29	16	17	18	7	7	25	35	19	17	18	14	34	35
Standard Deviation	2	8	2	0	1	0	16	1	2	1	2	0	5	8	10	1	9	1	16	4
Median	16	17	10	8	9	8	23	16	17	18	7	7	25	38	16	17	16	14	27	37
Iron, dissolved mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	73	8	74	8	66	8	74	7	54	8
No. of Detections	59	0	37	1	38	0	41	5	76	8	69	7	71	8	66	8	74	7	54	8
Maximum	0.3	ND	1.0	0.0	0.1	ND	3.4	1.1	7.5	4.6	0.4	0.1	8.5	0.2	3.8	1.2	3.2	1.3	2.9	2.3
Minimum	ND	ND	ND	ND	ND	ND	1.2	1.0	3.1	3.8	ND	ND	ND	0.1	0.6	0.7	0.1	0.7	0.0	1.6
Mean	0.0	ID	0.1	ID	0.0	ID	2.4	1.0	4.4	4.1	0.1	0.0	0.2	0.1	1.9	1.0	0.9	1.0	2.2	2.0
Standard Deviation	0.06	ID	0.14	ID	0.03	ID	0.54	0.05	0.51	0.28	0.07	0.02	0.98	0.04	0.73	0.14	0.54	0.20	0.43	0.26
Median	0.03	ID	0.09	ID	0.05	ID	2.40	1.04	4.30	4.10	0.07	0.02	0.07	0.13	1.89	0.99	0.78	1.03	2.10	2.09
Manganese, dissolved mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	73	8	74	8	66	8	74	7	54	8
No. of Detections	59	0	47	8	5	0	41	5	76	8	43	4	54	8	66	8	73	7	54	8
Maximum	0.110	ND	0.062	0.018	0.010	ND	0.230	0.375	0.350	0.115	0.028	0.002	0.270	0.128	0.390	0.276	0.280	0.212	0.360	0.303
Minimum	ND	ND	ND	0.00	ND	ND	0.10	0.31	0.09	0.09	ND	ND	ND	0.06	0.14	0.19	ND	0.15	0.01	0.26
Mean	0.04	ID	0.02	0.01	0.00	ID	0.16	0.35	0.11	0.10	0.00	0.00	0.03	0.09	0.24	0.23	0.15	0.19	0.27	0.28
Standard Deviation	0.03	ID	0.01	0.01	0.00	ID	0.04	0.03	0.03	0.01	0.01	0.00	0.04	0.02	0.06	0.03	0.05	0.02	0.05	0.02
Median	0.04	ID	0.02	0.01	0.00	ID	0.15	0.36	0.11	0.10	0.00	0.00	0.02	0.09	0.22	0.23	0.14	0.20	0.27	0.28
Calcium, dissolved mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	73	8	74	8	66	8	74	7	54	8
No. of Detections	75	8	48	8	46	8	41	5	76	8	76	8	74	8	66	8	74	7	54	8
Maximum	23	20	33	24	23	18	38	19	23	15	59	19	28	32	43	29	40	30	34	29
Minimum	13.0	16.8	19	20.2	13	13	23	15.4	12	12	12	15.2	15	26	15.0	24	11.0	22.6	18	25
Mean	18.0	18.5	26.6	21.7	17.4	15.2	28	17.0	14.3	13.4	26.5	17.2	19.4	29	24.2	26.6	22.0	27.1	25.0	26.6
Standard Deviation	2.5	0.9	3.4	1.1	2.6	1.5	4.0	1.5	1.6	0.9	13.5	1.5	3.2	2.0	6.7	1.8	6.8	2.5	3.4	2.0
Median	17.2	18.8	27	22	17	15.4	26	16.5	14	13	20.5	17.3	19.0	27.9	23	26.7	21	27.8	24	25.7
Magnesium, dissolved mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	73	8	74	8	66	8	74	7	54	8
No. of Detections	75	8	48	8	46	8	41	5	76	8	76	8	74	8	66	8	74	7	54	8
Maximum	13.0	10.8	17.0	13	10.0	8.6	21.0	9	13.0	10	25	9	15.7	18.8	22	16.7	18.0	15.1	19	17
Minimum	7.2	8.4	11.0	11.3	6.6	6.2	12.0	7.8	7.1	7.8	6.4	7.4	8.0	15.8	8.2	13.3	4.6	9.6	7.1	15
Mean	9.0	9.8	14.3	11.7	8.0	7.2	15.6	8.6	8.4	8.2	12.0	8.2	10.9	17.1	13.0	15.2	10.1	12.9	14.7	15.8
Standard Deviation	1.1	0.7	1.5	0.4	0.9	0.7	2.2	0.6	0.9	0.6	5.8	0.6	1.9	1.3	3.4	1.1	3.1	1.8	2.1	0.8
Median	8.9	10.1	14.6	12	7.8	7.1	15	8.7	8.3	8.0	9.6	8.2	10	16.4	12.5	15.4	9.8	12.9	14.0	16

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-74		MW-75		MW-80		MW-85		MW-87		MW-91		MW-86		MW-88		MW-89		MW-90		MW-43	
	Downgradient												Downgradient of Northhend Facilities									
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Nitrate as N, mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	34	8	7	1	0	3	46	8	11	2	17	8	40	8	45	8	7	1	4	1	12	0
Maximum	1.4	0.5	2.0	0.0	ND	0.0	0.2	0.2	0.2	0.0	1.0	0.0	2.5	0.5	1.7	0.6	0.2	0.0	1.4	0.0	0.4	ND
Minimum	ND	0.38	ND	ND	ND	ND	0.03	0.11	ND	ND	ND	0.02	ND	0.11	ND	0.46	ND	ND	ND	ND	ND	ND
Mean	0.38	0.45	0.05	ID	ID	0.01	0.13	0.14	0.01	ID	0.04	0.03	0.16	0.32	0.40	0.55	0.01	ID	0.06	ID	0.01	ID
Standard Deviation	0.47	0.04	0.29	ID	ID	0.01	0.03	0.03	0.04	ID	0.16	0.01	0.36	0.10	0.23	0.06	0.03	ID	0.26	ID	0.05	ID
Median	0.12	0.44	0.00	ID	ID	0.00	0.14	0.12	0.00	ID	0.00	0.03	0.08	0.32	0.37	0.56	0.00	ID	0.00	ID	0.00	ID
Sulfate, mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	48	8	49	8	11	8	46	8	48	8	42	8	46	8	44	8	46	8	41	8	75	8
Maximum	29	25	54	48	46	45	32	34	117	138	44	40	30	19	8	7	21	17	29	27	20	14
Minimum	5	21	16	43	32	41	16	31	72	123	4	36	10	15	ND	6	15	15	2	26	ND	13
Mean	24	23	40	45	39	43	25	32	95	130	32	39	18	17	6	7	17	16	24	26	13	14
Standard Deviation	4	1	6	2	5	1	5	1	11	5	6	1	2	1	1	0	1	0	4	1	2	0
Median	25	23	42	45	41	44	26	32	93	131	33	40	18	17	6	7	16	16	24	26	13	14
Iron, dissolved mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	48	1	49	8	11	8	34	0	48	8	42	8	46	8	34	0	46	8	41	8	76	8
Maximum	2.8	1.2	3.8	1.8	1.63	1.68	0.22	ND	3.21	3.88	2.88	3.77	2.00	0.50	2.90	ND	0.87	0.87	1.29	1.27	1.70	1.01
Minimum	0.0	ND	1.10	1.4	0.9	1.3	ND	ND	0.3	3.0	0.4	0.9	0.0	0.2	ND	ND	0.5	0.7	0.9	0.9	0.0	0.4
Mean	1.3	ID	1.7	1.6	1.3	1.5	0.0	ID	2.7	3.3	2.1	2.4	0.4	0.3	0.1	ID	0.7	0.8	1.0	1.1	1.0	0.9
Standard Deviation	0.96	ID	0.43	0.15	0.24	0.14	0.05	ID	0.43	0.26	0.34	0.78	0.27	0.09	0.42	ID	0.06	0.06	0.10	0.09	0.24	0.19
Median	1.59	ID	1.70	1.53	1.40	1.49	0.05	ID	2.70	3.26	2.10	2.48	0.36	0.31	0.03	ID	0.72	0.82	1.07	1.09	0.95	0.92
Manganese, dissolved mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	48	2	49	8	11	8	6	4	48	8	42	8	45	8	13	1	46	8	41	8	76	8
Maximum	0.176	0.069	0.170	0.159	0.276	0.273	0.003	0.001	0.380	0.387	0.290	0.405	0.250	0.026	0.310	0.001	0.400	0.256	0.380	0.271	0.250	0.255
Minimum	0.00	ND	0.07	0.11	0.18	0.22	ND	ND	0.02	0.34	0.02	0.24	ND	0.01	ND	ND	0.25	0.21	0.24	0.24	0.01	0.20
Mean	0.09	ID	0.12	0.13	0.24	0.25	0.00	0.00	0.30	0.36	0.24	0.32	0.02	0.01	0.01	ID	0.31	0.24	0.27	0.26	0.21	0.22
Standard Deviation	0.06	ID	0.02	0.01	0.03	0.02	0.00	0.00	0.05	0.02	0.04	0.06	0.04	0.01	0.05	ID	0.04	0.02	0.03	0.01	0.03	0.02
Median	0.11	ID	0.12	0.12	0.24	0.25	0.00	0.00	0.31	0.37	0.24	0.31	0.02	0.01	0.00	ID	0.32	0.24	0.27	0.26	0.21	0.21
Calcium, dissolved mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
Maximum	39	45	31	25	27	28	35	26	36	39	25	24	21	14	30	10	18	14	19	18	16	15
Minimum	19	35	11	21	18	23.6	8.4	20	4	34	15.0	20	11	12	7.4	8	10.0	12	14.0	16	1.2	12
Mean	29.0	40.1	19.4	23.1	23.1	26.4	18.9	22.8	28.7	36.7	21	22	14.0	13.0	9	9	13	13	16	17	12.7	12.5
Standard Deviation	5.5	3.2	4.0	1.4	2.7	1.7	4.1	1.8	5.3	2.2	2.0	1.3	1.7	0.9	3.7	0.6	1.3	0.6	1.1	0.9	1.8	0.9
Median	29	39.8	21	23.3	23	26.4	19	23	30.0	36.6	21	22	14	13	9	9	13	13	16	16	13	12.2
Magnesium, dissolved mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
Maximum	29	34	21	19	14	14.4	21.0	15.5	24.6	27	15.0	15.7	12	10	19.0	7.0	10.2	10.9	10.0	10.0	10	10.3
Minimum	15.0	25.2	8.5	15.9	9.5	11.4	6.4	12.1	11.0	19.7	9.6	12.8	8	7	4.9	5.9	7.0	9.0	7.3	9.0	2.8	8.2
Mean	21.0	30.3	14	17.2	11.7	13.2	11.5	14.0	20	23.9	12.7	14.2	9	8.6	6.5	6.5	8.7	9.8	8.7	9.5	8.6	8.7
Standard Deviation	3.6	2.5	2.8	0.9	1.2	0.9	2.2	1.1	2.7	2.1	1.0	0.9	0.9	0.9	2.1	0.4	0.8	0.7	0.8	0.4	0.9	0.7
Median	20	30.9	15	17.3	12.0	13.1	11.2	13.9	19.9	23.8	13.0	14.2	9	8.8	6.2	6.6	8.8	9.7	8.8	9.5	8.7	8.5

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-70		MW-77		MW-78		MW-100		MW-64		MW-66		MW-67		MW-68		MW-69		MW-72	
	Interior								Vertical to Key Facilities								Westside Downgradient			
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Potassium, dissolved mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	73	8	74	8	66	8	74	7	54	8
No. of Detections	75	8	48	8	46	8	41	5	76	8	76	8	74	8	66	8	74	7	54	8
Maximum	1.52	1.55	2.4	1.63	2.5	2.24	2.18	1.03	3.3	1.19	2.3	1.42	1.7	1.77	2.2	1.85	1.9	1.7	2.4	1.86
Minimum	1.1	1.3	1.3	1.3	1.7	1.8	1.4	0.9	0.6	0.9	0.9	1.0	0.8	1.4	0.7	1.5	0.6	1.4	1.1	1.6
Mean	1.3	1.5	1.5	1.4	2.1	2.0	1.7	1.0	1.0	1.0	1.3	1.1	1.3	1.5	1.5	1.6	1.4	1.6	1.7	1.7
Standard Deviation	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.0	0.3	0.1	0.4	0.1	0.2	0.1	0.2	0.1	0.3	0.1	0.2	0.1
Median	1.3	1.5	1.5	1.4	2.1	2.1	1.7	1.0	1.0	1.0	1.2	1.1	1.2	1.5	1.5	1.565	1.4	1.6	1.7	1.7
Sodium, dissolved mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	73	8	74	8	66	8	74	7	54	8
No. of Detections	75	8	48	8	46	8	41	5	76	8	76	8	74	8	66	8	74	7	54	8
Maximum	8.4	6.4	10	7.77	7.9	7.13	11	5.7	7.6	6	14	6.73	12.6	9.2	10	8.79	8.8	9.01	8.7	7.69
Minimum	4.7	5.16	7	6.97	5.2	5.6	7.5	4.97	4.73	4.92	4.7	5.06	5.9	7.84	5	7.05	4.7	5.88	6.08	6.61
Mean	5.8	6.0	8.5	7.4	6.0	6.1	8.7	5.5	5.6	5.3	6.8	5.7	7.4	8.5	7.3	8.1	6.6	7.5	7.0	7.1
Standard Deviation	0.6	0.4	0.7	0.3	0.6	0.5	0.7	0.3	0.5	0.4	2.0	0.5	0.9	0.4	1.0	0.6	1.0	1.0	0.7	0.4
Median	5.7	6.2	8.6	7.3	5.9	6.0	8.6	5.7	5.6	5.2	6.0	5.7	7.3	8.4	7.3	8.2	6.5	7.6	6.9	7.1
Arsenic, dissolved mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	73	8	73	8	66	8	74	7	54	8
No. of Detections	7	0	0	0	3	0	0	0	2	0	1	0	3	0	21	4	73	7	0	0
Maximum	0.002	ND	ND	ND	0.002	ND	ND	ND	0.001	ND	0.001	ND	0.003	ND	0.005	0.004	0.005	0.003	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	ND	ND
Mean	0.001	ID	ID	ID	0.001	ID	ID	ID	ID	ID	ID	ID	0.001	ID	0.001	0.002	0.003	0.002	ID	ID
Standard Deviation	0.000	ID	ID	ID	0.000	ID	ID	ID	ID	ID	ID	ID	0.000	ID	0.001	0.001	0.001	0.000	ID	ID
Median	0.001	ID	ID	ID	0.001	ID	ID	ID	ID	ID	ID	ID	0.001	ID	0.001	0.001	0.002	0.002	ID	ID
Barium, dissolved mg/L																				
No. of Analyses	75	8	48	8	46	8	41	5	74	7	73	8	73	8	66	8	74	7	54	8
No. of Detections	73	8	48	8	45	8	40	5	75	8	76	8	72	8	66	8	74	7	54	8
Maximum	0.017	0.002	0.008	0.003	0.005	0.002	0.013	0.005	0.005	0.003	0.017	0.003	0.015	0.009	0.018	0.013	0.018	0.012	0.017	0.011
Minimum	ND	0.002	0.003	0.003	ND	0.002	ND	0.004	ND	0.003	0.003	0.003	ND	0.008	0.005	0.01	0.004	0.009	0.008	0.009
Mean	0.003	0.002	0.004	0.003	0.002	0.002	0.008	0.004	0.004	0.003	0.006	0.003	0.006	0.009	0.012	0.011	0.010	0.011	0.011	0.010
Standard Deviation	0.002	0.000	0.001	0.000	0.001	0.000	0.002	0.000	0.001	0.000	0.004	0.000	0.002	0.000	0.003	0.001	0.003	0.001	0.002	0.000
Median	0.002	0.002	0.004	0.003	0.002	0.002	0.008	0.004	0.004	0.003	0.004	0.003	0.006	0.009	0.012	0.011	0.009	0.011	0.01	0.01
Dichlorodifluoromethane, ug/L																				
No. of Analyses	68	8	50	8	46	7	42	5	67	7	66	8	67	8	59	7	67	7	54	8
No. of Detections	0	0	8	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	ND	ND	0.45	ND	0.29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	0.14	ID	0.1	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	0.10	ID	0.0	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	0.1	ID	0.1	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
cis 1,2-Dichloroethene, ug/L																				
No. of Analyses	75	8	50	8	46	7	42	5	74	7	73	8	74	8	66	7	74	7	54	8
No. of Detections	0	0	0	0	0	0	0	0	12	8	0	0	0	0	0	0	0	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	0.666	0.857	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.454	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	0.1	0.7	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	0.1	0.1	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	0.1	0.67	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-74		MW-75		MW-80		MW-85		MW-87		MW-91		MW-86		MW-88		MW-89		MW-90		MW-43	
	Downgradient												Downgradient of Northhend Facilities									
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Potassium, dissolved mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
Maximum	2.5	2.05	2.3	1.76	1.62	1.6	2.3	1.51	2.27	2.17	1.9	1.94	1.6	1.17	2	0.932	1.6	1.72	1.43	1.35	2.1	1.39
Minimum	1.4	1.8	0.8	1.5	1.3	1.5	0.8	1.2	1.3	1.9	1.2	1.5	0.9	1.0	0.7	0.8	1.2	1.3	1.1	1.2	0.9	1.2
Mean	1.9	1.9	1.6	1.7	1.5	1.5	1.3	1.4	1.9	2.1	1.5	1.7	1.2	1.1	0.9	0.8	1.4	1.4	1.3	1.3	1.3	1.3
Standard Deviation	0.2	0.1	0.2	0.1	0.1	0.0	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1
Median	1.9	1.9	1.6	1.7	1.5	1.6	1.27	1.43	1.9	2.1	1.5	1.6	1.1	1.1	0.8	0.8	1.4	1.4	1.2	1.3	1.3	1.3
Sodium, dissolved mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
Maximum	12.7	12.7	46	8.84	7.77	7.56	8.11	7.99	10	9.81	8.2	7.65	7.4	6.57	8.6	5.77	9.8	9.01	7	6.41	6.9	6.84
Minimum	7.7	10.6	5.3	7.39	5.74	6.28	4.6	6.9	7.1	7.14	6.1	6.69	5.5	5.16	4.3	5.01	6.3	7.25	4.9	5.74	5.2	5.61
Mean	9.5	11.7	11.2	8.1	6.6	6.9	6.9	7.7	8.4	9.0	6.9	7.3	6.3	6.0	5.4	5.4	7.9	8.1	5.8	6.0	6.1	6.0
Standard Deviation	1.1	0.8	9.0	0.4	0.6	0.4	0.7	0.4	0.8	0.9	0.5	0.3	0.5	0.5	0.6	0.3	0.9	0.6	0.5	0.3	0.4	0.5
Median	9.3	11.8	7.8	8.0	6.6	6.9	7.0	7.8	8.4	9.1	6.8	7.4	6.3	6.1	5.4	5.4	8.1	8.3	5.7	6.0	6.1	5.8
Arsenic, dissolved mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	27	0	42	0	11	0	10	0	2	0	41	8	1	0	32	7	45	8	0	0	6	0
Maximum	0.003	ND	0.007	ND	0.005	ND	0.002	ND	0.003	ND	0.006	0.004	0.003	ND	0.001	0.001	0.007	0.001	ND	ND	0.002	ND
Minimum	ND	ND	ND	ND	0.004	ND	ND	ND	ND	ND	ND	0.002	ND	ND	ND	ND	ND	0.001	ND	ND	ND	ND
Mean	0.001	ID	0.002	ID	0.005	ID	0.001	ID	ID	ID	0.004	0.002	ID	ID	0.001	0.001	0.003	0.001	ID	ID	0.001	ID
Standard Deviation	0.001	ID	0.001	ID	0.000	ID	0.000	ID	ID	ID	0.001	0.001	ID	ID	0.000	0.000	0.002	0.000	ID	ID	0.000	ID
Median	0.001	ID	0.002	ID	0.005	ID	0.001	ID	ID	ID	0.004	0.002	ID	ID	0.001	0.001	0.002	0.001	ID	ID	0.001	ID
Barium, dissolved mg/L																						
No. of Analyses	48	8	49	8	11	8	46	8	48	8	42	8	46	8	46	8	46	8	41	8	76	8
No. of Detections	48	8	49	8	11	8	46	8	48	8	42	8	45	8	46	8	45	8	41	8	76	8
Maximum	0.019	0.014	0.02	0.01	0.013	0.005	0.023	0.005	0.02	0.022	0.012	0.01	0.008	0.005	0.006	0.003	0.009	0.006	0.008	0.006	0.012	0.007
Minimum	0.008	0.01	0.002	0.009	0.01	0.003	0.004	0.004	0.014	0.019	0.005	0.009	ND	0.004	0.002	0.002	ND	0.006	0.005	0.005	0.003	0.006
Mean	0.013	0.011	0.010	0.009	0.011	0.012	0.005	0.005	0.017	0.020	0.009	0.009	0.005	0.004	0.003	0.002	0.007	0.006	0.005	0.005	0.007	0.006
Standard Deviation	0.003	0.001	0.003	0.000	0.001	0.000	0.003	0.000	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.000
Median	0.014	0.011	0.009	0.009	0.011	0.012	0.004	0.005	0.017	0.02	0.009	0.01	0.005	0.004	0.002	0.002	0.006	0.006	0.005	0.005	0.007	0.006
Dichlorodifluoromethane, ug/L																						
No. of Analyses	141	12	144	12	11	8	47	8	139	12	42	8	46	8	45	8	45	8	41	8	69	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.2	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.3	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.1	ID
cis 1,2-Dichloroethene, ug/L																						
No. of Analyses	141	12	144	12	11	8	47	8	139	12	42	8	46	8	46	8	46	8	41	8	78	8
No. of Detections	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	ND	ND	0.26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-70		MW-77		MW-78		MW-100		MW-64		MW-66		MW-67		MW-68		MW-69		MW-72	
	Interior								Vertical to Key Facilities								Westside Downgradient			
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Tetrachloroethene, ug/L																				
No. of Analyses	75	8	50	8	46	7	42	5	74	7	73	8	74	8	66	7	74	7	54	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Trichloroethene, ug/L																				
No. of Analyses	75	8	50	8	46	7	42	5	74	7	73	8	74	8	66	7	74	7	54	8
No. of Detections	0	0	0	0	22	7	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Maximum	ND	ND	ND	ND	0.62	0.738	ND	ND	0.45	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	0.405	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	0.27	0.22	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	0.20	0.19	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	0.10	0.10	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Vinyl Chloride, ug/L																				
No. of Analyses	75	8	50	8	46	7	42	5	74	7	73	8	74	8	66	7	74	7	54	8
No. of Detections	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Maximum	ND	ND	ND	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID

NOTES: * Well location groupings are relative to the flow paths of the Aquifer and the placement of Solid Waste.
ND = Not Detected

Table 4-2a
Statistical Summary of Regional Aquifer
Groundwater Data

Well Location	MW-74		MW-75		MW-80		MW-85		MW-87		MW-91		MW-86		MW-88		MW-89		MW-90		MW-43	
	Downgradient												Downgradient of Northhend Facilities									
Time Period	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Tetrachloroethene, ug/L																						
No. of Analyses	141	12	144	12	11	8	47	8	139	12	42	8	46	8	46	8	46	8	41	8	78	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Trichloroethene, ug/L																						
No. of Analyses	141	12	144	12	11	8	47	8	139	12	42	8	46	8	46	8	46	8	41	8	78	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.23	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Vinyl Chloride, ug/L																						
No. of Analyses	141	12	144	12	11	8	47	8	139	12	42	8	46	8	46	8	46	8	41	8	78	8
No. of Detections	0	0	2	0	0	0	0	0	2	0	0	0	0	0	1	0	1	0	0	0	10	0
Maximum	ND	ND	0.07	ND	ND	ND	ND	ND	0.08	ND	ND	ND	ND	ND	0.03	ND	0.04	ND	ND	ND	0.07	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.02	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.03	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.01	ID

NOTES: * Well location groupings are relative to the flow paths of the Aquifer and the placement of Solid Waste.
ND = Not Detected

Table 4-2b
Statistical Summary of Perched Zones
Groundwater Data

Well Location	MW-27A		MW-28		MW-29		MW-55		MW-30A		MW-47		MW-62		MW-EB6		MW-101	MW-101
	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Zone	North and West Perched Zones								East Perched Zone								SSWA	
pH, (Field) Standard Units																		
No. of Analyses	72	8	64	7	74	7	76	8	82	8	82	8	49	5	37	6	15	8
No. of Detections	72	8	64	7	74	7	76	8	82	8	82	8	49	5	37	6	15	8
Maximum	8.3	7.9	7.6	6.0	7.9	6.5	8.6	7.9	7.4	6.4	7.5	7.1	7.5	6.8	7.6	6.2	7.1	7.2
Minimum	5.9	7.1	5.4	5.5	5.8	5.9	6.9	7.5	5.8	6.1	6.4	6.7	6.1	6.1	5.6	5.2	6.6	6.8
Mean	7.6	7.6	6.1	5.7	6.6	6.3	7.8	7.8	6.5	6.3	7.0	6.9	6.8	6.5	6.7	5.7	6.9	7.1
Standard Deviation	0.46	0.28	0.43	0.19	0.50	0.20	0.30	0.14	0.30	0.12	0.20	0.13	0.35	0.27	0.48	0.38	0.13	0.15
Median	7.7	7.7	6.0	5.7	6.5	6.4	7.8	7.8	6.5	6.3	7.0	6.9	6.8	6.5	6.7	5.8	6.8	7.1
Specific Conductance, (Field) uS/cm																		
No. of Analyses	72	8	64	7	74	7	76	8	81	8	82	8	49	5	37	6	16	8
No. of Detections	72	8	64	7	74	7	76	8	118	8	82	8	49	5	37	6	16	8
Maximum	185	205	242	105	108	85	160	165	469	350	1090	750	324	210	710	240	827	670
Minimum	87	140	73	80	68	74	104	120	70	240	8	650	50	140	100	120	250	420
Mean	155	161	139	95	83	79	132	142	245	285	816	710	245	187	245	167	651	579
Standard Deviation	16	21	39	8	7	5	11	15	121	43	142	34	48	30	116	42	147	89
Median	157	160	125	98	84	78	130	143	278	268	829	710	250	200	206	160	687	593
Total Dissolved Solids, mg/L																		
No. of Analyses	72	8	64	7	75	7	76	8	82	8	82	8	49	5	29	6	15	8
No. of Detections	72	8	64	7	75	7	76	8	82	8	82	8	49	5	29	6	15	8
Maximum	500	140	180	125	3100	153	130	121	350	245	1500	719	240	147	560	430	490	435
Minimum	27.0	116.0	47.0	70.0	40.0	65	58	101	120	196	120	620	95	122	29	72	162	341
Mean	117.2	131.1	98.6	85.0	145.1	83.9	98.5	113.9	226.5	219.9	541.6	675.6	165.7	133.8	162.7	173.1	439.7	406.6
Standard Deviation	51.40	8.32	25.93	18.38	362	31	14.84	7.70	38.63	16.57	130	30.2	27.80	9.34	96.3	129.69	78.77	29.08
Median	110	134	98	80	78	72	99	116	220	222	525	677	170	132	141	140	455	415
Alkalinity, total (CaCO3), mg/L																		
No. of Analyses	63	8	57	7	66	7	67	8	67	8	67	8	43	5	25	6	15	8
No. of Detections	63	8	57	7	66	7	67	8	67	8	67	8	43	5	25	6	15	8
Maximum	90	82	71	34	48	28	68	67	200	193	920	688	110	78	600	160	520	389
Minimum	29	62	24	25	21	23	52	58	66	139	400	642	42	49	64	48	122	286
Mean	79	77	37	28	26	25	60	63	140	169	541	666	71	64	151	91	415	364
Standard Deviation	8	6	11	3	4	2	4	3	39	19	77	16	15	12	134	39	103	38
Median	80	79	34	26	26	25	59	63	150	172	530	669	70	63	100	81	437	382
Ammonia as N, mg/L																		
No. of Analyses	72	8	64	7	75	7	76	8	82	8	82	8	49	5	23	6	15	8
No. of Detections	72	8	23	0	18	0	69	8	15	0	63	8	7	0	23	6	9	7
Maximum	0.26	0.20	0.22	ND	0.12	ND	0.12	0.06	0.29	ND	0.16	0.10	0.03	ND	1.97	2.95	0.1	0.02
Minimum	0.0	0.1	ND	ND	ND	ND	ND	0.0	ND	ND	ND	0.0	ND	ND	0.1	2.0	ND	ND
Mean	0.15	0.16	0.02	ID	0.01	ID	0.05	0.06	0.02	ID	0.05	0.06	0.01	ID	1.00	2.37	0.02	0.02
Standard Deviation	0.05	0.04	0.04	ID	0.02	ID	0.02	0.00	0.03	ID	0.04	0.02	0.01	ID	0.53	0.35	0.02	0.01
Median	0.2	0.2	0.01	ID	0.01	ID	0.1	0.1	0.01	ID	0.1	0.1	0.01	ID	1.0	2.3	0.02	0.02
Chloride, mg/L																		
No. of Analyses	72	8	64	7	75	7	76	8	82	8	82	8	49	5	26	6	15	8
No. of Detections	72	8	64	7	74	7	76	8	81	8	82	8	49	5	22	6	15	8
Maximum	43.0	6.7	5.0	4.4	14.0	3.2	3.7	2.6	10.3	5.9	26.0	7.8	30.0	7.9	33.0	2.0	8.9	5.1
Minimum	1.0	3.7	2.0	3.2	ND	2.5	1.6	1.8	ND	1.4	3.8	6.1	3.0	4.9	ND	0.8	3.3	3.6
Mean	2.5	5.1	3.2	3.8	3.5	2.9	2.0	2.0	3.2	2.5	12.8	6.9	10.9	5.8	2.7	1.2	6.7	4.3
Standard Deviation	5.09	0.97	0.68	0.48	1.78	0.24	0.24	0.27	2.61	1.46	5.65	0.59	6.58	1.25	6.23	0.45	1.88	0.56
Median	1.5	5.3	3.0	3.7	3.2	2.9	2.0	1.9	2.0	2.0	10.0	6.8	9.0	5.4	1.3	1.1	6.7	4.2

Table 4-2b
Statistical Summary of Perched Zones
Groundwater Data

Well Location	MW-27A		MW-28		MW-29		MW-55		MW-30A		MW-47		MW-62		MW-EB6		MW-101	MW-101
	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Zone	North and West Perched Zones								East Perched Zone								SSWA	
Nitrate as N, mg/L																		
No. of Analyses	72	8	64	7	75	7	76	8	82	8	82	8	49	5	24	6	15	8
No. of Detections	32	8	56	7	73	7	8	3	81	8	9	0	49	5	9	5	1	0
Maximum	1.1	0.2	1.2	0.5	5.1	2.3	0.1	0.0	22.0	1.6	1.1	ND	12.0	3.6	0.1	10.6	0.0	ND
Minimum	ND	0.02	ND	0.17	ND	1.30	ND	ND	ND	0.29	ND	ND	2.57	2.16	ND	ND	ND	ND
Mean	0.06	0.11	0.35	0.31	2.34	1.87	0.005	0.01	4.04	0.63	0.02	ID	5.58	3.11	0.02	1.82	ID	ID
Standard Deviation	0.16	0.07	0.30	0.14	0.86	0.34	0.01	0.01	4.80	0.46	0.12	ID	1.88	0.57	0.04	4.30	ID	ID
Median	0.01	0.10	0.34	0.26	2.30	1.97	0.001	0.01	2.20	0.41	0.003	ID	5.40	3.27	0.01	0.05	ID	ID
Sulfate, mg/L																		
No. of Analyses	72	8	63	7	75	7	76	8	82	8	82	8	49	5	26	6	15	8
No. of Detections	72	8	63	7	74	7	76	8	82	8	82	8	49	5	15	6	15	8
Maximum	16.5	11.8	59.5	16.1	4.0	2.0	27.0	13.1	65.0	13.9	13.9	7.3	41.0	20.3	8.0	32.7	20.9	5.5
Minimum	1.6	7.8	13.8	12.9	ND	1.6	9.0	10.7	2.0	7.8	1.6	5.3	16.3	14.4	ND	0.1	5.2	4.4
Mean	7.6	10.3	26.7	14.2	2.0	1.8	10.7	11.7	22.4	10.3	6.9	6.7	25.5	16.6	1.4	11.6	7.3	5.0
Standard Deviation	1.94	1.30	11.45	1.05	0.60	0.14	2.09	0.78	9.65	1.97	1.90	0.66	5.16	2.73	2.00	13.93	4.22	0.33
Median	7.1	10.5	23.0	14.1	2.0	1.8	10.0	11.8	22.3	10.0	6.8	6.9	25.3	14.8	0.3	5.8	5.9	5.0
Iron, dissolved mg/L																		
No. of Analyses	72	8	64	7	75	7	76	8	82	8	82	8	50	5	34	6	15	8
No. of Detections	61	0	53	1	63	1	76	8	66	1	80	8	43	2	34	6	15	8
Maximum	0.2	ND	1.11	0.01	34.0	0.1	0.6	0.3	0.5	0.1	3.0	3.3	1.7	0.0	29.3	28.0	3.5	1.5
Minimum	ND	ND	ND	ND	ND	ND	0.0	0.2	ND	ND	0.0	0.2	ND	ND	0.5	0.9	0.3	0.1
Mean	0.0	ID	0.1	ID	0.8	ID	0.2	0.3	0.1	ID	0.6	0.8	0.1	ID	10.7	9.3	1.3	0.6
Standard Deviation	0.04	ID	0.18	ID	4.05	ID	0.08	0.04	0.09	ID	0.59	1.03	0.28	ID	7.46	9.86	0.98	0.55
Median	0.0	ID	0.0	ID	0.0	ID	0.2	0.3	0.1	ID	0.4	0.4	0.1	ID	8.9	7.0	1.0	0.3
Manganese, dissolved mg/L																		
No. of Analyses	72	8	64	7	75	7	76	8	82	8	82	8	50	5	34	6	15	8
No. of Detections	72	8	61	3	42	1	76	8	21	1	82	8	12	1	34	6	15	8
Maximum	0.2	0.1	4.2	0.0	0.5	0.0	0.2	0.2	0.1	0.0	2.8	2.5	0.0	0.0	3.0	1.1	2.00	1.60
Minimum	0.01	0.03	ND	ND	ND	ND	0.02	0.14	ND	ND	0.54	1.36	ND	ND	0.19	0.36	0.17	0.90
Mean	0.1	0.1	0.8	0.0	0.0	ID	0.1	0.2	0.0	ID	1.2	1.7	0.0	ID	1.0	0.7	1.5	1.3
Standard Deviation	0.02	0.01	1.21	0.00	0.07	ID	0.02	0.01	0.01	ID	0.47	0.37	0.01	ID	0.57	0.28	0.40	0.21
Median	0.06	0.05	0.13	0.00	0.00	ID	0.13	0.16	0.00	ID	1.06	1.71	0.00	ID	0.82	0.63	1.60	1.28
Calcium, dissolved mg/L																		
No. of Analyses	72	8	64	7	75	7	76	8	82	8	82	8	50	5	34	6	15	8
No. of Detections	72	8	64	7	75	7	76	8	82	8	82	8	50	5	34	6	15	8
Maximum	24.7	21.2	25.2	10.6	12	7.71	17	13.4	54.6	37.2	160	154	32	19	28.8	14.2	98	69.2
Minimum	2.8	17.6	8.47	8.35	5.5	6.08	1.8	11.6	6.2	22.4	63	123	16	15.1	4.8	6	23.7	56.8
Mean	18.1	19.7	14.1	9.2	7.9	7.1	11.7	12.4	31.2	28.8	106.5	131.9	23.4	17.8	14.0	9.9	71.8	63.8
Standard Deviation	3.0	1.3	4.4	0.8	1.3	0.5	1.7	0.6	8.4	4.6	17.0	11.3	4.0	1.6	5.5	3.4	15.5	4.0
Median	19	19.95	13	8.93	7.78	7.26	12	12.5	30.55	26.95	108.5	126.5	23	18.5	12.75	10.07	73	63.8
Magnesium, dissolved mg/L																		
No. of Analyses	72	8	64	7	75	7	76	8	82	8	82	8	50	5	34	6	15	8
No. of Detections	72	8	64	7	75	7	76	8	82	8	82	8	50	5	34	6	15	8
Maximum	6.41	6.64	8.6	2.86	6.3	2.2	7.6	7.2	31.0	21.5	64.0	70.0	12.0	6.7	12.9	8.1	50.0	40.6
Minimum	2.1	5.0	2.0	2.1	1.5	1.5	3.4	5.9	1.7	12.4	31.0	57.9	4.4	4.6	2.7	3.2	15.3	24.0
Mean	4.9	5.7	3.4	2.4	2.0	1.9	5.7	6.6	17.9	16.0	50.4	65.1	7.8	5.3	6.7	5.3	40.2	36.6
Standard Deviation	0.65	0.59	1.15	0.25	0.6	0.2	0.6	0.5	5.0	3.1	6.8	4.9	1.8	0.8	2.4	2.0	8.0	5.2
Median	4.80	5.71	3.05	2.25	1.9	1.9	5.7	6.8	17.0	15.3	50.0	67.1	7.7	5.0	6.4	5.3	42.0	37.9

Table 4-2b
Statistical Summary of Perched Zones
Groundwater Data

Well Location	MW-27A		MW-28		MW-29		MW-55		MW-30A		MW-47		MW-62		MW-EB6		MW-101	MW-101
	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Zone	North and West Perched Zones								East Perched Zone								SSWA	
Potassium, dissolved mg/L																		
No. of Analyses	72	8	64	7	75	7	76	8	82	8	82	8	50	5	34	6	15	8
No. of Detections	72	8	64	7	71	7	76	8	82	8	82	8	50	5	34	6	15	8
Maximum	15	3.77	4.6	1.1	1.6	0.63	2.2	1.93	7.2	1.89	24	5.9	1.6	0.964	2.8	2.71	3.7	3.31
Minimum	1.28	2.77	0.893	0.847	ND	0.47	1.00	1.49	0.53	1.55	3.70	4.25	0.70	0.83	1.00	1.20	1.92	2.4
Mean	3.4	3.5	1.2	0.9	0.6	0.5	1.57	1.66	1.8	1.7	5.12	4.91	1.14	0.90	1.56	1.70	3.0	3.0
Standard Deviation	1.4	0.3	0.6	0.1	0.2	0.1	0.2	0.1	0.7	0.1	2.2	0.5	0.2	0.1	0.4	0.5	0.4	0.3
Median	3.3	3.5	1	0.895	0.5	0.5	1.6	1.6	1.7	1.7	4.9	4.9	1.1	0.9	1.5	1.6	2.9	3.0
Sodium, dissolved mg/L																		
No. of Analyses	72	8	64	7	75	7	76	8	82	8	82	8	50	5	34	6	15	8
No. of Detections	72	8	64	7	75	7	76	8	82	8	82	8	50	5	34	6	15	8
Maximum	7.96	7.76	10.6	7.22	7.6	5.13	6.9	6.34	20	16.4	21	20	20	15.5	350	120	25	16.7
Minimum	3.01	5.92	5.02	5.33	3.5	4.23	4.7	5.18	4.3	11.4	13	14.5	12.4	13	8.9	7.95	9.05	13.8
Mean	6.5	6.8	7.4	6.0	5.0	4.6	5.6	5.7	13.6	14.6	16.4	17.8	15.4	14.0	31.7	28.6	17.3	15.5
Standard Deviation	0.68	0.57	1.29	0.59	0.79	0.32	0.44	0.39	1.82	1.73	1.71	2.02	1.67	0.97	60.16	44.81	3.51	1.01
Median	6.5	6.8	7.2	5.9	4.8	4.7	5.5	5.6	13.0	15.2	16.0	18.6	15.0	13.9	14.0	10.7	17.0	15.6
Arsenic, dissolved mg/L																		
No. of Analyses	72	8	64	7	75	7	76	8	82	8	82	8	50	5	34	6	15	8
No. of Detections	72	8	1	0	5	0	2	0	4	0	69	3	1	0	34	5	14	8
Maximum	0.019	0.016	0.002	ND	0.009	ND	0.001	ND	0.013	ND	0.006	0.002	0.001	ND	0.016	0.0067	0.0155	0.0146
Minimum	0.005	0.011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.001	ND	ND	0.003
Mean	0.016	0.015	ID	ID	0.001	ID	ID	ID	0.001	ID	0.002	0.001	ID	ID	0.006	0.003	0.008	0.006
Standard Deviation	0.002	0.002	ID	ID	0.001	ID	ID	ID	0.001	ID	0.001	0.001	ID	ID	0.004	0.002	0.004	0.004
Median	0.016	0.016	ID	ID	0.001	ID	ID	ID	5E-04	ID	0.002	5E-04	ID	ID	0.005	0.0017	0.007	0.005
Barium, dissolved mg/L																		
No. of Analyses	72	8	64	7	75	7	76	8	82	8	82	8	50	5	34	6	15	8
No. of Detections	72	8	63	7	71	7	76	8	82	8	82	8	50	5	34	6	15	8
Maximum	0.018	0.007	0.02	0.007	0.2	0.002	0.009	0.005	0.083	0.007	0.04	0.04	0.008	0.003	0.04	0.0166	0.049	0.0354
Minimum	0.004	0.005	ND	0.005	ND	0.001	0.004	0.004	0.005	0.005	0.026	0.034	0.002	0.002	0.009	0.007	0.0071	0.0229
Mean	0.007	0.006	0.010	0.006	0.006	0.001	0.005	0.004	0.009	0.006	0.034	0.037	0.003	0.002	0.023	0.011	0.035	0.030
Standard Deviation	0.002	0.001	0.004	0.000	0.024	0.000	0.001	0.000	0.009	0.001	0.003	0.002	0.001	0.000	0.009	0.004	0.009	0.004
Median	0.007	0.006	0.010	0.006	0.002	0.001	0.005	0.004	0.007	0.006	0.034	0.037	0.002	0.002	0.022	0.012	0.0364	0.03145
Benzene, ug/L																		
No. of Analyses	76	8	64	7	75	7	76	8	82	8	82	8	50	5	39	6	14	8
No. of Detections	0	0	0	0	0	0	0	0	3	0	2	0	0	0	3	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	0.6	ND	0.24	ND	ND	ND	1.23	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	0.1	ID	ID	ID	ID	ID	0.2	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	0.1	ID	ID	ID	ID	ID	0.3	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	0.1	ID	ID	ID	ID	ID	0.1	ID	ID	ID
Dichlorodifluoromethane, ug/L																		
No. of Analyses	67	8	56	7	66	7	67	8	67	8	66	8	43	5	32	6	14	8
No. of Detections	0	0	1	0	0	0	0	0	17	0	59	8	0	0	0	0	0	0
Maximum	ND	ND	0.84	ND	ND	ND	ND	ND	0.67	ND	46	8.24	ND	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.29	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	0.2	ID	11.1	5.6	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	0.1	ID	11.6	1.4	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	0.1	ID	6.75	5.465	ID	ID	ID	ID	ID	ID

Table 4-2b
Statistical Summary of Perched Zones
Groundwater Data

Well Location	MW-27A		MW-28		MW-29		MW-55		MW-30A		MW-47		MW-62		MW-EB6		MW-101	MW-101
	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Zone	North and West Perched Zones								East Perched Zone								SSWA	
1,1-Dichloroethane, ug/L																		
No. of Analyses	76	8	64	7	75	7	76	8	82	8	82	8	50	5	39	6	14	8
No. of Detections	0	0	0	0	0	0	0	0	81	8	74	8	49	5	0	0	1	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	77	2.6	2.1	0.67	13	1.65	ND	ND	0.21	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.57	ND	0.46	ND	0.764	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	17.2	2.2	0.5	0.5	5.5	1.1	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	17.8	0.3	0.3	0.1	3.6	0.4	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	9.75	2.295	0.469	0.537	5.25	0.971	ID	ID	ID	ID
1,2-Dichloroethane, ug/L																		
No. of Analyses	76	8	64	7	75	7	76	8	82	8	82	8	50	5	39	6	14	8
No. of Detections	0	0	0	0	0	0	0	0	42	0	1	0	7	0	0	0	1	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	3.8	ND	0.21	ND	0.6	ND	ND	ND	0.22	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	0.6	ID	ID	ID	0.1	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	0.7	ID	ID	ID	0.1	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	0.265	ID	ID	ID	0.1	ID	ID	ID	ID	ID
cis 1,2-Dichloroethene, ug/L																		
No. of Analyses	76	8	64	7	75	7	76	8	82	8	82	8	50	5	39	6	14	8
No. of Detections	0	0	2	0	0	0	0	0	81	8	77	8	50	5	0	0	1	1
Maximum	ND	ND	0.24	ND	ND	ND	ND	ND	110	6.54	3.2	2.92	14	4.05	ND	ND	0.21	0.21
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.92	ND	1.11	1.3	1.29	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	26.1	3.6	1.0	1.7	6.8	2.3	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	26.0	1.6	0.7	0.6	3.5	1.1	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	17	3.12	0.72	1.47	6.9	1.85	ID	ID	ID	ID
1,2-Dichloropropane, ug/L																		
No. of Analyses	76	8	64	7	75	7	76	8	82	8	82	8	50	5	39	6	14	8
No. of Detections	0	0	0	0	0	0	0	0	45	0	0	0	6	0	0	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	ND	ND	0.32	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	0.4	ID	ID	ID	0.1	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	0.4	ID	ID	ID	0.1	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	0.245	ID	ID	ID	0.1	ID	ID	ID	ID	ID
Tetrachloroethene, ug/L																		
No. of Analyses	76	8	64	7	75	7	76	8	82	8	82	8	50	5	39	6	14	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Toluene, ug/L																		
No. of Analyses	76	8	64	7	75	7	76	8	82	8	82	8	50	5	39	6	14	8
No. of Detections	0	0	2	0	2	0	3	0	2	0	4	0	1	1	14	4	0	0
Maximum	ND	ND	0.41	ND	0.38	ND	0.59	ND	1.7	ND	0.78	ND	0.72	0.518	4.27	3.49	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	0.11	ID	ID	ID	0.13	ID	ID	ID	0.47	0.93	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	0.06	ID	ID	ID	0.11	ID	ID	ID	0.95	1.30	ID	ID
Median	ID	ID	ID	ID	ID	ID	0.10	ID	ID	ID	0.10	ID	ID	ID	0.10	0.43	ID	ID

Table 4-2b
Statistical Summary of Perched Zones
Groundwater Data

Well Location	MW-27A		MW-28		MW-29		MW-55		MW-30A		MW-47		MW-62		MW-EB6		MW-101	MW-101
	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Zone	North and West Perched Zones								East Perched Zone								SSWA	
Trichloroethene, ug/L																		
No. of Analyses	76	8	64	7	75	7	76	8	82	8	82	8	50	5	39	6	14	8
No. of Detections	0	0	0	0	0	0	0	0	82	8	0	0	25	0	0	0	0	0
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	3.5	1.39	ND	ND	0.47	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	0.93	0.86	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	1.75	1.15	ID	ID	0.19	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	0.53	0.21	ID	ID	0.10	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	1.6	1.225	ID	ID	0.15	ID	ID	ID	ID	ID
Vinyl Chloride, ug/L																		
No. of Analyses	76	8	64	7	75	7	76	8	82	8	82	8	50	5	39	6	14	8
No. of Detections	1	0	0	0	0	0	0	0	24	0	82	8	3	0	1	0	14	8
Maximum	0.06	ND	ND	ND	ND	ND	ND	ND	3.22	ND	15.9	8.55	0.23	ND	0.02	ND	0.9	0.553
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	4.54	ND	ND	ND	ND	0.328	0.219
Mean	ID	ID	ID	ID	ID	ID	ID	ID	0.23	ID	7.20	5.66	0.03	ID	ID	ID	1	0
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	0.57	ID	3.61	1.28	0.05	ID	ID	ID	0	0
Median	ID	ID	ID	ID	ID	ID	ID	ID	0.01	ID	6.64	5.075	0.01	ID	ID	ID	0.5935	0.394

NOTES: ND = Not Detected ID = Insufficent Data to calculate statistic.

Perched Zone Wells MW-25, MW-41S, MW-41D, NW-45, MW-79, MW-102 and MW-103 are not tabulated due to insufficient data.

Table 4-3a
Summary of Regional Aquifer Data Trend Tests

Well Location	MW-24		MW-56		MW-57		MW-58A		MW-59 Upgradient South		MW-60		MW-65		MW-76		MW-82	
	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH, (Field) Standard Units	--	--	D	--	D	--	--	--	D	--	D	--	--	--	D	--	--	--
Specific Conductance, (Field) uS/cm	D	--	--	--	D	--	I	--	D	--	--	--	--	--	I	--	I	--
Total Dissolved Solids, mg/L	D	--	I	--	--	--	--	--	--	--	--	--	I	--	I	--	I	--
Alkalinity, total (CaCO3), mg/L	D	I	D	--	D	D	--	D	D	--	--	D	I	--	I	--	I	--
Ammonia as N, mg/L	--	--	D	--	--	--	I	D	--	--	--	--	--	--	D	--	--	--
Chloride, mg/L	I	--	I	--	--	I	D	I	I	--	D	--	--	--	--	--	--	--
Nitrate as N, mg/L	--	--	I	D	--	--	--	--	--	--	D	--	--	I	D	--	--	--
Sulfate, mg/L	D	--	--	--	--	--	--	--	--	--	I	--	--	--	--	--	I	--
Iron, dissolved mg/L	D	--	D	--	--	--	--	D	D	--	D	--	I	--	D	--	D	--
Manganese, dissolved mg/L	D	--	D	--	D	--	--	--	D	--	--	--	D	--	--	--	--	--
Calcium, dissolved mg/L	D	--	I	--	D	--	--	--	D	--	--	--	--	--	I	--	I	--
Magnesium, dissolved mg/L	D	--	--	I	--	--	--	--	D	--	I	--	I	--	I	--	I	I
Potassium, dissolved mg/L	D	--	D	I	--	--	I	--	--	--	I	--	I	--	I	--	I	--
Sodium, dissolved mg/L	D	--	--	--	--	--	--	--	D	--	I	--	I	--	--	--	I	I
Arsenic, dissolved mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Barium, dissolved mg/L	D	--	--	D	D	--	D	--	D	--	D	D	D	--	--	--	--	--
Dichlorodifluoromethane, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
cis 1,2-Dichloroethene, ug/L	I	--	D	I	--	--	--	--	I	I	--	--	--	--	D	--	--	--
Tetrachloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	D	--	--	--
Trichloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	D	--	D	I
Vinyl Chloride, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	D	--	--	--	--	--

D	Decreasing Trend
I	Increasing Trend
--	No Trend

Table 4-3a
Summary of Regional Aquifer Data Trend Tests

Well Location	MW-83		MW-94		MW-21		MW-73		MW-84		MW-81		MW-99		MW-93		MW-95	
	Upgradient South				Upgradient Northwest						Upgradient Northeast				Cross Gradient			
	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH, (Field) Standard Units	D	--	--	--	I	--	D	--	D	--	--	--	--	I	--	--	--	--
Specific Conductance, (Field) uS/cm	I	--	--	--	--	--	D	--	--	--	I	--	--	--	I	--	D	--
Total Dissolved Solids, mg/L	I	--	I	--	--	--	--	--	I	--	--	--	--	--	I	--	--	--
Alkalinity, total (CaCO3), mg/L	I	--	I	--	I	--	D	--	--	--	I	D	D	--	I	--	D	--
Ammonia as N, mg/L	--	--	D	--	--	--	--	--	--	--	D	--	--	--	I	--	I	--
Chloride, mg/L	I	--	I	--	D	--	--	D	I	--	I	--	I	--	D	--	I	--
Nitrate as N, mg/L	D	I	--	--	--	--	I	D	I	--	--	I	D	--	--	--	--	--
Sulfate, mg/L	D	--	D	--	D	--	D	--	--	--	--	D	--	--	I	--	D	--
Iron, dissolved mg/L	D	--	D	--	D	--	D	--	D	--	D	--	D	--	D	--	D	--
Manganese, dissolved mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	I	--	D	--
Calcium, dissolved mg/L	I	--	I	--	I	--	D	--	--	--	I	--	--	--	I	--	D	D
Magnesium, dissolved mg/L	I	--	I	--	I	--	D	--	--	--	I	--	I	--	I	--	--	--
Potassium, dissolved mg/L	I	--	I	--	I	--	D	--	--	--	--	--	D	--	I	--	--	--
Sodium, dissolved mg/L	I	--	I	--	I	--	D	--	--	--	--	--	D	--	I	--	D	--
Arsenic, dissolved mg/L	--	--	--	--	--	--	--	--	--	--	--	--	D	--	D	--	--	--
Barium, dissolved mg/L	--	--	D	--	D	--	D	--	--	--	D	--	D	--	I	--	D	--
Dichlorodifluoromethane, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
cis 1,2-Dichloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene, ug/L	D	--	D	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vinyl Chloride, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

D	Decreasing Trend
I	Increasing Trend
--	No Trend

Table 4-3a
Summary of Regional Aquifer Data Trend Tests

Well Location	MW-70		MW-77		MW-78		MW-100		MW-64		MW-66		MW-67		MW-68	
	Interior								Vertical to Key Facilities							
	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH, (Field) Standard Units	--	--	--	--	D	--	D	I	D	--	D	--	D	--	D	--
Specific Conductance, (Field) uS/cm	--	--	D	--	D	--	D	--	I	--	I	--	I	--	I	--
Total Dissolved Solids, mg/L	I	--	D	D	--	--	D	--	I	--	I	--	I	I	I	--
Alkalinity, total (CaCO3), mg/L	I	--	D	D	D	--	D	--	I	--	I	--	I	I	--	--
Ammonia as N, mg/L	--	--	D	--	D	--	D	--	--	--	D	--	D	--	--	--
Chloride, mg/L	I	--	I	D	--	I	D	I	--	--	--	--	I	--	--	--
Nitrate as N, mg/L	D	--	I	D	D	I	--	I	I	--	I	I	D	D	--	--
Sulfate, mg/L	I	D	--	--	D	--	D	--	I	--	I	--	I	--	I	--
Iron, dissolved mg/L	D	--	D	--	D	--	D	--	--	D	D	--	--	I	--	--
Manganese, dissolved mg/L	D	--	D	D	--	--	I	I	--	D	--	--	I	--	--	I
Calcium, dissolved mg/L	I	--	D	--	--	I	D	--	I	--	I	--	I	--	I	--
Magnesium, dissolved mg/L	I	--	D	--	D	I	--	--	I	--	I	--	I	--	I	--
Potassium, dissolved mg/L	I	--	--	--	--	--	I	--	I	--	I	--	I	--	I	--
Sodium, dissolved mg/L	I	--	D	--	I	--	I	--	I	--	I	--	I	--	I	--
Arsenic, dissolved mg/L	--	--	--	--	--	--	--	--	D	D	--	--	--	--	--	I
Barium, dissolved mg/L	D	--	D	D	D	--	D	--	--	--	I	--	I	--	--	--
Dichlorodifluoromethane, ug/L	--	--	D	--	--	--	--	--	--	--	--	--	--	--	--	--
cis 1,2-Dichloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene, ug/L	--	--	--	--	I	--	--	--	--	--	--	--	--	--	--	--
Vinyl Chloride, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

D	Decreasing Trend
I	Increasing Trend
--	No Trend

Table 4-3a
Summary of Regional Aquifer Data Trend Tests

Well Location	MW-69		MW-72		MW-74		MW-75		MW-80		MW-85		MW-86	
	Westside Downgradient				Downgradient									
	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH, (Field) Standard Units	--	--	D	--	--	--	D	--	--	--	D	--	--	--
Specific Conductance, (Field) uS/cm	81.00	--	D	--	I	--	--	--	--	--	I	--	--	--
Total Dissolved Solids, mg/L	--	--	--	I	I	I	I	--	I	I	I	--	--	--
Alkalinity, total (CaCO3), mg/L	I	--	--	--	I	--	I	--	I	--	I	--	D	--
Ammonia as N, mg/L	--	--	--	--	D	--	--	--	--	--	--	--	--	--
Chloride, mg/L	I	--	I	--	I	--	I	--	--	--	I	--	D	--
Nitrate as N, mg/L	--	--	--	--	--	--	--	--	I	--	--	--	I	--
Sulfate, mg/L	D	D	--	--	--	--	I	--	I	--	I	I	D	--
Iron, dissolved mg/L	--	--	D	--	I	--	D	--	I	--	D	--	--	--
Manganese, dissolved mg/L	--	--	--	--	--	--	--	--	I	--	--	--	D	--
Calcium, dissolved mg/L	I	--	--	--	I	--	I	--	I	I	I	I	D	I
Magnesium, dissolved mg/L	I	--	--	--	I	I	I	--	I	I	I	--	D	--
Potassium, dissolved mg/L	I	--	--	--	I	--	I	--	I	--	I	--	--	--
Sodium, dissolved mg/L	I	--	--	--	I	--	I	--	--	--	I	I	--	--
Arsenic, dissolved mg/L	I	--	--	--	D	--	D	--	D	D	--	--	--	--
Barium, dissolved mg/L	--	--	D	--	I	--	D	--	I	--	I	I	D	--
Dichlorodifluoromethane, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--
cis 1,2-Dichloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vinyl Chloride, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--

D	Decreasing Trend
I	Increasing Trend
--	No Trend

Table 4-3a
Summary of Regional Aquifer Data Trend Tests

Well Location	MW-87		MW-88		MW-89 Downgradient		MW-90		MW-91		MW-43 DNF	
	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH, (Field) Standard Units	D	--	D	--	--	--	--	--	D	--	--	--
Specific Conductance, (Field) uS/cm	I	--	I	--	I	--	--	--	D	--	--	--
Total Dissolved Solids, mg/L	I	--	I	--	I	--	I	--	I	--	I	--
Alkalinity, total (CaCO3), mg/L	D	D	--	--	I	D	--	D	D	--	--	--
Ammonia as N, mg/L	--	--	--	--	--	--	I	--	I	--	I	--
Chloride, mg/L	I	--	I	--	I	--	I	I	D	--	I	I
Nitrate as N, mg/L	--	--	I	I	--	I	--	I	I	--	--	--
Sulfate, mg/L	I	I	--	--	--	--	I	--	I	--	I	--
Iron, dissolved mg/L	I	I	D	--	I	--	I	--	--	--	--	--
Manganese, dissolved mg/L	I	--	--	--	D	--	--	--	--	I	--	--
Calcium, dissolved mg/L	I	--	--	--	I	--	I	--	--	--	--	--
Magnesium, dissolved mg/L	I	--	--	--	I	--	I	--	--	--	I	--
Potassium, dissolved mg/L	I	--	--	--	--	--	I	--	I	--	--	--
Sodium, dissolved mg/L	I	--	--	--	I	--	I	--	I	--	--	--
Arsenic, dissolved mg/L	--	--	I	--	D	D	--	--	D	--	--	--
Barium, dissolved mg/L	I	--	D	--	D	--	--	--	--	--	D	--
Dichlorodifluoromethane, ug/L	--	--	--	--	--	--	--	--	--	--	--	--
cis 1,2-Dichloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--
Vinyl Chloride, ug/L	--	--	--	--	--	--	--	--	--	--	--	--

D	Decreasing Trend
I	Increasing Trend
--	No Trend

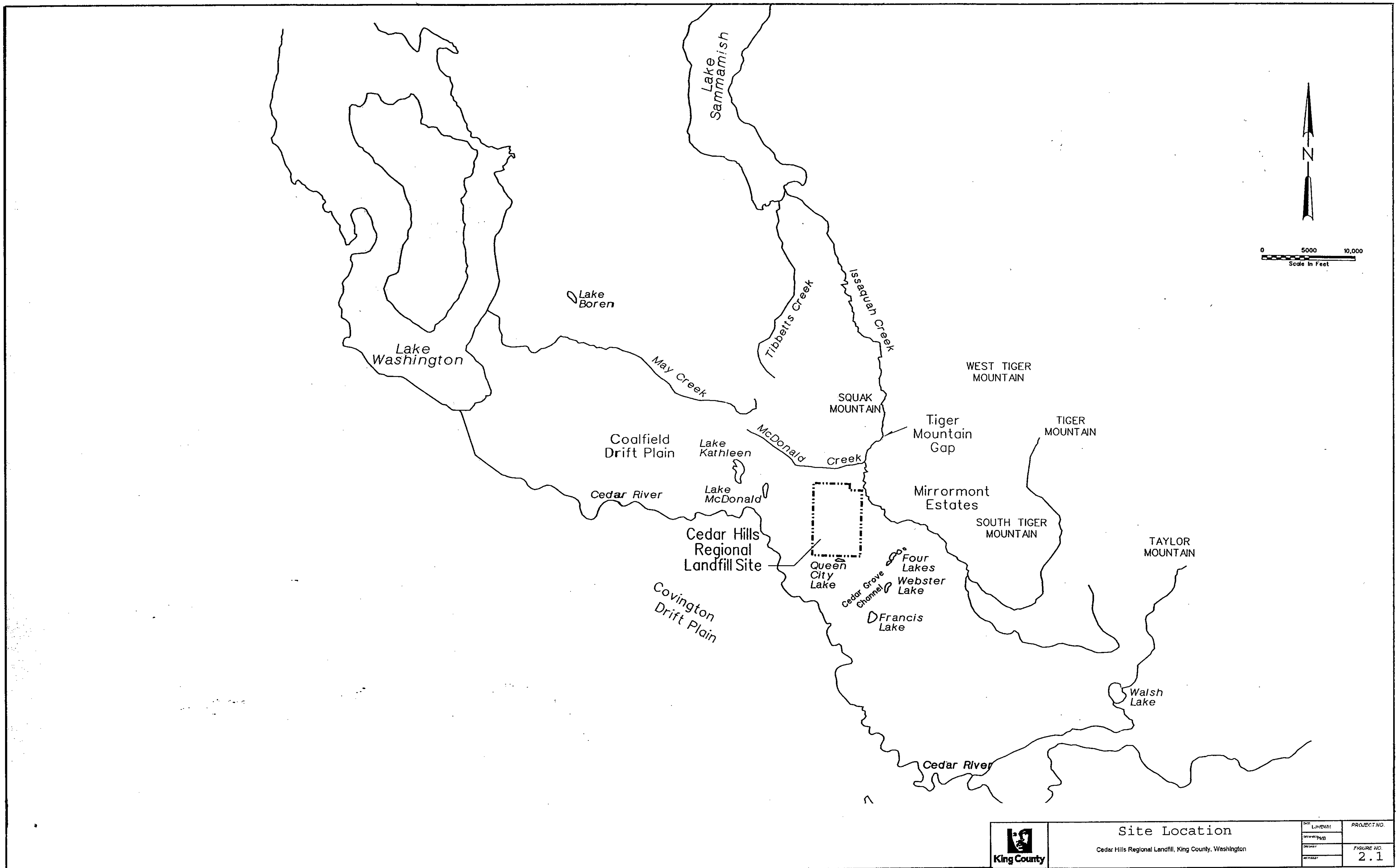
Table 4-3b
Summary of Perched Zones Data Trend Tests

Well Location	MW-27A		MW-28		MW-29		MW-55		MW-30A		MW-47		MW-62		MW-EB6		MW-101	
	North and West Perched Zones								East Perched Zone								SSWA	
	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH, (Field) Standard Units	D	--	D	--	D	--	D	--	D	--	--	--	D	I	D	--	I	--
Specific Conductance, (Field) uS/cm	I	--	D	--	--	--	I	--	--	--	--	D	D	--	D	--	D	D
Total Dissolved Solids, mg/L	I	--	D	--	--	--	I	--	--	--	I	--	D	--	--	--	--	--
Alkalinity, total (CaCO3), mg/L	--	D	D	--	--	--	I	--	I	--	I	--	--	--	--	--	--	D
Ammonia as N, mg/L	--	--	--	--	D	--	--	--	D	--	--	--	--	--	--	--	--	D
Chloride, mg/L	I	D	I	I	--	--	--	--	I	--	D	D	D	--	--	--	--	D
Nitrate as N, mg/L	I	--	--	--	D	--	--	--	D	D	--	--	D	--	--	I	--	--
Sulfate, mg/L	I	D	D	--	--	--	I	--	D	--	I	--	D	--	--	--	--	--
Iron, dissolved mg/L	D	--	D	--	D	--	--	--	D	--	D	--	D	--	D	--	--	--
Manganese, dissolved mg/L	--	--	D	--	--	--	I	--	--	--	I	D	--	--	D	--	--	--
Calcium, dissolved mg/L	I	--	D	--	--	--	--	--	--	--	I	--	D	--	D	--	--	--
Magnesium, dissolved mg/L	I	--	D	--	--	--	I	--	--	--	I	--	D	--	D	--	--	--
Potassium, dissolved mg/L	--	--	D	--	--	--	I	--	I	--	--	--	D	--	--	--	--	--
Sodium, dissolved mg/L	--	--	D	--	--	--	--	--	I	--	I	--	D	--	--	--	--	--
Arsenic, dissolved mg/L	--	D	--	--	--	--	--	--	--	--	D	--	--	--	D	--	--	--
Barium, dissolved mg/L	D	--	D	D	D	--	D	--	--	--	I	--	--	D	D	--	--	D
Benzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane	--	--	--	--	--	--	--	--	--	--	--	D	--	I	--	--	--	--
1,1-DCA	--	--	--	--	--	--	--	--	D	--	I	--	D	--	--	--	--	--
1,2-DCA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
cis 1,2-Dichloroethene, ug/L	--	--	--	--	--	--	--	--	D	--	I	D	D	--	--	--	--	--
1,2-Dichloropropane, ug/L	--	--	--	--	--	--	--	--	D	--	--	--	--	--	--	--	--	--
Tetrachloroethene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene, ug/L	--	--	--	--	--	--	--	--	D	--	--	--	D	--	--	--	--	--
Vinyl Chloride, ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	D	--	D	--

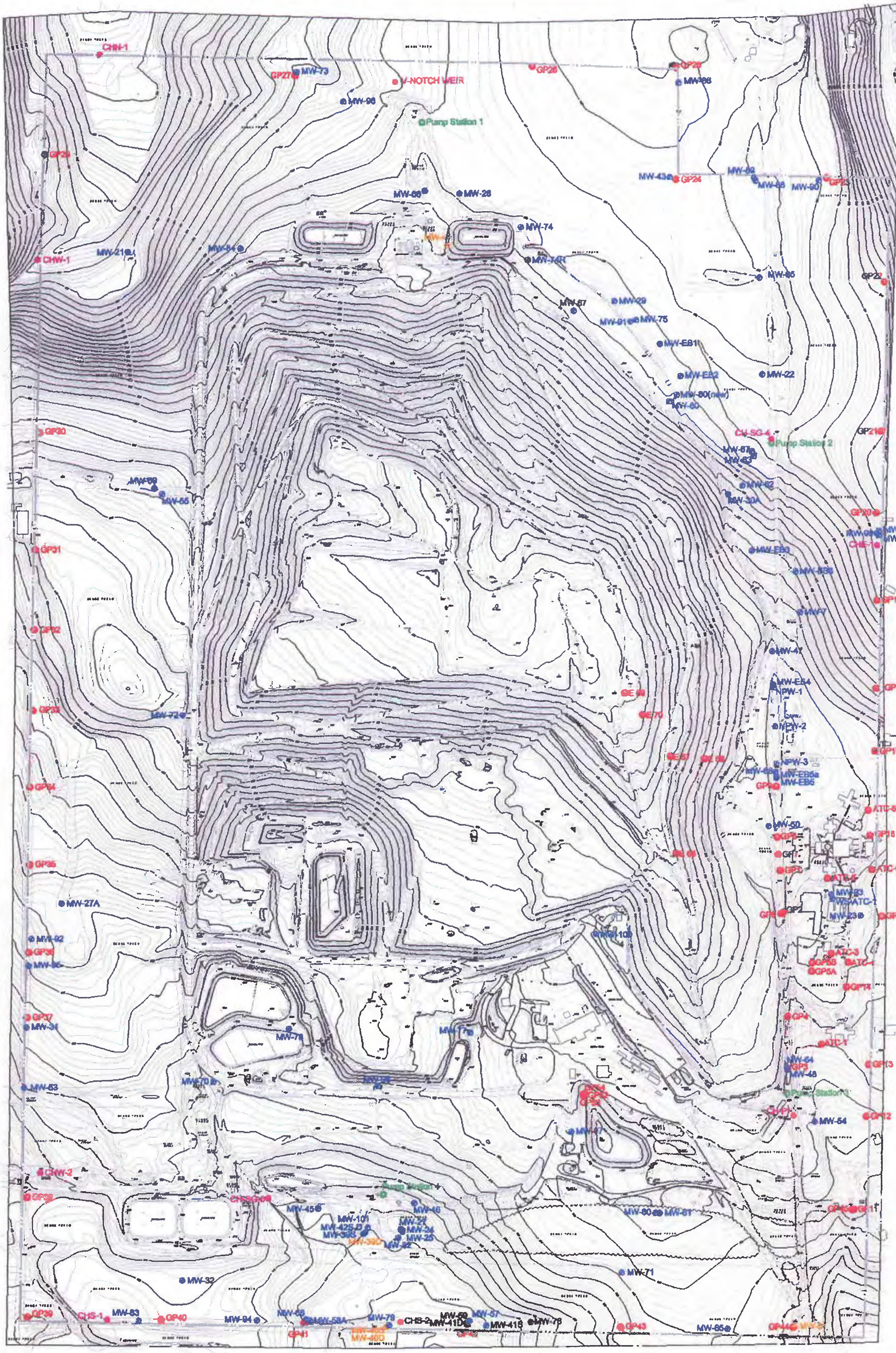
TABLE 4-4
CEDAR HILLS 2012 REGIONAL LANDFILL REGIONAL AQUIFER
SUMMARY OF WAC 173-351 APPENDIX I INTRAWELL PREDICTION LIMIT EXCEEDANCES

Parameter	Units	Well ID	Sample Date	Sample Value	Intrawell Limit Value
South Upgradient Wells					
cis 1,2-Dichloroethene	ug/L	MW-59	07/02/13	0.86	0.68
		MW-59	10/09/13	0.84	0.68
Downgradient Wells					
Barium	mg/L	MW-87	10/22/13	0.022	0.020
Nitrate	mg/L	MW-66	10/12/12	0.757	0.719

FIGURES



Excerpted from *Cedar Hills Regional Landfill Site-Wide Hydrogeologic Report* 2004

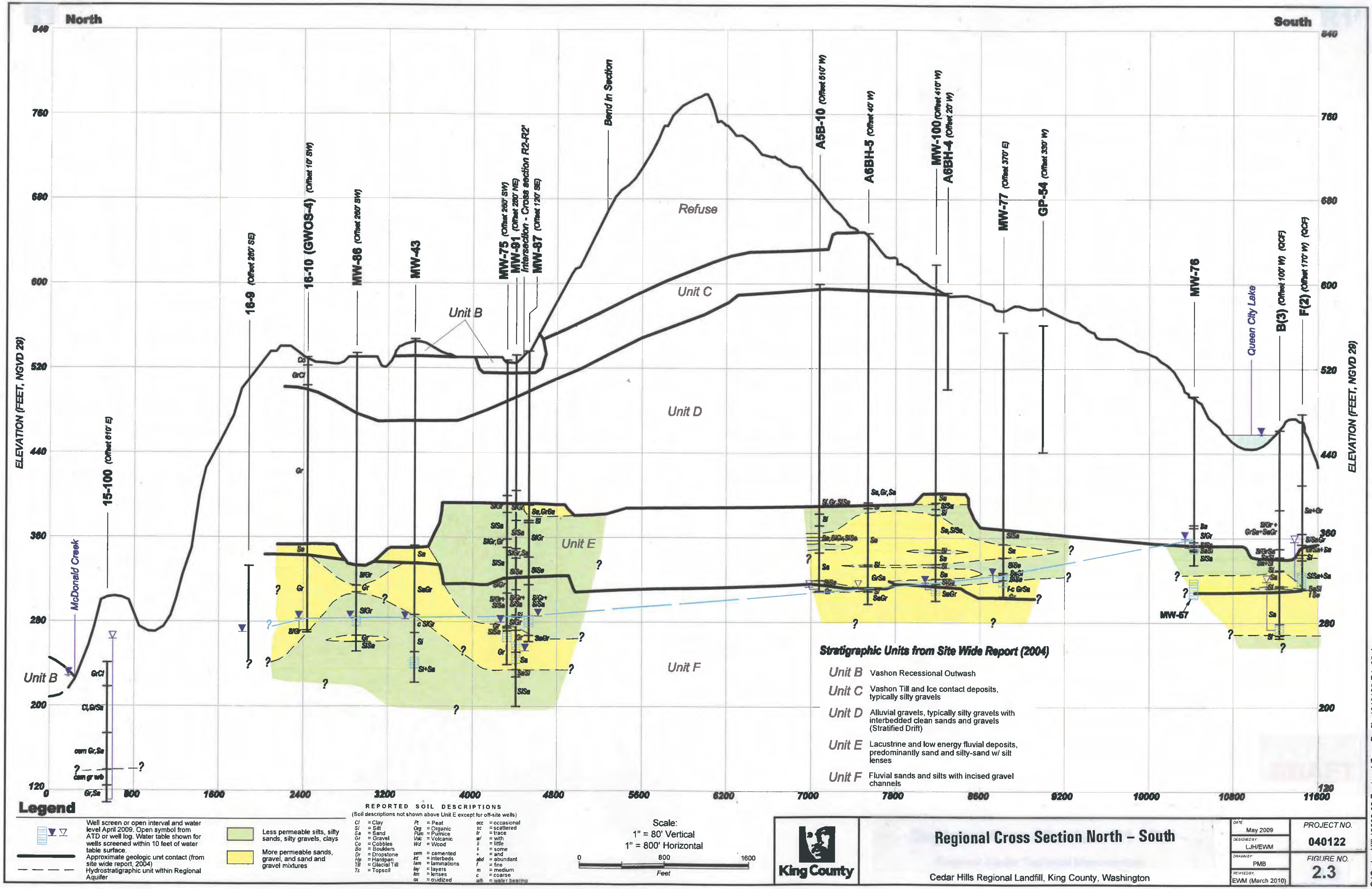


LEGEND

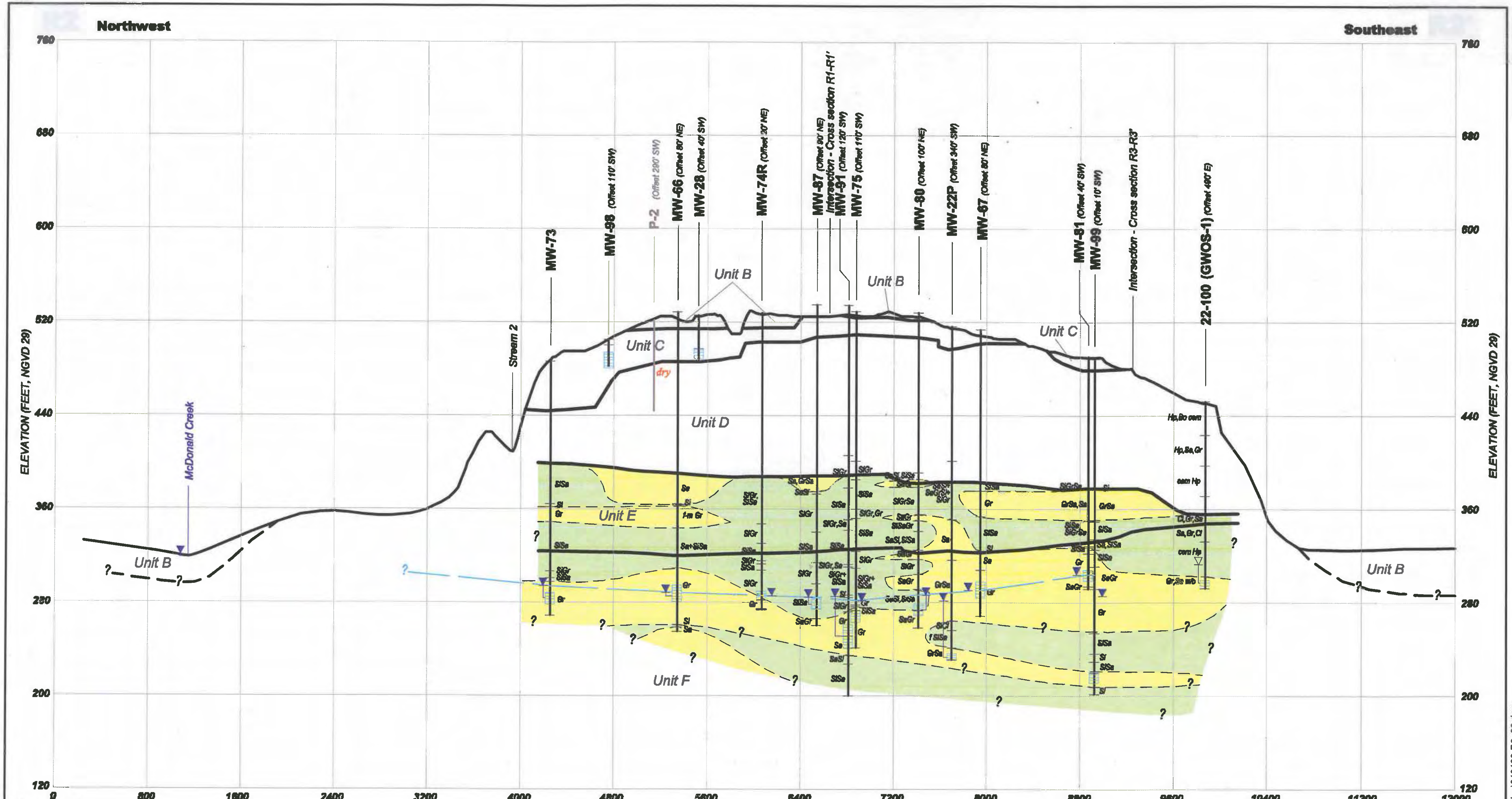
MW–9 Monitoring Well
GP–19 Gas Probe
MW–8 Decommissioned Monitoring Well
GP–13 Decommissioned Gas Probe
Pump Station NO.__
MW–9 Surface Water Stations

Scale 1"-200'

King County Solid Waste Division	DATE: Oct. 2007 DESIGNED/DWN:	Figure 2.2 **SITE MAP** Cedar Hills Landfill Maple Valley, Washington	Aero-Metric Aerial Photo taked August 24, 2007	PROJECT NO. FIGURE NO.



Excerpted from: *Cedar Hills Regional Landfill Regional Aquifer Technical Memorandum* 2011



Legend

- Well screen or open interval and water level April 2009. Open symbol from ATD or well log. Water table shown for wells screened within 10 feet of water table surface.
- Approximate geologic unit contact (from site wide report, 2004)
- Hydrostratigraphic unit within Regional Aquifer
- Less permeable silts, silty sands, silty gravels, clays
- More permeable sands, gravel, and sand and gravel mixtures

Stratigraphic Units from Site Wide Report (2004)

Unit B	Vashon Recessional Outwash
Unit C	Vashon Till and Ice contact deposits, typically silty gravels
Unit D	Alluvial gravels, typically silty gravels with interbedded clean sands and gravels (Stratified Drift)
Unit E	Lacustrine and low energy fluvial deposits, predominantly sand and silty-sand w/ silt lenses
Unit F	Fluvial sands and silts with incised gravel channels

REPORTED SOIL DESCRIPTIONS

(Soil descriptions not shown above Unit E except for off-site wells)

Cl	= Clay	occ	= occasional	cem	= cemented
Si	= Silt	sc	= scattered	int	= interbeds
Sa	= Sand	tr	= trace	lam	= laminations
Gr	= Gravel	w/	= with	lay	= layers
Co	= Cobbles	li	= little	len	= lenses
Bo	= Boulders	s	= some	ox	= oxidized
Dr	= Dropstone	+	= and	wb	= water bearing
Hp	= Hardpan	abd	= abundant		
Till	= Glacial Till	f	= fine		
Ts	= Topsoil	m	= medium		
Pt	= Peat	c	= coarse		
Org	= Organic				
Pum	= Pumice				
Volc	= Volcanic				
Wd	= Wood				

Scale:
1" = 80' Vertical
1" = 800' Horizontal

0 800 1600
Feet

King County

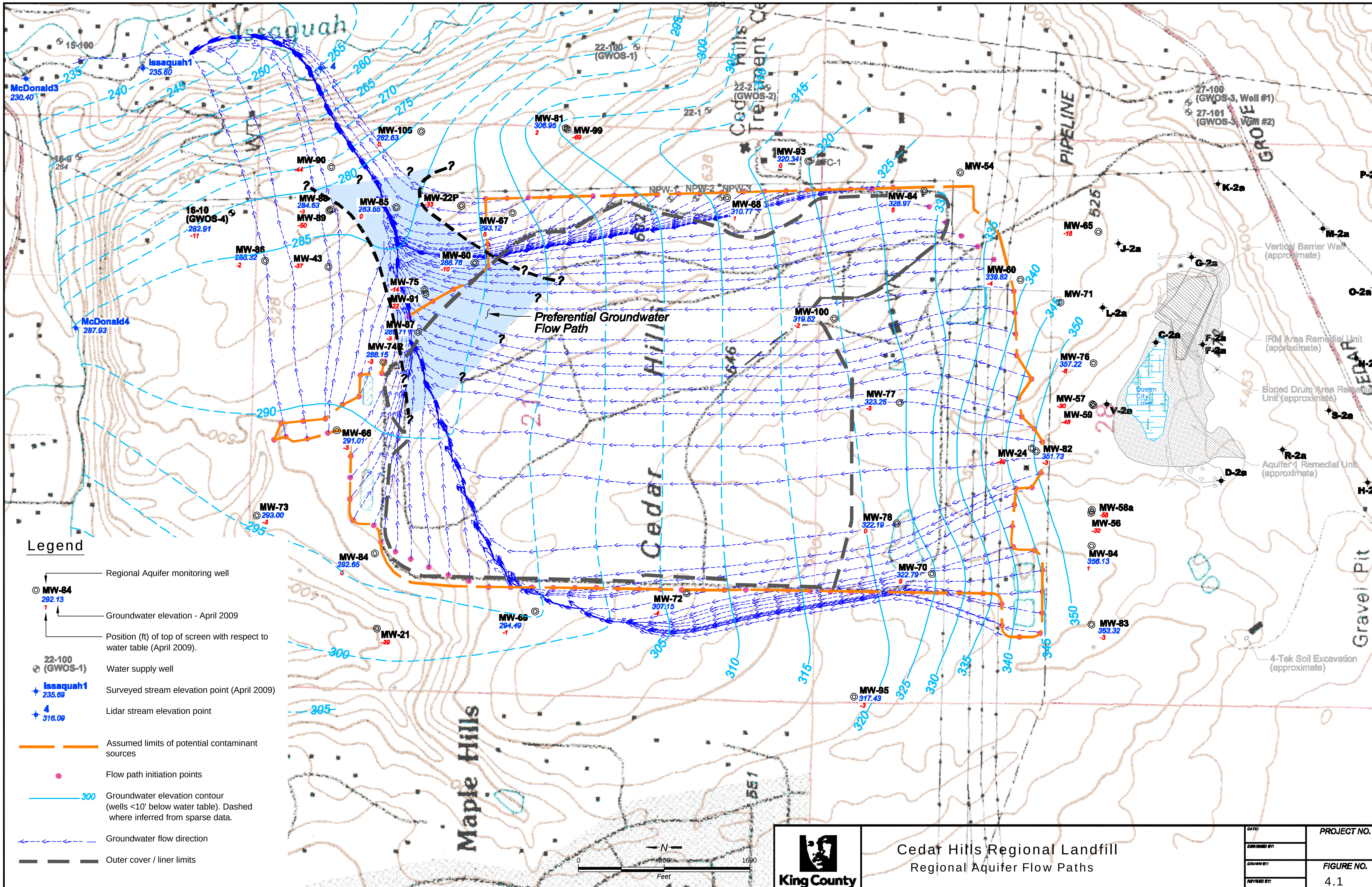
Regional Cross Section Northwest – Southeast

Cedar Hills Regional Landfill, King County, Washington

DATE: May 2009	PROJECT NO. 040122
DESIGNED BY: LJH/EWM	
DRAWN BY: PMB	FIGURE NO. 2.4
REVISED BY: EWM (March 2010)	

Q:\Cedar Hills\2009-05 Regional Zone Profiles\040122-R2_33.dwg

Excerpted From: *Cedar Hills Regional Aquifer Regional Aquifer Technical Memorandum* 2011



King County

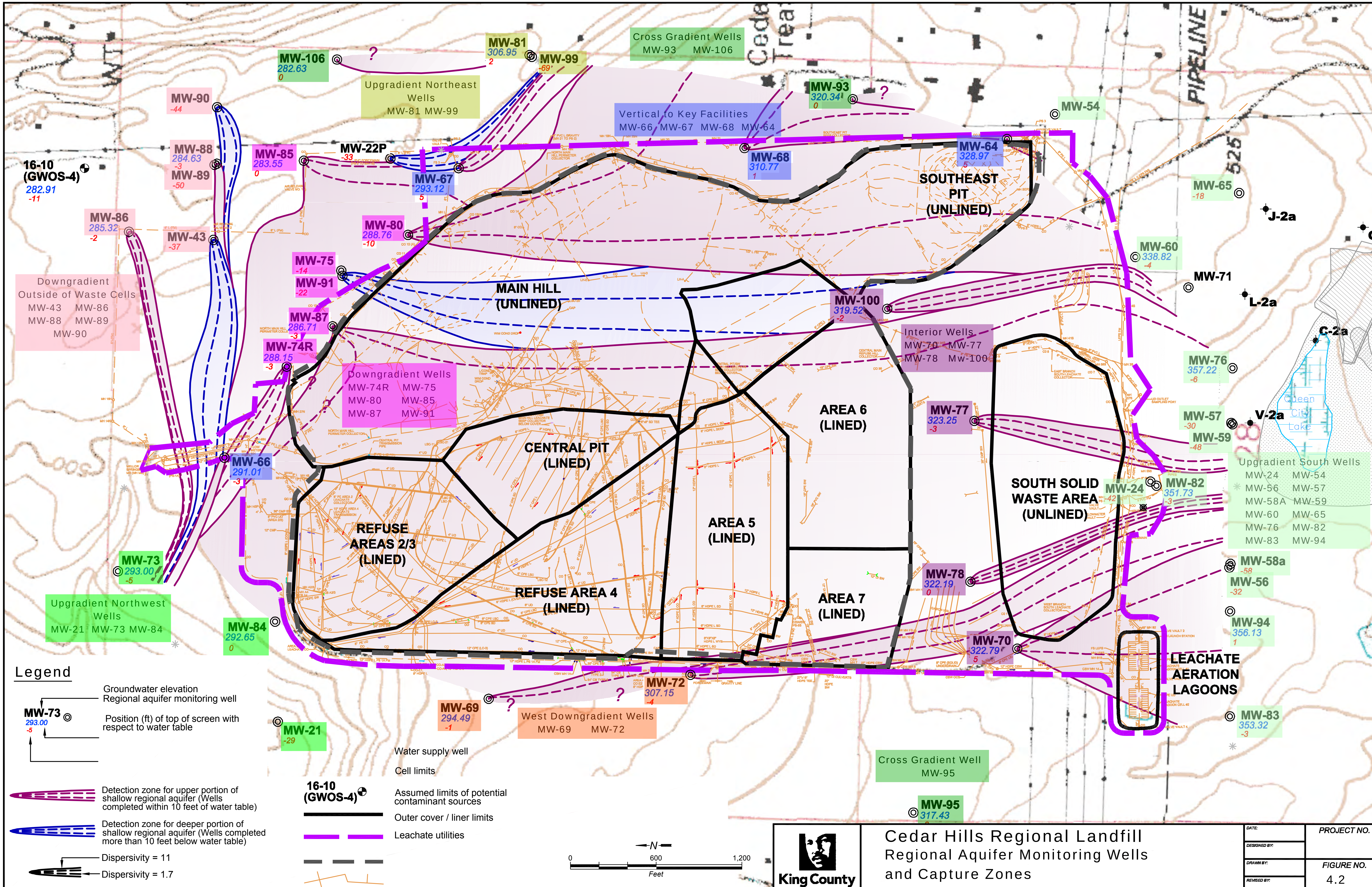
Cedar Hills Regional Landfill

Regional Aquifer Flow Paths

DATE:
DESIGNED BY:
DRAWN BY:
REVISED BY:

PROJECT NO.

FIGURE NO.
4.1



Cedar Hills Regional Landfill
Regional Aquifer Monitoring Wells and Capture Zones

APPENDIX A

Potentiometric Surface Maps and Aquifer Flow Calculations

King County

ORIGINAL

Water and Land Resources Division
Department of Natural Resources and Parks
King Street Center
201 South Jackson Street, Suite 600
Seattle, WA 98104-3855
206.296.6519 Fax 206.296.0192

Memorandum

To: Tom Theno
King County Solid Waste Division

From: Sevin Bilir
King County Water & Land Resources Division

Re: **Potentiometric Groundwater Surface Mapping & Groundwater Velocity Calculations**
First Quarter 2013 Results
Cedar Hills Landfill, King County, Washington
Project No. 1033379 – Task 02.14.137.20

Date: May 1, 2013

King County Water & Land Resources Division (KCWLRD) submits this letter report on groundwater conditions during the first quarter of 2013 for the Cedar Hills Landfill (landfill), in accordance with the *Proposal for Potentiometric Groundwater Surface Maps & Groundwater Velocity Calculations* (KCWLRD, 2013). King County Solid Waste Division (KCSWD) personnel measured groundwater elevations at the landfill on January 2 and 7, 2013. These measurements were received by KCWLRD on April 8, 2013 and were used to:

1. Evaluate the potentiometric groundwater surface elevation for the regional aquifer;
2. Determine the groundwater flow direction and horizontal gradient for the regional aquifer; and
3. Calculate the groundwater velocity of the regional aquifer.

With the exception of the minor local effects of the pumping at NPW-1 in the previous quarter, there have been no significant changes in the interpreted groundwater conditions since the report submitted for the fourth quarter of the 2012 monitoring event.

Groundwater Elevation Data

KCSWD attempted groundwater level measurements at 44 monitoring wells during the first quarter of 2013. These wells were completed in the regional aquifer as referred to in *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill* (Aspect, 2010).

Table 1 lists the well identifications, locations, well details, measured groundwater levels and calculated groundwater elevations for the regional aquifer. Wells with screened intervals within ten feet of the water table were used for potentiometric surface mapping purposes. A total of26 wells with water levels within ten feet of the top of screen were selected.

Figure 1 shows well locations, groundwater elevations at the 26 selected wells, groundwater potentiometric surface contours, and interpreted groundwater flow direction in the regional aquifer for the January 2 and 7, 2013measurement event.

Direction of Groundwater Flow

Figure 1 shows interpreted groundwater potentiometric surface contours and groundwater flow directions in the regional aquifer, based on the January 2 and 7, 2013measurements. Groundwater elevations indicate that groundwater in the regional aquifer generally flowed north beneath the southern and central portions of the landfill with minor components of flow to the north-northwest and north-northeast. At the northern end of the landfill, groundwater generally flowed to the north-northeast and northeast.

Groundwater Parameters

Horizontal groundwater velocity was calculated using the following formula:

where: $$v = \frac{1}{n_{eff}} K \frac{\Delta H}{\Delta L}$$

v = Groundwater velocity [L/t]
n_{eff} = Effective porosity [dimensionless]
K = Hydraulic conductivity [L/t]
$\frac{\Delta H}{\Delta L}$ = Hydraulic gradient [L/L]

Horizontal groundwater velocity was calculated for the regional aquifer below the landfill. Horizontal groundwater velocity was calculated for the southern, central, and northern portions of the regional aquifer, based on spatial differences in aquifer parameters and hydraulic gradients. The hydraulic conductivity and effective porosity values were based on the range referred to in the *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill* (Aspect, 2010).

Table 2 presents a summary of the groundwater parameters used to calculate a groundwater velocity from the first quarter 2013 data. The hydraulic gradient was greatest under the southern portion of the landfill and smallest under the northern portion. On January 2 and 7, 2013, average horizontal groundwater velocity within the regional aquifer ranged from 0.014 feet per day (ft/d) under the southern portion of the landfill to 2 ft/d under the central portion of the landfill.

References

Aspect Consulting (Aspect). 2010. *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill*. Unpublished work. April 30.

King County Water & Land Resources Division (KCWLRD). 2013. *Proposal for Potentiometric Groundwater Surface Maps & Groundwater Velocity Calculations*. Unpublished.

Thank you for the opportunity to provide hydrogeologic services to the KCSWD. Please contact me if you have any questions.

Sincerely,

State of Washington
Hydrogeologist
1301
Licensed Geologist
Sevin Bilir

Sevin Bilir, WA LHG
Environmental Scientist III
King County Water & Land Resources Division

Attachments

Table 1:	Groundwater Elevations - First Quarter 2013
Table 2:	Groundwater Parameters - First Quarter 2013
Figure 1:	Groundwater Potentiometric Surface Map - First Quarter 2013 – Regional Aquifer

Table 1: Groundwater Elevations – First Quarter 2013

Cedar Hills Landfill

King County, Washington

							January 2 and 7, 2013	
Regional Aquifer Unit	Well Identification	X (ft)	Y (ft)	Top of Casing Elevation (ft MSL)	Top of Screen Elevation (ft)	Bottom of Screen Elevation (ft)	Measured Depth to Water (ft)	Groundwater Elevations (ft MSL)
Wells with water levels within 10 feet of the top of screen	MW-60	1701154.47	167873.20	567.15	334.81	325.81	226.77	340.38
	MW-64	1701980.27	168772.19	596.55	334.03	320.23	266.35	330.20
	MW-66	1699750.19	174250.32	531.28	294.39	280.59	238.52	292.76
	MW-67	1701776.69	172610.65	516.43	297.80	284.00	221.06	295.37
	MW-68	1701917.32	170609.35	647.07	311.29	292.29	333.03	314.04
	MW-69	1698061.86	172400.20	653.69	293.57	279.97	358.17	295.52
	MW-70	1698412.97	168699.89	530.57	322.75	309.05	205.77	324.80
	MW-72	1698229.92	170987.71	671.87	303.63	294.03	361.97	309.90
	MW-73	1698954.95	174995.59	485.70	288.11	278.81	191.03	294.67
	MW-74R	1700386.85	173813.79	531.26	289.90	280.40	240.48	290.78
	MW-76	1700376.23	167193.13	491.71	351.06	341.56	132.58	359.13
	MW-77	1700007.63	168999.71	552.67	320.47	310.97	227.55	325.12
	MW-78	1698881.94	169027.58	537.35	322.34	309.84	213.16	324.19
	MW-81	1702568.87	172113.99	493.66	309.19	300.19	184.26	309.40
	MW-82	1699553.72	167725.31	474.85	348.88	339.38	123.57	351.28
	MW-83	1697939.89	167212.27	496.81	350.19	340.69	144.72	352.09
	MW-84	1698602.89	173894.54	530.80	292.46	282.96	236.37	294.43
	MW-85	1701828.95	173694.52	531.76	282.56	273.06	246.20	285.56
	MW-86	1701331.25	174917.90	536.04	283.43	274.63	249.37	286.67
	MW-87	1700670.27	173493.76	537.31	283.68	274.38	248.62	288.69
	MW-88	1701807.87	174303.06	513.68	281.52	272.22	227.30	286.38
	MW-93	1702259.35	169851.24	632.15	319.87	310.07	307.35	324.8
	MW-94	1698674.21	167210.22	495.51	357.22	348.52	140.76	354.75
	MW-95	1697265.32	169426.92	571.54	314.60	305.90	251.90	319.64
	MW-100	1700791.72	169610.46	620.32	319.06	309.06	298.70	321.62
	MW-106	1702536.99	173461.69	475.47	280.04	270.04	190.88	284.59
Wells with water levels greater than 10 feet above the top of screen	MW-21	1697901.86	173876.38	420.66	263.22	255.22	125.32	295.34
	MW-22P	1701844.34	173088.17	517.09	236.02	231.22	233.24	283.85
	MW-24	1699582.39	167767.76	475.99	286.76	281.76	145.47	330.52
	MW-43	1701274.23	174327.14	547.06	245.63	235.63	263.38	283.68
	MW-54	1702154.28	168435.53	580.43	250.25	228.25	279.41	301.02
	MW-56	1698980.77	167214.82	480.33	323.15	313.15	125.71	354.62
	MW-57	1699993.32	167201.99	456.64	326.65	311.65	99.17	357.47
	MW-58A	1699006.59	167207.16	479.27	270.05	260.05	149.23	330.04
	MW-59	1699983.91	167193.44	457.13	285.08	275.08	123.65	333.48
	MW-65	1701602.10	167146.55	545.83	317.71	308.91	209.11	336.72
	MW-75	1701059.70	173432.42	532.40	271.10	261.00	245.87	286.53
	MW-80	1701309.78	172964.99	530.41	279.17	269.67	239.65	290.76
	MW-89	1701799.57	174319.44	512.82	229.20	219.90	231.99	280.83
	MW-90	1702203.13	174300.67	502.22	235.16	226.16	221.85	280.37
	MW-91	1701023.09	173423.94	532.02	260.81	240.71	247.14	284.88
	MW-99	1702556.06	172098.73	493.64	221.77	212.77	200.81	292.83
	NPW-1	1701906.96	171138.99	646.33	299.87	284.87	333.25	313.08
	NPW-3	1701922.88	170663.28	645.81	284.87	276.87	331.57	314.24

Notes

1. Water level measurements made by KCSWD personnel.
2. Reference datum for XY coordinates is the North American Datum of 1927 (NAD27)
3. Elevations reported in feet above Mean Sea Level based on the National Geodetic Vertical Datum, 1929.

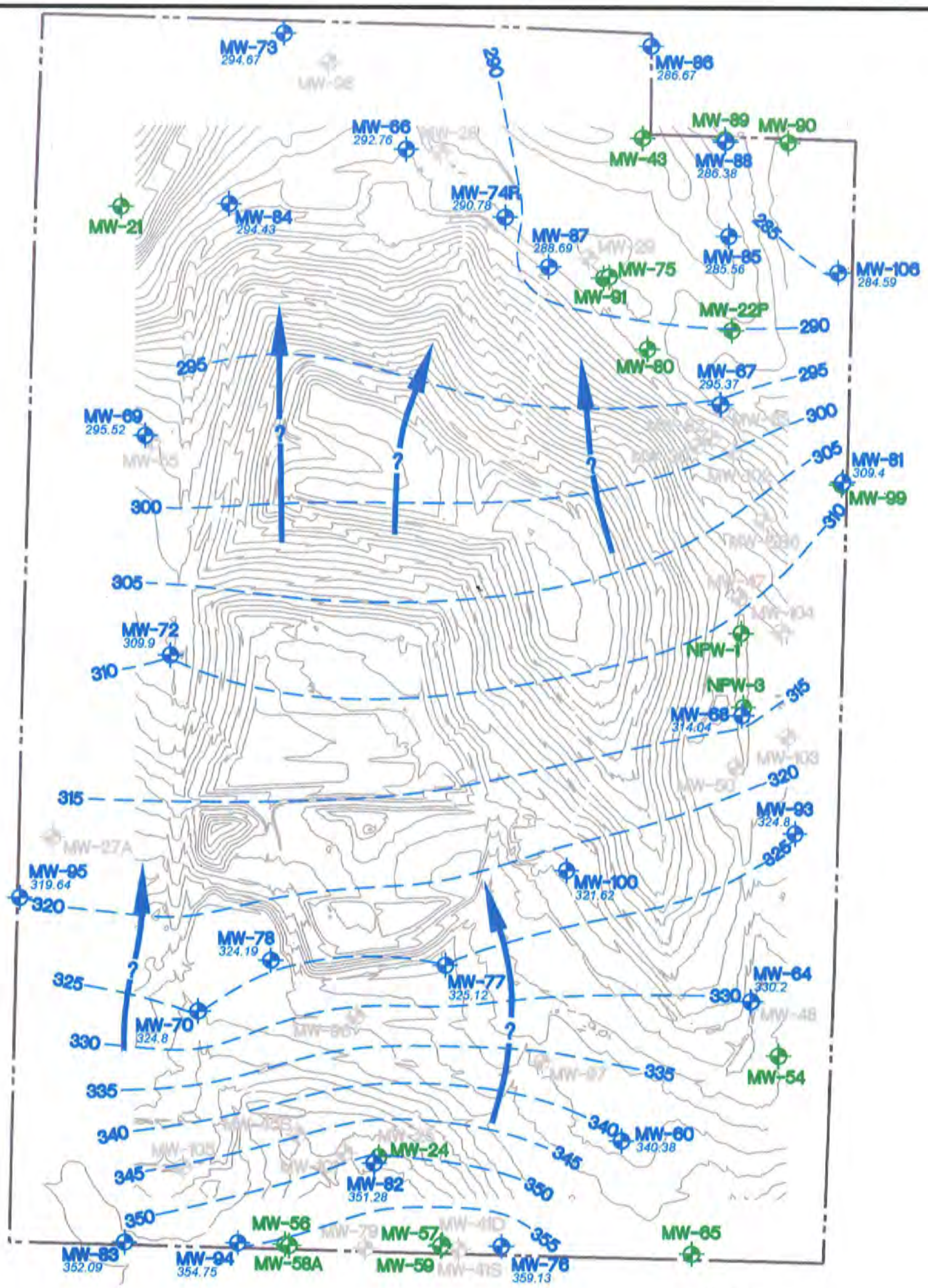
Table 2: Groundwater Parameters – First Quarter 2013

Cedar Hills Landfill
King County, Washington

Regional Aquifer Zone Beneath the Landfill	Horizontal Hydraulic Conductivity (K) Range	(cm/s)	(ft/d)	Horizontal Hydraulic Gradient (ft/ft)	Effective Porosity (n_{eff})	Horizontal Groundwater Velocity (v) (ft/d)	General Groundwater Flow Direction
Northern	Minimum	2.10E-03	6	0.007	24%	0.179	N, NE
	Maximum	4.20E-02	120	0.007	24%	3.58	
	Mean	2.10E-02	60	0.007	24%	1.79	
Central	Minimum	2.10E-03	6	0.008	24%	0.20	N, NNE, NNW
	Maximum	4.20E-02	120	0.008	24%	4.0	
	Mean	2.10E-02	60	0.008	24%	2.0	
Southern	Minimum	6.40E-06	0.018	0.020	26%	0.0014	N, NNE, NNW
	Maximum	6.40E-04	1.8	0.020	26%	0.14	
	Mean	6.40E-05	0.18	0.020	26%	0.014	

Notes

1. Horizontal hydraulic conductivity values and effective porosity values from
Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill (Aspect, 2010).
2. Hydraulic gradients measured from the potentiometric surface map shown on Figure 1.
3. Mean hydraulic conductivity values are the geometric mean of the high and low values.
4. NNE, north-northeast; NNW, north-northwest; NE, northeast; N, north



Legend

MW-X XXX.XX	Well completed in Regional Aquifer within 10 feet of the water table
MW-X	Wells completed in Regional Aquifer more than 10 ft below water table
MW-X	Wells screened in discontinuous Perched Zones
300 — — —	Regional Aquifer Groundwater Elevation Contour *(feet MSL)*.
←—?—	Inferred Horizontal Groundwater Flow Path

0 1000 2000
Feet

N

Notes:

1. Groundwater measurements made on January 2&7,2013.
2. Only wells completed in the Regional Aquifer within 10 feet of the water table were used for contouring.

King County

Groundwater Potentiometric Surface Map
First Quarter 2013 - Regional Aquifer
Cedar Hills Landfill
King County, Washington

DATE:	April 2013	PROJECT NO.	1033379
DESIGNED BY:	SB		
DRAWN BY:	LT	FIGURE NO.	1
REVISED BY:	SB		

CH_1Q2013.dwg

King County

Water and Land Resources Division
Department of Natural Resources and Parks
King Street Center
201 South Jackson Street, Suite 600
Seattle, WA 98104-3855
206.296.6519 Fax 206.296.0192

Memorandum

To: Tom Theno
King County Solid Waste Division

From: Sevin Bilir
King County Water & Land Resources Division

Re: **Potentiometric Groundwater Surface Mapping & Groundwater Velocity Calculations**
Second Quarter 2013 Results
Cedar Hills Landfill, King County, Washington
Project No. 1033379 – Task 02.14.137.20

Date: August 1, 2013

King County Water & Land Resources Division (KCWLRD) submits this letter report on groundwater conditions during the second quarter of 2013 for the Cedar Hills Landfill (landfill), in accordance with the *Proposal for Potentiometric Groundwater Surface Maps & Groundwater Velocity Calculations* (KCWLRD, 2013). King County Solid Waste Division (KCSWD) personnel measured groundwater elevations at the landfill on April 1, 2013. These measurements were received by KCWLRD on June 11, 2013 and were used to:

1. Evaluate the potentiometric groundwater surface elevation for the regional aquifer;
2. Determine the groundwater flow direction and horizontal gradient for the regional aquifer; and
3. Calculate the groundwater velocity of the regional aquifer.

There have been no significant changes in the interpreted groundwater conditions since the report submitted for the first quarter of the 2013 monitoring event.

Groundwater Elevation Data

KCSWD attempted groundwater level measurements at 44 monitoring wells during the second quarter of 2013. These wells were completed in the regional aquifer as referred to in *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill* (Aspect, 2010).

Table 1 lists the well identifications, locations, well details, measured groundwater levels and calculated groundwater elevations for the regional aquifer. Wells with screened intervals within ten feet of the water table were used for potentiometric surface mapping purposes. A total of 26 wells with water levels within ten feet of the top of screen were selected.

Figure 1 shows well locations, groundwater elevations at the 26 selected wells, groundwater potentiometric surface contours, and interpreted groundwater flow direction in the regional aquifer for the April 1, 2013 measurement event.

Direction of Groundwater Flow

Figure 1 shows interpreted groundwater potentiometric surface contours and groundwater flow directions in the regional aquifer, based on the April 1, 2013 measurements. Groundwater elevations indicate that groundwater in the regional aquifer generally flowed north beneath the southern and central portions of the landfill with minor components of flow to the north-northwest and north-northeast. At the northern end of the landfill, groundwater generally flowed to the north and northeast.

Groundwater Parameters

Horizontal groundwater velocity was calculated using the following formula:

where: $$v = \frac{1}{n_{eff}} K \frac{\Delta H}{\Delta L}$$

v = Groundwater velocity [L/t]
n_{eff} = Effective porosity [dimensionless]
K = Hydraulic conductivity [L/t]
$\frac{\Delta H}{\Delta L}$ = Hydraulic gradient [L/L]

Horizontal groundwater velocity was calculated for the regional aquifer below the landfill. Horizontal groundwater velocity was calculated for the southern, central, and northern portions of the regional aquifer, based on spatial differences in aquifer parameters and hydraulic gradients. The hydraulic conductivity and effective porosity values were based on the range referred to in the *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill* (Aspect, 2010).

Table 2 presents a summary of the groundwater parameters used to calculate a groundwater velocity from the second quarter 2013 data. The hydraulic gradient was greatest under the southern portion of the landfill and smallest under the northern portion. On April 1, 2013, average horizontal groundwater velocity within the regional aquifer ranged from 0.014 feet per day (ft/d) under the southern portion of the landfill to 2.1 ft/d under the central portion of the landfill.

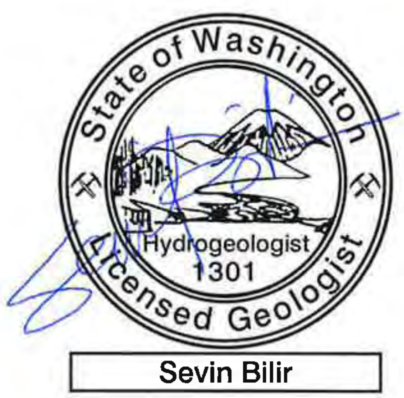
References

Aspect Consulting (Aspect). 2010. *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill.* Unpublished work. April 30.

King County Water & Land Resources Division (KCWLRD). 2013. *Proposal for Potentiometric Groundwater Surface Maps & Groundwater Velocity Calculations.* Unpublished.

Thank you for the opportunity to provide hydrogeologic services to the KCSWD. Please contact me if you have any questions.

Sincerely,



Sevin Bilir, WA LHG
Environmental Scientist III
King County Water & Land Resources Division

Attachments

Table 1:	Groundwater Elevations - Second Quarter 2013
Table 2:	Groundwater Parameters - Second Quarter 2013
Figure 1:	Groundwater Potentiometric Surface Map - Second Quarter 2013 – Regional Aquifer

Table 1: Groundwater Elevations – Second Quarter 2013

Cedar Hills Landfill

King County, Washington

Regional Aquifer Unit	Well Identification	X (ft)	Y (ft)	Top of Casing Elevation (ft MSL)	Top of Screen Elevation (ft)	Bottom of Screen Elevation (ft)	April 1, 2013 Measured Depth to Water (ft)	April 1, 2013 Groundwater Elevations (ft MSL)
Wells with water levels within 10 feet of the top of screen	MW-60	1701154.47	167873.20	567.15	334.81	325.81	224.40	342.75
	MW-64	1701980.27	168772.19	596.55	334.03	320.23	265.50	331.05
	MW-66	1699750.19	174250.32	531.28	294.39	280.59	238.55	292.73
	MW-67	1701776.69	172610.65	516.43	297.80	284.00	221.18	295.25
	MW-68	1701917.32	170609.35	647.07	311.29	292.29	332.74	314.33
	MW-69	1698061.86	172400.20	653.69	293.57	279.97	356.48	297.21
	MW-70	1698412.97	168699.89	530.57	322.75	309.05	205.01	325.56
	MW-72	1698229.92	170987.71	671.87	303.63	294.03	362.59	309.28
	MW-73	1698954.95	174995.59	485.70	288.11	278.81	191.71	293.99
	MW-74R	1700386.85	173813.79	531.26	289.90	280.40	240.49	290.77
	MW-76	1700376.23	167193.13	491.71	351.06	341.56	133.61	358.10
	MW-77	1700007.63	168999.71	552.67	320.47	310.97	226.52	326.15
	MW-78	1698881.94	169027.58	537.35	322.34	309.84	212.34	325.01
	MW-81	1702568.87	172113.99	493.66	309.19	300.19	184.58	309.08
	MW-82	1699553.72	167725.31	474.85	348.88	339.38	120.98	353.87
	MW-83	1697939.89	167212.27	496.81	350.19	340.69	143.28	353.53
	MW-84	1698602.89	173894.54	530.80	292.46	282.96	236.94	293.86
	MW-85	1701828.95	173694.52	531.76	282.56	273.06	246.09	285.67
	MW-86	1701331.25	174917.90	536.04	283.43	274.63	249.27	286.77
	MW-87	1700670.27	173493.76	537.31	283.68	274.38	248.65	288.66
	MW-88	1701807.87	174303.06	513.68	281.52	272.22	227.07	286.61
	MW-93	1702259.35	169851.24	632.15	319.87	310.07	309.82	322.33
	MW-94	1698674.21	167210.22	495.51	357.22	348.52	139.54	355.97
	MW-95	1697265.32	169426.92	571.54	314.60	305.90	251.63	319.91
	MW-100	1700791.72	169610.46	620.32	319.06	309.06	297.92	322.40
	MW-106	1702536.99	173461.69	475.47	280.04	270.04	190.57	284.90
Wells with water levels greater than 10 feet above the top of screen	MW-21	1697901.86	173876.38	420.66	263.22	255.22	125.45	295.21
	MW-22P	1701844.34	173088.17	517.09	236.02	231.22	232.50	284.59
	MW-24	1699582.39	167767.76	475.99	286.76	281.76	144.41	331.58
	MW-43	1701274.23	174327.14	547.06	245.63	235.63	263.04	284.02
	MW-54	1702154.28	168435.53	580.43	250.25	228.25	278.22	302.21
	MW-56	1698980.77	167214.82	480.33	323.15	313.15	124.48	355.85
	MW-57	1699993.32	167201.99	456.64	326.65	311.65	99.32	357.32
	MW-58A	1699006.59	167207.16	479.27	270.05	260.05	148.37	330.90
	MW-59	1699983.91	167193.44	457.13	285.08	275.08	122.66	334.47
	MW-65	1701602.10	167146.55	545.83	317.71	308.91	208.11	337.72
	MW-75	1701059.70	173432.42	532.40	271.10	261.00	245.84	286.56
	MW-80	1701309.78	172964.99	530.41	279.17	269.67	239.65	290.76
	MW-89	1701799.57	174319.44	512.82	229.20	219.90	231.81	281.01
	MW-90	1702203.13	174300.67	502.22	235.16	226.16	221.25	280.97
	MW-91	1701023.09	173423.94	532.02	260.81	240.71	247.11	284.91
	MW-99	1702556.06	172098.73	493.64	221.77	212.77	200.71	292.93
	NPW-1	1701906.96	171138.99	646.33	299.87	284.87	334.60	311.73
	NPW-3	1701922.88	170663.28	645.81	284.87	276.87	331.85	313.96

Notes

1. Water level measurements made by KCSWD personnel.
2. Reference datum for XY coordinates is the North American Datum of 1927 (NAD27)
3. Elevations reported in feet above Mean Sea Level based on the National Geodetic Vertical Datum, 1929.

Table 2: Groundwater Parameters – Second Quarter 2013

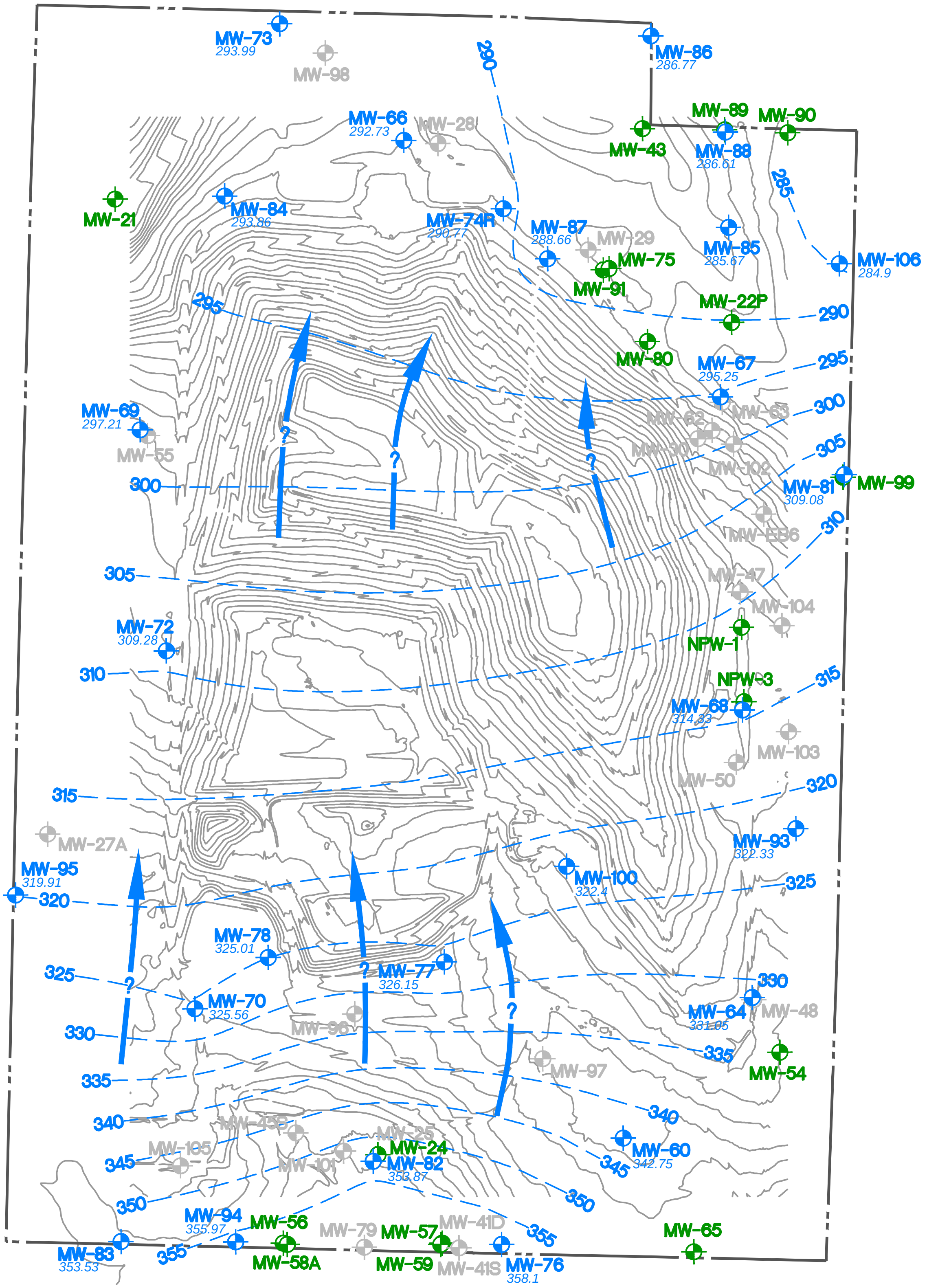
Cedar Hills Landfill

King County, Washington

	Horizontal Hydraulic Conductivity (K)			Horizontal Hydraulic Gradient	Effective Porosity (n_{eff})	Horizontal Groundwater Velocity (v)	General Groundwater Flow Direction
Regional Aquifer Zone Beneath the Landfill	Range	(cm/s)	(ft/d)	(ft/ft)		(ft/d)	
Northern	Minimum	2.10E-03	6	0.0077	24%	0.192	N, NE
	Maximum	4.20E-02	120	0.0077	24%	3.84	
	Mean	2.10E-02	60	0.0077	24%	1.92	
Central	Minimum	2.10E-03	6	0.0082	24%	0.21	N, NNW
	Maximum	4.20E-02	120	0.0082	24%	4.1	
	Mean	2.10E-02	60	0.0082	24%	2.1	
Southern	Minimum	6.40E-06	0.018	0.0196	26%	0.0014	N, NNE, NNW
	Maximum	6.40E-04	1.8	0.0196	26%	0.14	
	Mean	6.40E-05	0.18	0.0196	26%	0.014	

Notes

1. Horizontal hydraulic conductivity values and effective porosity values from *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill (Aspect, 2010).*
2. Hydraulic gradients measured from the potentiometric surface map shown on Figure 1.
3. Mean hydraulic conductivity values are the geometric mean of the high and low values.
4. NNE, north-northeast; NNW, north-northwest; NE, northeast; N, north



Legend

MW-X *XXX.XX*	Well completed in Regional Aquifer within 10 feet of the water table
MW-X	Wells completed in Regional Aquifer more than 10 ft below water table
MW-X	Wells screened in discontinuous Perched Zones
300	Regional Aquifer Groundwater Elevation Contour *(feet MSL)*.
?	Inferred Horizontal Groundwater Flow Path

0 1000 2000
Feet

N

Notes:

1. Groundwater measurements made on April 1, 2013.
2. Only wells completed in the Regional Aquifer within 10 feet of the water table were used for contouring.

King County

Groundwater Potentiometric Surface Map

Second Quarter 2013 - Regional Aquifer

Cedar Hills Landfill

King County, Washington

DATE:	June 2013
DESIGNED BY:	SB
DRAWN BY:	KK
REVISED BY:	SB
PROJECT NO.	1033379
FIGURE NO.	1

CH_2Q2013.dwg

King County

Water and Land Resources Division
Department of Natural Resources and Parks
King Street Center
201 South Jackson Street, Suite 600
Seattle, WA 98104-3855
206.296.6519 Fax 206.296.0192

Memorandum

To: Tom Theno
King County Solid Waste Division

From: Sevin Bilir
King County Water & Land Resources Division

Re: **Potentiometric Groundwater Surface Mapping & Groundwater Velocity Calculations**
Third Quarter 2013 Results
Cedar Hills Landfill, King County, Washington
Project No. 1033379 – Task 02.14.137.20

Date: October 28, 2013

King County Water & Land Resources Division (KCWLRD) submits this letter report on groundwater conditions during the third quarter of 2013 for the Cedar Hills Landfill (landfill), in accordance with the *Proposal for Potentiometric Groundwater Surface Maps & Groundwater Velocity Calculations* (KCWLRD, 2013). King County Solid Waste Division (KCSWD) personnel measured groundwater elevations at the landfill on July 1, 2013. These measurements were received by KCWLRD on October 1, 2013 and were used to:

1. Evaluate the potentiometric groundwater surface elevation for the regional aquifer;
2. Determine the groundwater flow direction and horizontal gradient for the regional aquifer; and
3. Calculate the groundwater velocity of the regional aquifer.

There have been no significant changes in the interpreted groundwater conditions since the report submitted for the second quarter of the 2013 monitoring event.

Groundwater Elevation Data

KCSWD attempted groundwater level measurements at 44 monitoring wells during the third quarter of 2013. These wells were completed in the regional aquifer as referred to in *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill* (Aspect, 2010).

Table 1 lists the well identifications, locations, well details, measured groundwater levels and calculated groundwater elevations for the regional aquifer. Wells with screened intervals within ten feet of the water table were used for potentiometric surface mapping purposes. A total of 26 wells with water levels within ten feet of the top of screen were selected.

Figure 1 shows well locations, groundwater elevations at the 26 selected wells, groundwater potentiometric surface contours, and interpreted groundwater flow direction in the regional aquifer for the July 1, 2013 measurement event.

Direction of Groundwater Flow

Figure 1 shows interpreted groundwater potentiometric surface contours and groundwater flow directions in the regional aquifer, based on the July 1, 2013 measurements. Groundwater elevations indicate that groundwater in the regional aquifer generally flowed north beneath the southern and central portions of the landfill with minor components of flow to the north-northwest and north-northeast. At the northern end of the landfill, groundwater generally flowed to the north and northeast.

Groundwater Parameters

Horizontal groundwater velocity was calculated using the following formula:

where: $$v = \frac{1}{n_{eff}} K \frac{\Delta H}{\Delta L}$$

v = Groundwater velocity [L/t]
n_{eff} = Effective porosity [dimensionless]
K = Hydraulic conductivity [L/t]
$\frac{\Delta H}{\Delta L}$ = Hydraulic gradient [L/L]

Horizontal groundwater velocity was calculated for the regional aquifer below the landfill. Horizontal groundwater velocity was calculated for the southern, central, and northern portions of the regional aquifer, based on spatial differences in aquifer parameters and hydraulic gradients. The hydraulic conductivity and effective porosity values were based on the range referred to in the *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill* (Aspect, 2010).

Table 2 presents a summary of the groundwater parameters used to calculate a groundwater velocity from the third quarter 2013 data. The hydraulic gradient was greatest under the southern portion of the landfill and smallest under the northern portion. On July 1, 2013, average horizontal groundwater velocity within the regional aquifer ranged from 0.012 feet per day (ft/d) under the southern portion of the landfill to 2.1 ft/d under the central portion of the landfill.

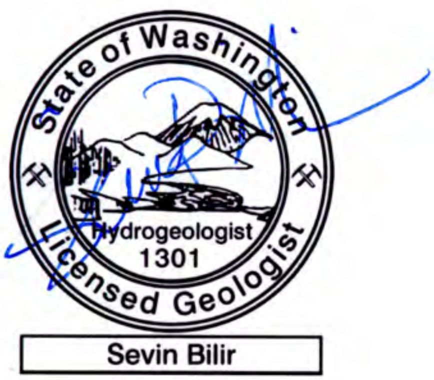
References

Aspect Consulting (Aspect). 2010. *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill*. Unpublished work. April 30.

King County Water & Land Resources Division (KCWLRD). 2013. *Proposal for Potentiometric Groundwater Surface Maps & Groundwater Velocity Calculations*. Unpublished.

Thank you for the opportunity to provide hydrogeologic services to the KCSWD. Please contact me if you have any questions.

Sincerely,



Sevin Bilir, WA LHG
Environmental Scientist III
King County Water & Land Resources Division

Attachments

Table 1:	Groundwater Elevations - Third Quarter 2013
Table 2:	Groundwater Parameters - Third Quarter 2013
Figure 1:	Groundwater Potentiometric Surface Map - Third Quarter 2013 – Regional Aquifer

Table 1: Groundwater Elevations – Third Quarter 2013

Cedar Hills Landfill

King County, Washington

Regional Aquifer Unit	Well Identification	X (ft)	Y (ft)	Top of Casing Elevation (ft MSL)	Top of Screen Elevation (ft)	Bottom of Screen Elevation (ft)	July 1, 2013 Measured Depth to Water (ft)	July 1, 2013 Groundwater Elevations (ft MSL)
Wells with water levels within 10 feet of the top of screen	MW-60	1701154.47	167873.20	567.15	334.81	325.81	224.82	342.33
	MW-64	1701980.27	168772.19	596.55	334.03	320.23	265.23	331.32
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	MW-68	1701917.32	170609.35	647.07	311.29	292.29	332.44	314.63
	MW-69	1698061.86	172400.20	653.69	293.57	279.97	356.90	296.79
	MW-70	1698412.97	168699.89	530.57	322.75	309.05	204.77	325.80
	MW-72	1698229.92	170987.71	671.87	303.63	294.03	361.95	309.92
	MW-73	1698954.95	174995.59	485.70	288.11	278.81	190.97	294.73
	MW-74R	1700386.85	173813.79	531.26	289.90	280.40	240.20	291.06
	MW-76	1700376.23	167193.13	491.71	351.06	341.56	135.98	355.73
	MW-77	1700007.63	168999.71	552.67	320.47	310.97	226.26	326.41
	MW-78	1698881.94	169027.58	537.35	322.34	309.84	212.12	325.23
	MW-81	1702568.87	172113.99	493.66	309.19	300.19	184.52	309.14
	MW-82	1699553.72	167725.31	474.85	348.88	339.38	121.10	353.75
	MW-83	1697939.89	167212.27	496.81	350.19	340.69	143.00	353.81
	MW-84	1698602.89	173894.54	530.80	292.46	282.96	236.23	294.57
	MW-85	1701828.95	173694.52	531.76	282.56	273.06	246.14	285.62
	MW-86	1701331.25	174917.90	536.04	283.43	274.63	249.18	286.86
	MW-87	1700670.27	173493.76	537.31	283.68	274.38	248.47	288.84
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	MW-106	1702536.99	173461.69	475.47	280.04	270.04	190.61	284.86
Wells with water levels greater than 10 feet above the top of screen	MW-21	1697901.86	173876.38	420.66	263.22	255.22	125.23	295.43
	MW-22P	1701844.34	173088.17	517.09	236.02	231.22	232.60	284.49
	MW-24	1699582.39	167767.76	475.99	286.76	281.76	144.51	331.48
	MW-43	1701274.23	174327.14	547.06	245.63	235.63	263.28	283.78
	MW-54	1702154.28	168435.53	580.43	250.25	228.25	278.18	302.25
	MW-56	1698980.77	167214.82	480.33	323.15	313.15	125.07	355.26
	MW-57	1699993.32	167201.99	456.64	326.65	311.65	101.03	355.61
	MW-58A	1699006.59	167207.16	479.27	270.05	260.05	148.47	330.80
	MW-59	1699983.91	167193.44	457.13	285.08	275.08	123.02	334.11
	MW-65	1701602.10	167146.55	545.83	317.71	308.91	208.40	337.43
	MW-75	1701059.70	173432.42	532.40	271.10	261.00	245.80	286.60
	MW-80	1701309.78	172964.99	530.41	279.17	269.67	239.40	291.01
	MW-89	1701799.57	174319.44	512.82	229.20	219.90	231.97	280.85
	MW-90	1702203.13	174300.67	502.22	235.16	226.16	221.60	280.62
	MW-91	1701023.09	173423.94	532.02	260.81	240.71	247.08	284.94
	MW-99	1702556.06	172098.73	493.64	221.77	212.77	200.74	292.90
	NPW-1	1701906.96	171138.99	646.33	299.87	284.87	333.61	312.72
	NPW-3	1701922.88	170663.28	645.81	284.87	276.87	331.62	314.19

Notes
1. Water level measurements made by KCSWD personnel.
2. Reference datum for XY coordinates is the North American Datum of 1927 (NAD27)
3. Elevations reported in feet above Mean Sea Level based on the National Geodetic Vertical Datum, 1929.

Table 2: Groundwater Parameters – Third Quarter 2013

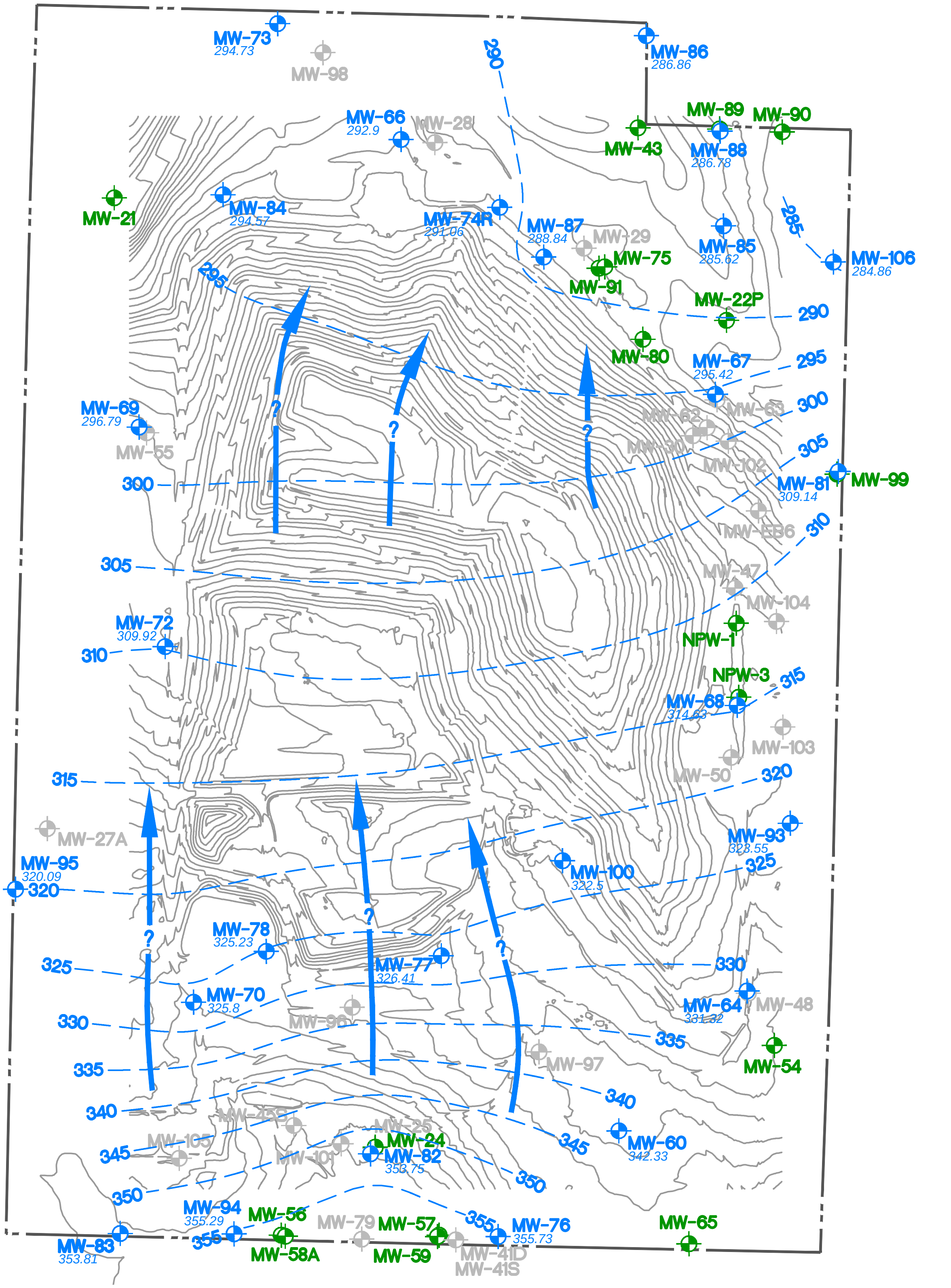
Cedar Hills Landfill

King County, Washington

Regional Aquifer Zone Beneath the Landfill	Horizontal Hydraulic Conductivity (K) Range	(cm/s)	(ft/d)	Horizontal Hydraulic Gradient (ft/ft)	Effective Porosity (n_{eff})	Horizontal Groundwater Velocity (v) (ft/d)	General Groundwater Flow Direction
Northern	Minimum	2.10E-03	6	0.0077	24%	0.192	N, NE
	Maximum	4.20E-02	120	0.0077	24%	3.84	
	Mean	2.10E-02	60	0.0077	24%	1.92	
Central	Minimum	2.10E-03	6	0.0084	24%	0.21	N, NNW
	Maximum	4.20E-02	120	0.0084	24%	4.2	
	Mean	2.10E-02	60	0.0084	24%	2.1	
Southern	Minimum	6.40E-06	0.018	0.0172	26%	0.0012	N, NNE, NNW
	Maximum	6.40E-04	1.8	0.0172	26%	0.12	
	Mean	6.40E-05	0.18	0.0172	26%	0.012	

Notes

1. Horizontal hydraulic conductivity values and effective porosity values from *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill (Aspect, 2010).*
2. Hydraulic gradients measured from the potentiometric surface map shown on Figure 1.
3. Mean hydraulic conductivity values are the geometric mean of the high and low values.
4. NNE, north-northeast; NNW, north-northwest; NE, northeast; N, north



Legend

MW-X XXX.XX	Well completed in Regional Aquifer within 10 feet of the water table
MW-X	Wells completed in Regional Aquifer more than 10 ft below water table
MW-X	Wells screened in discontinuous Perched Zones
300	Regional Aquifer Groundwater Elevation Contour *(feet MSL)*.
?	Inferred Horizontal Groundwater Flow Path

0 1000 2000
Feet
N

Notes:

1. Groundwater measurements made on July 1, 2013.
2. Only wells completed in the Regional Aquifer within 10 feet of the water table were used for contouring.

King County

Groundwater Potentiometric Surface Map
Third Quarter 2013 - Regional Aquifer
Cedar Hills Landfill
King County, Washington

DATE: October 2013	PROJECT NO. 1033379
DESIGNED BY: SB	
DRAWN BY: LT	FIGURE NO. 1
REVISED BY: SB	

CH_3Q2013.dwg

King County

Water and Land Resources Division
Department of Natural Resources and Parks
King Street Center
201 South Jackson Street, Suite 600
Seattle, WA 98104-3855
206.296.6519 Fax 206.296.0192

Memorandum

To: Tom Theno
King County Solid Waste Division

From: Sevin Bilir
King County Water & Land Resources Division

Re: **Potentiometric Groundwater Surface Mapping & Groundwater Velocity Calculations**
Fourth Quarter 2013 Results
Cedar Hills Landfill, King County, Washington
Project No. 1033379 – Task 02.14.137.20

Date: February 12, 2014

King County Water & Land Resources Division (KCWLRD) submits this letter report on groundwater conditions during the fourth quarter of 2013 for the Cedar Hills Landfill (landfill), in accordance with the *Proposal for Potentiometric Groundwater Surface Maps & Groundwater Velocity Calculations* (KCWLRD, 2013). King County Solid Waste Division (KCSWD) personnel measured groundwater elevations at the landfill on October 1, 2 and 17, 2013. These measurements were received by KCWLRD on January 17, 2014 and were used to:

1. Evaluate the potentiometric groundwater surface elevation for the regional aquifer;

2. Determine the groundwater flow direction and horizontal gradient for the regional aquifer; and

3. Calculate the groundwater velocity of the regional aquifer.

There have been no significant changes in the interpreted groundwater conditions since the report submitted for the third quarter of the 2013 monitoring event.

Groundwater Elevation Data

KCSWD attempted groundwater level measurements at 44 monitoring wells during the fourth quarter of 2013. These wells were completed in the regional aquifer as referred to in *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill* (Aspect, 2010).

Table 1 lists the well identifications, locations, well details, measured groundwater levels and calculated groundwater elevations for the regional aquifer. Wells with screened intervals within ten feet of the water table were used for potentiometric surface mapping purposes. A total of 26 wells with water levels within ten feet of the top of screen were selected.

Figure 1 shows well locations, groundwater elevations at the 26 selected wells, groundwater potentiometric surface contours, and interpreted groundwater flow direction in the regional aquifer for the October 1, 2 and 17, 2013 measurement event.

Direction of Groundwater Flow

Figure 1 shows interpreted groundwater potentiometric surface contours and groundwater flow directions in the regional aquifer, based on the October 1, 2 and 17, 2013 measurements. Groundwater elevations indicate that groundwater in the regional aquifer generally flowed north beneath the southern and central portions of the landfill with minor components of flow to the northwest and northeast. At the northern end of the landfill, groundwater generally flowed to the north and northeast.

Groundwater Parameters

Horizontal groundwater velocity was calculated using the following formula:

where: $$v = \frac{1}{n_{eff}} K \frac{\Delta H}{\Delta L}$$

v = Groundwater velocity [L/t]
n_{eff} = Effective porosity [dimensionless]
K = Hydraulic conductivity [L/t]
$\frac{\Delta H}{\Delta L}$ = Hydraulic gradient [L/L]

Horizontal groundwater velocity was calculated for the regional aquifer below the landfill. Horizontal groundwater velocity was calculated for the southern, central, and northern portions of the regional aquifer, based on spatial differences in aquifer parameters and hydraulic gradients. The hydraulic conductivity and effective porosity values were based on the range referred to in the *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill* (Aspect, 2010).

Table 2 presents a summary of the groundwater parameters used to calculate a groundwater velocity from the fourth quarter 2013 data. The hydraulic gradient was greatest under the southern portion of the landfill and smallest under the northern portion. On October 1, 2 and 17, 2013, average horizontal groundwater velocity within the regional aquifer ranged from 0.011 feet per day (ft/d) under the southern portion of the landfill to 4.1 ft/d under the central portion of the landfill.

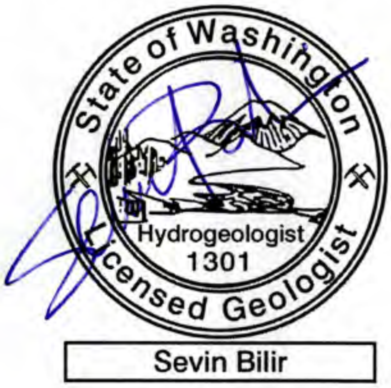
References

Aspect Consulting (Aspect). 2010. *Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill.* Unpublished work. April 30.

King County Water & Land Resources Division (KCWLRD). 2013. *Proposal for Potentiometric Groundwater Surface Maps & Groundwater Velocity Calculations.* Unpublished.

Thank you for the opportunity to provide hydrogeologic services to the KCSWD. Please contact me if you have any questions.

Sincerely,



Sevin Bilir, WA LHG
Environmental Scientist III
King County Water & Land Resources Division

Attachments

Table 1:	Groundwater Elevations - Fourth Quarter 2013
Table 2:	Groundwater Parameters - Fourth Quarter 2013
Figure 1:	Groundwater Potentiometric Surface Map - Fourth Quarter 2013 – Regional Aquifer

Table 1: Groundwater Elevations – Fourth Quarter 2013

Cedar Hills Landfill

King County, Washington

Regional Aquifer Unit	Well Identification	X (ft)	Y (ft)	Top of Casing Elevation (ft MSL)	Top of Screen Elevation (ft)	Bottom of Screen Elevation (ft)	October 1,2 and 17, 2013 Measured Depth to Water (ft)	October 1,2 and 17, 2013 Groundwater Elevations (ft MSL)
Wells with water levels within 10 feet of the top of screen	MW-60	1701154.47	167873.20	567.15	334.81	325.81	227.76	339.39
	MW-64	1701980.27	168772.19	596.55	334.03	320.23	265.9	330.65
	MW-66	1699750.19	174250.32	531.28	294.39	280.59	238.85	292.43
	MW-67	1701776.69	172610.65	516.43	297.80	284.00	221.2	295.23
	MW-68	1701917.32	170609.35	647.07	311.29	292.29	332.98	314.09
	MW-69	1698061.86	172400.20	653.69	293.57	279.97	356.92	296.77
	MW-70	1698412.97	168699.89	530.57	322.75	309.05	205.57	325
	MW-72	1698229.92	170987.71	671.87	303.63	294.03	362.64	309.23
	MW-73	1698954.95	174995.59	485.70	288.11	278.81	191.45	294.25
	MW-74R	1700386.85	173813.79	531.26	289.90	280.40	240.4	290.86
	MW-76	1700376.23	167193.13	491.71	351.06	341.56	140.47	351.24
	MW-77	1700007.63	168999.71	552.67	320.47	310.97	227.24	325.43
	MW-78	1698881.94	169027.58	537.35	322.34	309.84	212.98	324.37
	MW-81	1702568.87	172113.99	493.66	309.19	300.19	184.68	308.98
	MW-82	1699553.72	167725.31	474.85	348.88	339.38	124.48	350.37
	MW-83	1697939.89	167212.27	496.81	350.19	340.69	144.73	352.08
	MW-84	1698602.89	173894.54	530.80	292.46	282.96	236.64	294.16
	MW-85	1701828.95	173694.52	531.76	282.56	273.06	246.64	285.12
	MW-86	1701331.25	174917.90	536.04	283.43	274.63	249.53	286.51
	MW-87	1700670.27	173493.76	537.31	283.68	274.38	248.66	288.65
	MW-88	1701807.87	174303.06	513.68	281.52	272.22	227.36	286.32
	MW-93	1702259.35	169851.24	632.15	319.87	310.07	309.13	323.02
	MW-94	1698674.21	167210.22	495.51	357.22	348.52	143.12	352.39
	MW-95	1697265.32	169426.92	571.54	314.60	305.90	251.66	319.88
	MW-100	1700791.72	169610.46	620.32	319.06	309.06	298.32	322
	MW-106	1702536.99	173461.69	475.47	280.04	270.04	191.27	284.2
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3. Elevations reported in feet above Mean Sea Level based on the National Geodetic Vertical Datum, 1929.

Table 2: Groundwater Parameters – Fourth Quarter 2013
Cedar Hills Landfill
King County, Washington

Regional Aquifer Zone Beneath the Landfill	Horizontal Hydraulic Conductivity (K) Range	(cm/s)	(ft/d)	Horizontal Hydraulic Gradient (ft/ft)	Effective Porosity (n_{eff})	Horizontal Groundwater Velocity (v) (ft/d)	General Groundwater Flow Direction
Northern	Minimum	2.10E-03	6	0.007	24%	0.170	N, NW, NE
	Maximum	4.20E-02	120	0.007	24%	3.40	
	Mean	2.10E-02	60	0.007	24%	1.70	
Central	Minimum	2.10E-03	6	0.008	24%	0.20	N, NNW
	Maximum	4.20E-02	120	0.008	24%	4.1	
	Mean	2.10E-02	60	0.008	24%	2.0	
Southern	Minimum	6.40E-06	0.018	0.016	26%	0.0011	N, NNE, NNW
	Maximum	6.40E-04	1.8	0.016	26%	0.11	
	Mean	6.40E-05	0.18	0.016	26%	0.011	

Notes
1. Horizontal hydraulic conductivity values and effective porosity values from
Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation – Cedar Hills Landfill (Aspect, 2010).
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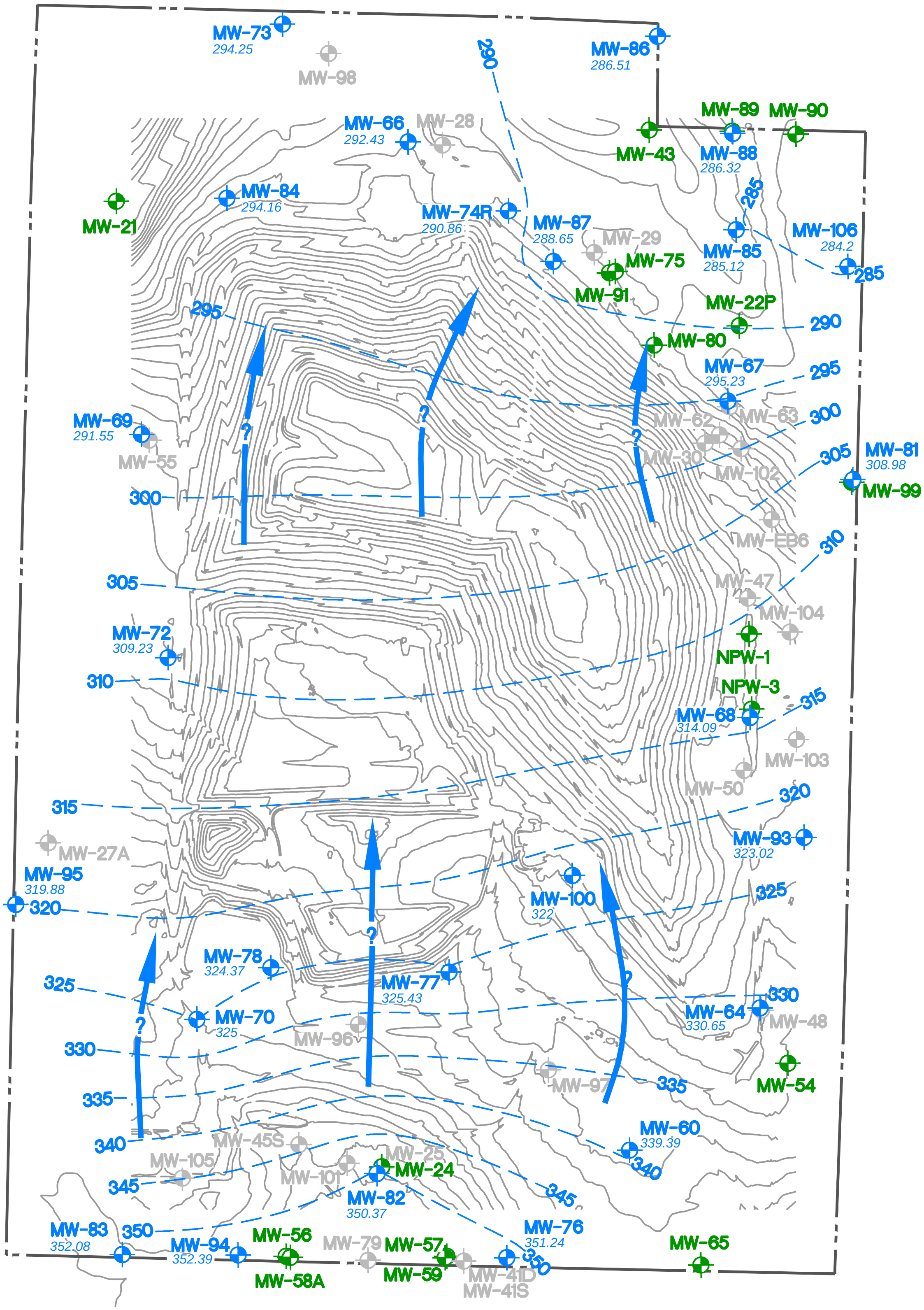

Legend

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0 1000 2000
Feet

N

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King County

Groundwater Potentiometric Surface Map

Fourth Quarter 2013 - Regional Aquifer

Cedar Hills Landfill

King County, Washington

DATE:	PROJECT NO.
February 2014	1033379
DESIGNED BY: SB	FIGURE NO.
DRAWN BY: LT	1
REVISED BY: SB	

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