FINAL REPORT

Post-Closure Groundwater Monitoring 2015 Annual Report

Prepared for

Intalco Aluminum Corporation
Ferndale, Washington

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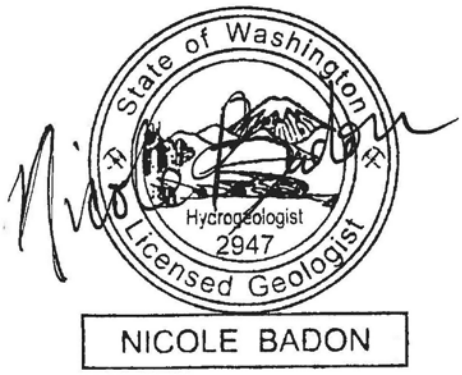

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Executive Summary

This report presents and evaluates groundwater monitoring data collected from the uppermost aquifer located near the landfill area at the Intalco Aluminum Corporation (Intalco) facility in Ferndale, Washington. The groundwater monitoring data were collected in accordance with the post-closure monitoring plan approved by the Washington State Department of Ecology (Ecology). During the post-closure monitoring period, which began in 2012 after closure of the Triple-lined Landfill, Intalco will collect and analyze four quarters of groundwater monitoring data from the installed groundwater monitoring system once every five years, beginning in 2015, over the 30-year post-closure period. The groundwater monitoring system encompasses the area of the three closed landfills - the unlined landfill, Double-lined Landfill, and Triple-lined Landfill. Eleven existing wells are included in the post-closure groundwater monitoring program. This report includes data collected during the landfill operational period from 1988 through 2011 and post-closure monitoring data collected during the calendar year 2015.

Groundwater Quality Data and MCL Exceedances

The groundwater quality data for the calendar year 2015 are generally consistent with data collected during the operational period groundwater monitoring program from 1988 through 2011, based on visual analysis of long-term time-series plots, including several secondary Maximum Contaminant Levels (MCL) exceedances. There are, however, several MCL exceedances recorded in 2015 that were not recorded in the previous sampling quarters in 2011, as noted below. Of the eleven wells sampled, four met the primary and secondary MCLs for all constituents. For the remaining seven wells, the following parameters exceeded the secondary MCLs for one or more quarterly monitoring events in 2015:

- Chloride (secondary MCL) in well SMW-12.
- The pH levels (secondary GWQS; below the lower limit of 6.5) in wells SMW-06, SMW-10, SMW-12, SMW-14, and SMW-15 (lower limit not exceeded in 2011 at these locations).
- Specific conductance (secondary MCL) in wells SMW-03, SMW-12, and SMW-13 (background well).

Groundwater Elevation and Flow Data

The groundwater flow paths and flow velocities generated for the four quarters of 2015 are very similar to the ones produced over the previous 12 years of landfill operational period groundwater monitoring (CH2M HILL 2000, 2001, 2005, 2006, 2007, 2008, 2009, 2010, 2011, and MFG 2002, 2003, 2004). This indicates there is no significant change in either groundwater flow direction or flow velocities and that the monitoring well network is appropriately positioned to detect releases from the landfills into the uppermost aquifer at the site.

SECTION 1

Introduction

This report presents and evaluates groundwater monitoring data collected from the uppermost aquifer located near the three solid waste landfills at the Intalco facility at 4050 Mountain View Road, Ferndale, Washington 98248. Per the Ecology approved post-closure plan for the Triple-lined landfill, and in accordance with the Washington Administrative Code (WAC) Chapter 173-303-610, Intalco is required to monitor the groundwater quality and report the groundwater flow rate and direction on a quarterly basis once every five years during the 30-year post-closure period, which began in 2012. Post-closure monitoring is conducted during the year prior to the 5, 10, 15, 20, 25, and 30 monitoring years. This report includes data collected during the landfill operational period from 1988 through 2011 along with post-closure monitoring data collected during the calendar year 2015, and is the first post-closure groundwater monitoring report.

Similar to the previous 23 years of monitoring conducted during the operational period groundwater monitoring program, Intalco will conduct the post-closure groundwater monitoring program approved by Ecology for the Landfill Area encompassing the closed unlined landfill, the closed Double-lined Landfill, and the closed Triple-lined Landfill. Intalco collects and analyzes samples from the installed groundwater monitoring system on a quarterly basis every fifth year per the Ecology approved program. The groundwater monitoring program focuses on the landfill wastes associated with the aluminum smelter which have been the only site operations since it was constructed in 1969. Wastes landfilled at the site and the associated constituents of concern (COCs) have been consistent over the life of the landfills. The current approved groundwater monitoring program monitors for COCs for wastes placed in the landfill area which includes spent potliner.

SECTION 2

Background

This section presents a summary of the operational period and post-closure period groundwater monitoring programs at the landfill area at the Intalco facility from 1986 through the present.

During 1986 and early 1987, Intalco closed an existing solid waste disposal facility and opened a new facility consisting of two cells known as the double-lined and triple-lined cells located north of the main plant (Figure 1). The double and triple lined cells were constructed using best available design, material, and construction methods coupled with the implementation of a groundwater monitoring program to monitor for release from any of the three landfills in the landfill area to the site upper most aquifer. In 2007, Intalco completed closure of the double-lined landfill. And, in November 2011, after reaching capacity in June 2011, Intalco completed closure of the triple-lined landfill. Intalco has worked with Ecology and the Whatcom County Health Department consistently over the life of the landfills to design and install a groundwater monitoring network acceptable to Ecology. The current 15 well monitoring network encompasses the closed unlined landfill, the closed Double-lined Landfill, and the closed Triple-lined Landfill and effectively monitors the upper aquifer of the landfill area (refer to Ecology letter of March 5, 2002). Following is a description of the evolution of the program:

The proposed groundwater monitoring plan for the landfill area including the new double-lined and triple-lined cells was submitted with the solid waste permit application in April 1986 and included the use of existing monitoring wells and five new wells. In July 1987, a monitoring plan was approved by Ecology's Industrial Waste Section. This monitoring system consisted of the following shallow monitoring wells (SMW): SMW-02, SMW-03, SMW-06, SMW-08, SMW-09, SMW-10, SMW-11, SMW-12, and SMW-13 (Figure 1). Wells SMW-11 and SMW-13 were considered the upgradient or background wells. A revised groundwater monitoring system was approved by Ecology in 1989. This system included the addition of wells SMW-14, SMW-15, SMW-16, and SMW-17.

In October 1999, Intalco representatives met with Ecology representatives to discuss Intalco's request for a waiver to the groundwater monitoring requirements contained in the Resource Conservation and Recovery Act (RCRA) Interim Status Regulations (Title 40 of the Code of Federal Regulations Part 265). These regulations apply to the groundwater monitoring network associated with the triple-lined landfill and its lateral extension. In February 2000, Ecology issued a letter requiring Intalco to install one additional groundwater monitoring well at a location approved by Ecology. Intalco was required to monitor the new well for one year. If the new well was continuously dry for one year, Ecology would grant the waiver. If the well was not continuously dry for one year, it would be integrated into the existing monitoring well network for all onsite landfills.

In August 2000, Intalco installed two additional groundwater monitoring wells at locations approved by Ecology (SMW-18 and SMW-19). SMW-18 has been continuously dry since it was installed. SMW-19 has produced groundwater monitoring data, and is included in the monitoring network.

In 2011, Ecology approved the Triple-lined Landfill post-closure plan which covers groundwater monitoring and landfill cover maintenance requirements for the 30-year post-closure period, in accordance with WAC 173-303-610. Based on analysis of time series data from 22 years of operational period groundwater monitoring at the landfill area, closure monitoring was reduced from quarterly monitoring on an annual basis to quarterly monitoring once every five years over the 30-year post-closure period. The number of monitoring wells included in the post-closure monitoring program was also reduced from 15 existing wells to 12 existing wells, to exclude wells that were consistently dry

during operational period monitoring (SMW-11, SMW-16, SMW-17, and SMW-18) or were not installed in the uppermost aquifer (SMW-4). The post-closure monitoring period began in 2012, after Ecology's approval of the Triple-lined Landfill closure report.

Table 2-1 presents a listing of wells currently used to comply with the requirements of WAC 173-303-610 and the post-closure monitoring plan. Figure 1 shows the location of each well. Well SMW-13 is the background well. All other wells are considered downgradient wells to well SMW-13.

Table 1 Intalco Groundwater Monitoring System

Post-Closure Groundwater Monitoring

Well	Required Sampling Frequency	Well Designation	Data Included In this Report?
SMW-02	Quarterly in 2015, 2020, 2025, 2030, 2035, 2040	Point of Compliance Well	Yes
SMW-03		Point of Compliance Well	Yes
SMW-06		Additional monitoring location	Yes
SMW-08		Point of Compliance Well	Yes
SMW-09		Additional monitoring location	Yes
SMW-10		Additional monitoring location	Yes
SMW-12		Point of Compliance Well	Yes
SMW-13		Background monitoring well	Yes
SMW-14		Point of Compliance Well	Yes
SMW-15		Additional monitoring location	Yes
SMW-19		Point of Compliance Well	Yes

Note: Appendix D presents a listing of documents prepared for the site well installations, characterization, and monitoring programs.

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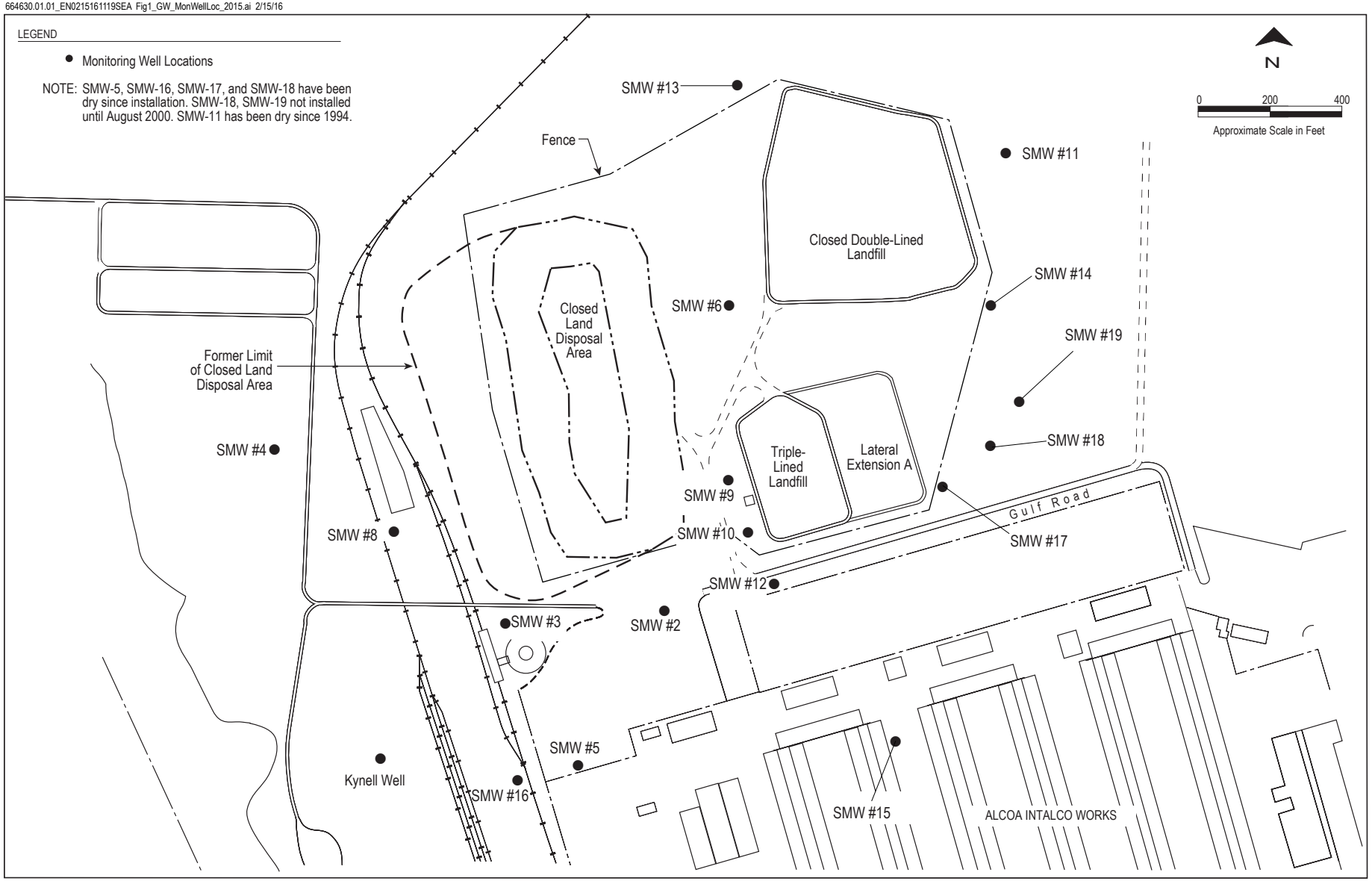

Figure 1
Monitoring Well Locations
ALCOA Intalco Works, Ferndale, WA

SECTION 3

Groundwater Quality Data Analysis

3.1 Groundwater Quality Data - 2015

The Ecology-approved monitoring plan stipulated that Intalco test for the following groundwater quality parameters:

- Temperature
- pH
- Specific conductance
- Total aluminum
- Total calcium
- Chloride
- Total cyanide
- Total fluoride
- Total potassium
- Total sodium
- Sulfate

Appendix A presents a tabulation of the data collected from the first quarter 2015 through the last quarter of 2015 for wells SMW-02, SMW-03, SMW-06, SMW-08, SMW-09, SMW-10, SMW-12, SMW-13 (designated as USMW013 in Appendix A), SMW-14, SMW-15, and SMW-19.

A leak detection system is present between the primary and secondary liners of the landfill that was sampled as part of the operational-period groundwater monitoring program in the landfill area and is sampled as part of the post-closure groundwater monitoring program. Results of the leak detection system sampling are provided in Appendix C.

3.2 Analytical Methods

Time-series plots (including a comparison to applicable primary and secondary drinking water standards) are used to evaluate the groundwater monitoring data. A visual examination of concentrations over time was conducted to identify any substantive changes or possible trends in the data.

3.2.1 Time-Series Plots

Time-series plots are useful for detecting trends in monitoring data over time. The inclusion of the primary and secondary MCLs, if applicable, provides a context for the data. Time-series plots for the required parameters (except temperature) from the earliest monitoring date through the last quarter of 2015 are presented in Appendix B.

Each parameter is graphed separately and within each parameter graph, the background well (SMW-13) is graphed separate from the rest. Results for the downgradient wells are presented in two separate plots for clarity. The drinking water standards per WAC 246-290-310 and groundwater quality standards (GWQS) per WAC 173-200 are included in the plots, where applicable. The required parameters that have associated MCLs are:

- Chloride 250 milligrams per liter (mg/L) (Secondary MCL)
- Cyanide (as HCN) 0.2 mg/L (Primary MCL)
- Fluoride 4.0 mg/L (Primary MCL), 2.0 mg/L (Secondary MCL)
- pH 6.5 to 8.5 (Secondary GWQS)
- Specific Conductance 700 micromhos per centimeter (µmhos/cm) (Secondary MCL)
- Sulfate 250 mg/L (Secondary MCL)

Primary standards are for the protection of human health. Secondary standards are based on aesthetics such as taste, odor, and possible staining of tooth enamel (fluoride).

3.3 Results of Time-Series Analysis

The time-series plots are presented in Appendix B and are discussed below. The parameters that have been detected in the groundwater monitoring network for the entire landfill area and discussed in this section have been consistent over time and included in each annual report since the monitoring program began after construction of the two new landfills and closure of the former unlined landfill. Ecology has attributed the identified parameter detections in the groundwater monitoring network to releases from the closed unlined spent potliner landfill which was closed and capped in 1986. There are no documented releases from the double-lined and triple-lined landfills constructed in 1986 which are now closed.

The following parameters exceeded the MCLs or GWQS in the indicated downgradient wells for one or more quarterly monitoring events in 2015:

- Chloride (secondary MCL) in well SMW-12.
- The pH levels (secondary GWQS; below the lower limit of 6.5) in wells SMW-06, SMW-10, SMW-12, SMW-14, and SMW-15.
- Specific conductance (secondary MCL) in wells SMW-03, SMW-12, and SMW-13 (background well).

The time-series plots are generally consistent over time regarding MCL or GWQS exceedances and observance of apparent trends, based on visual examination. None of the 2015 concentrations show substantive departures from previously observed levels, as shown in Appendix B. For 2015, the following changes in parameter concentration over time were observed in the time series plots:

- Aluminum concentrations are primarily non-detect (below the laboratory detection limit/threshold which changed over time from 0.1, 0.01, 0.004, and 0.005) in most locations over time. The greatest concentration variance for 2015 occurred in SMW-10 where aluminum concentrations increased from 0.01 mg/L in the second quarter of 2015 to 0.1 mg/L in the third quarter of 2015. No primary or secondary groundwater quality standards are available for comparison.
- Calcium concentrations are fairly consistent over time, based on visual examination, for most wells, with two exceptions: SMW-03 and SMW-12. Compared to the 2010 and 2011 data, 2015 concentrations in SMW-03 decreased to below the values recorded during the previous sampling periods; concentrations in SMW-12 have increased (from 93 mg/L in November 2011 to 96 mg/L in 2015) while demonstrating quarterly variations which have been present for this location over time. No primary or secondary groundwater quality standards are available for comparison.
- Chloride concentrations are consistently detected below the secondary MCL of 250 mg/L, with the exception of SMW-03 and SMW-12. Compared to chloride concentrations detected above the MCL in previous years, chloride concentrations in SMW-03 decreased to levels below the secondary MCL

during all four monitoring quarters of 2015. In SMW-12, chloride concentrations fluctuated, similar to previous years, and exceeded the secondary MCL during the fourth quarter of 2015. Visual examination of chloride concentrations in SMW-10 show an apparent decreasing trend and concentrations in SMW-02 show an apparent increasing trend over time.

- Cyanide concentrations are consistently detected below the primary MCL of 0.2 mg/L; none of the 2015 detected concentrations exceeded the primary MCL. Cyanide concentrations were reported as non-detect (below the laboratory detection limit/threshold of 0.0019 mg/L [historically 0.005 mg/L]) in 8 of the 11 wells (SMW-02, SMW-03, SMW-06, SMW-08, SMW-14, SMW-15, SMW-19, and background well SMW-13) from one to all four quarters of 2015 and have historically been reported as non-detect in most wells. Cyanide concentrations increased over the monitoring period in SMW-12 with the greatest 2015 quarterly cyanide concentration of 0.175 mg/L having been recorded in December of 2015.
- The primary MCL for fluoride is 4.0 mg/L and the secondary MCL is 2.0 mg/L. Fluoride concentrations in all wells were below the MCLs for all four 2015 monitoring quarters, and have been since 2007. The concentration of fluoride fluctuated in multiple wells over the 2015 monitoring period. Fluoride concentrations in SMW-06 increased during the second and third monitoring quarters to 0.83 mg/L and 1.15 mg/L, respectively. Five wells (SMW-09, SMW-12, SMW-14, SMW-19, and background well SMW-13) had non-detect concentrations for at least three of the four quarters in 2015.
- pH was within the secondary GWQS range of 6.5 to 8.5 for many wells during the past four quarters; however, five wells (SMW-06, SMW-10, SMW-12, SMW-14, and SMW-15) had at least one quarterly sample fall below the lower pH limit of 6.5. Wells SMW-06 and SMW-12 are the more common locations for historic excursions outside the secondary GWQS range, yet these instances occur sporadically. A visual examination of the pH levels over time show that levels fluctuate, with occasional exceedances outside of the secondary GWQS range.
- Potassium concentrations are fairly consistent over time, based on visual examination, for most wells. Compared to 2011 data, potassium concentrations in SMW-10 and SMW-19 increased from previous levels to 8.2 mg/L and 8.8 mg/L, respectively, during the third monitoring quarter of 2015. No primary or secondary groundwater quality standards are available for comparison.
- Sodium concentrations were relatively stable in all wells over the four quarters of 2015 with a few exceptions. Concentrations in SMW-10 and SMW-19 fluctuated, exhibiting an increase in concentration during the third quarter from 30 mg/L (SMW-10) and 11.1 mg/L (SMW-19) in June 2015 to 76.9 mg/L (SMW-10) and 35.9 mg/L (SMW-19) in September 2015 before returning to a lower concentration of 22.4 mg/L (SMW-10) and 12.1 mg/L (SMW-19) in December 2015. In addition, concentrations in SMW-03 have decreased from 2011 minimum values of 82.5 mg/L to 2015 maximum values of 42.4 mg/L. No primary or secondary groundwater quality standards are available for comparison.
- Specific conductance levels in the background well SMW-13 increased to just above the secondary MCL of 700 µmhos/cm during the first and second quarters of 2015, similar to previous exceedances over time. Specific conductance levels in downgradient wells SMW-03 and SMW-12 fluctuated and consistently exceeded the secondary MCL, dating back to the initial start date of groundwater monitoring. The specific conductance levels measured in SMW-03 during 2015, however, were lower than recent results from 2005 through 2011. Modest and steady increases are observed in a number of downgradient wells over the period of record.

- Sulfate concentrations are consistently detected below the secondary MCL of 250 mg/L; none of the 2015 detected concentrations exceeded the secondary MCL. Concentrations from 2015 remained consistent with values observed during the 2011 sampling period, with no substantive increases or decreases. Based on visual examination of the sulfate levels over time, an apparent increasing trend is observed in several downgradient wells.

SECTION 4

Groundwater Elevations and Flow

Per the Ecology approved post-closure plan, and in accordance with WAC 173-303-610, Intalco evaluates and reports groundwater direction and flow rate in the uppermost aquifer from quarterly data collected every five years. This section discusses the methods used to fulfill this requirement and presents the results of the evaluation.

4.1 Methods

Groundwater level measurements were collected from each well as part of the quarterly sampling protocol. The data are summarized in Table 2. These data were used to construct the groundwater elevation contour maps (potentiometric maps) of the uppermost aquifer for each quarter (Figures 2 through 5). The direction of groundwater flow can be estimated from the potentiometric maps by drawing flow-lines perpendicular to the groundwater elevation contours from highest to lowest elevation. [Note: Minor deviations from perpendicular are sometimes required to smooth the flow lines. These have no significant effect on the calculated gradients.]

Groundwater flow rates (velocities) were calculated based on the hydraulic gradients measured from the potentiometric maps and estimated aquifer coefficients. The flow velocity is estimated based on a modified form of Darcy's Law:

$$V = Ki / n$$

Where:

V = Average linear groundwater flow velocity (length/time)
K = Average hydraulic conductivity (length/time)
i = Hydraulic gradient along flow line (length/length)
n = Estimated effective porosity (dimensionless)

Input parameters for this equation were as follows:

K – During the well installation program in 1987, a relatively undisturbed soil sample of shallow aquifer material (Esperance sand) was obtained from the 57- to 58-foot depth interval in the boring that is now SMW-13. The triaxial cell permeability test of this sample yielded a hydraulic conductivity of 1.4 x 10^{-4} centimeters per second (cm/sec) (CH2M HILL, 2000).

i – The hydraulic gradient was calculated based on the potentiometric maps (Figures 2 through 5). Three flow lines were chosen for each quarterly map to account for the variability in the groundwater gradient within the site.

n – The estimated effective porosity of silty sand and sandy silt in the uppermost aquifer is 0.20 (EPA, 1989).

TABLE 2
2015 Quarterly Groundwater Level Data
ALCOA Intalco

Well Number	2015 Measuring Date	Measuring Point Elevation (ft AMSL[1])	Depth to Water (in)	Depth to Water (ft)	Water Level Elevation (ft AMSL[1])
SMW-2	24-Mar	199	756	63	136.4
	25-Jun		752	62.7	136.8
	24-Sep		758.4	63.2	136.2
	2-Dec		758.4	63.2	136.2
SMW-3	30-Mar	199	612	51	147.9
	30-Jun		608	50.7	148.2
	30-Sep		610.8	50.9	148.0
	4-Dec		604.8	50.4	148.5
SMW-6	25-Mar	214	726	60.5	153.4
	26-Jun		726	60.5	153.4
	25-Sep		729.6	60.8	153.1
	2-Dec		726	60.5	153.4
SMW-8	28-Mar	196	638	53.2	142.6
	24-Jun		638	53.2	142.6
	24-Sep		636	53	142.8
	3-Dec		636	53	142.8
SMW-9	31-Mar	212	898	74.8	137.6
	24-Jun		828	69	143.4
	24-Sep		825.6	68.8	143.6
	20-Nov		829.2	69.1	143.3
SMW-10	26-Mar	210	847	70.6	139.8
	27-Jun		844	70.3	140.0
	18-Sep		849.6	70.8	139.6
	2-Dec		849.6	70.8	139.6
SMW-12	26-Mar	204	823	68.6	135.4
	25-Jun		813	67.8	136.3
	25-Sep		818.4	68.2	135.8
	1-Dec		823.2	68.6	135.4
SMW-13[2]	26-Mar	216	716	59.7	156.2
	24-Jun		716	59.7	156.2
	29-Sep		715.4	59.6	156.2
	1-Dec		716.4	59.7	156.1
SMW-14	26-Mar	221	1,995	166.3	54.7
	25-Jun		1,994	166.2	54.8
	25-Sep		1994.4	166.2	54.8
	1-Dec		1994.4	166.2	54.8
SMW-15	27-Mar	198	1,444	120.3	77.8
	27-Jun		1,446	120.5	77.6
	30-Sep		1447.2	120.6	77.5
	10-Dec		1,446	120.5	77.6
SMW-19	25-Mar	218	2,040	170	47.5
	24-Jun		2,061	171.8	45.8
	18-Sep		2068.8	172.4	45.1
	19-Nov		2067.6	172.3	45.2

[1] Feet above mean sea level according to National Geodetic Vertical Datum (NGVD)

[2] Monitoring well SMW-13 is the background well for the Intalco facility.

4.2 Results

Figures 2 through 5 present the groundwater elevation contours and inferred groundwater flow directions at the site. Table 3 presents the results of the groundwater flow velocity calculations for each flow-line identified in the groundwater elevation contour maps.

The three groundwater flow paths and flow velocities generated for the four quarters of 2015 are similar to the ones produced over the previous twelve monitored years (CH2M HILL 2000, 2001, 2005, 2006, 2007, 2008, 2009, 2010, 2011, and MFG 2002, 2003, 2004). This indicates there is no significant change in either groundwater flow direction or flow velocities and that the monitoring network is appropriately positioned downgradient to detect a release from the landfill area to the uppermost aquifer at the site.

TABLE 3
2015 Groundwater Flow Velocity
ALCOA Intalco

2015 Quarterly Event	Estimated Groundwater Flow Velocity (ft/day)		
	Flow Line #1	Flow Line #2	Flow Line #3
First Quarter	0.27	0.22	0.18
Second Quarter	0.27	0.27	0.18
Third Quarter	0.26	0.27	0.16
Fourth Quarter	0.28	0.27	0.16

V = average linear groundwater flow velocity (ft/day) = (K*i)/n
K = average hydraulic conductivity = 0.00014 cm/sec = 0.397 ft/day
i = average hydraulic gradient along flow line (ft/ft)
n = estimated effective porosity = 0.20

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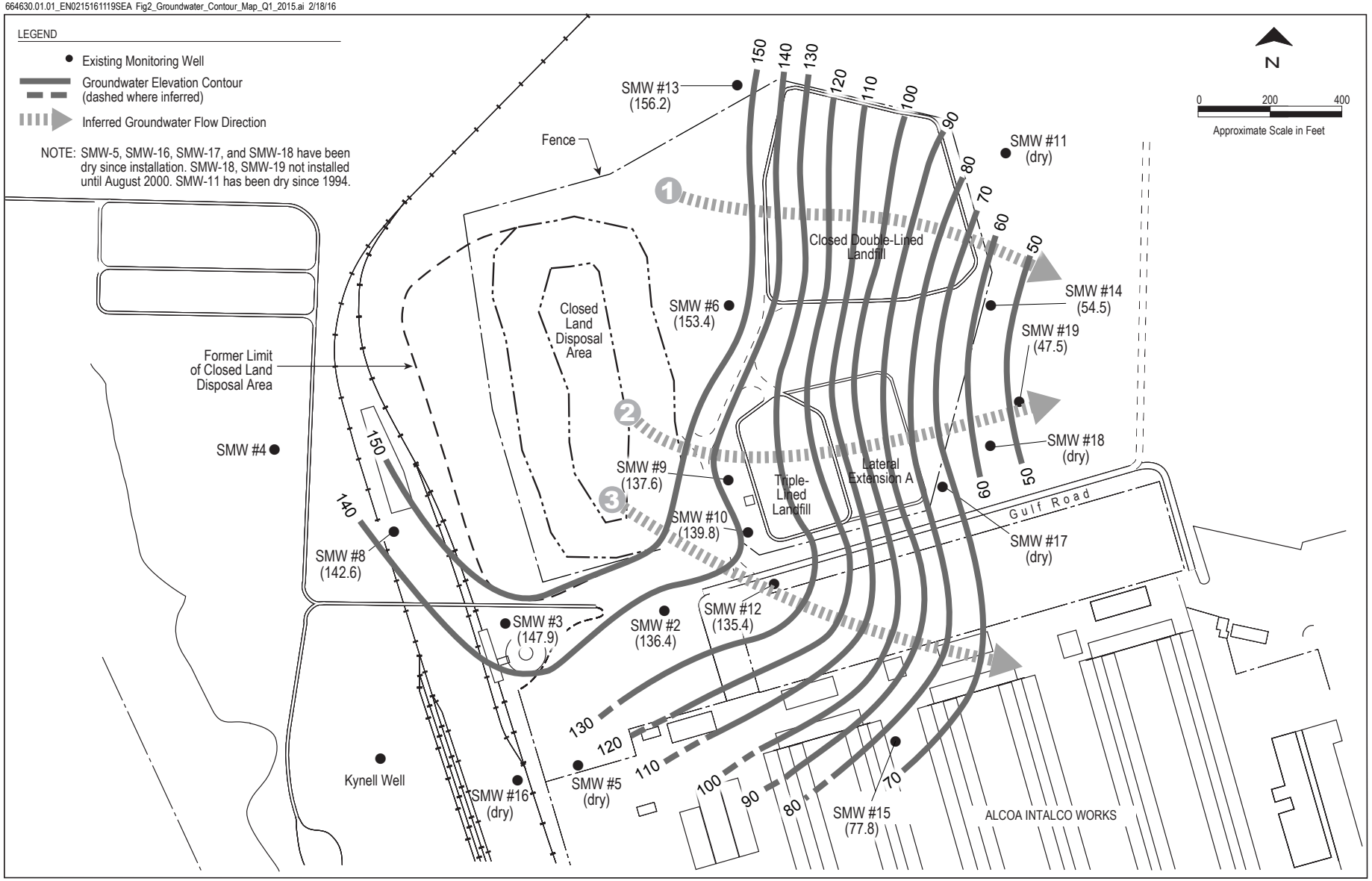

Figure 2
Groundwater Elevation Contour Map
First Quarter 2015
ALCOA Intalco Works, Ferndale, WA

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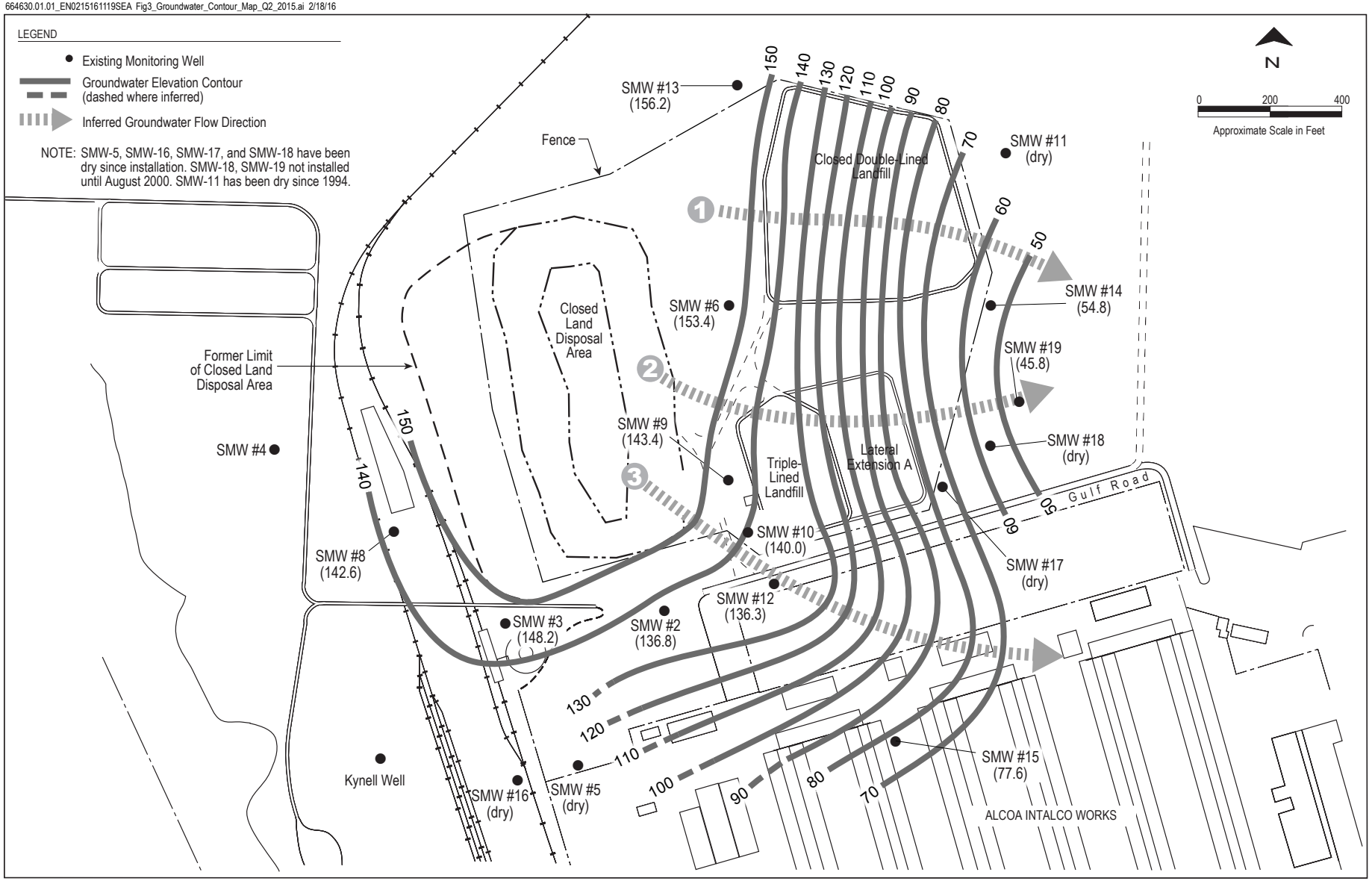

Figure 3
Groundwater Elevation Contour Map
Second Quarter 2015
ALCOA Intalco Works, Ferndale, WA

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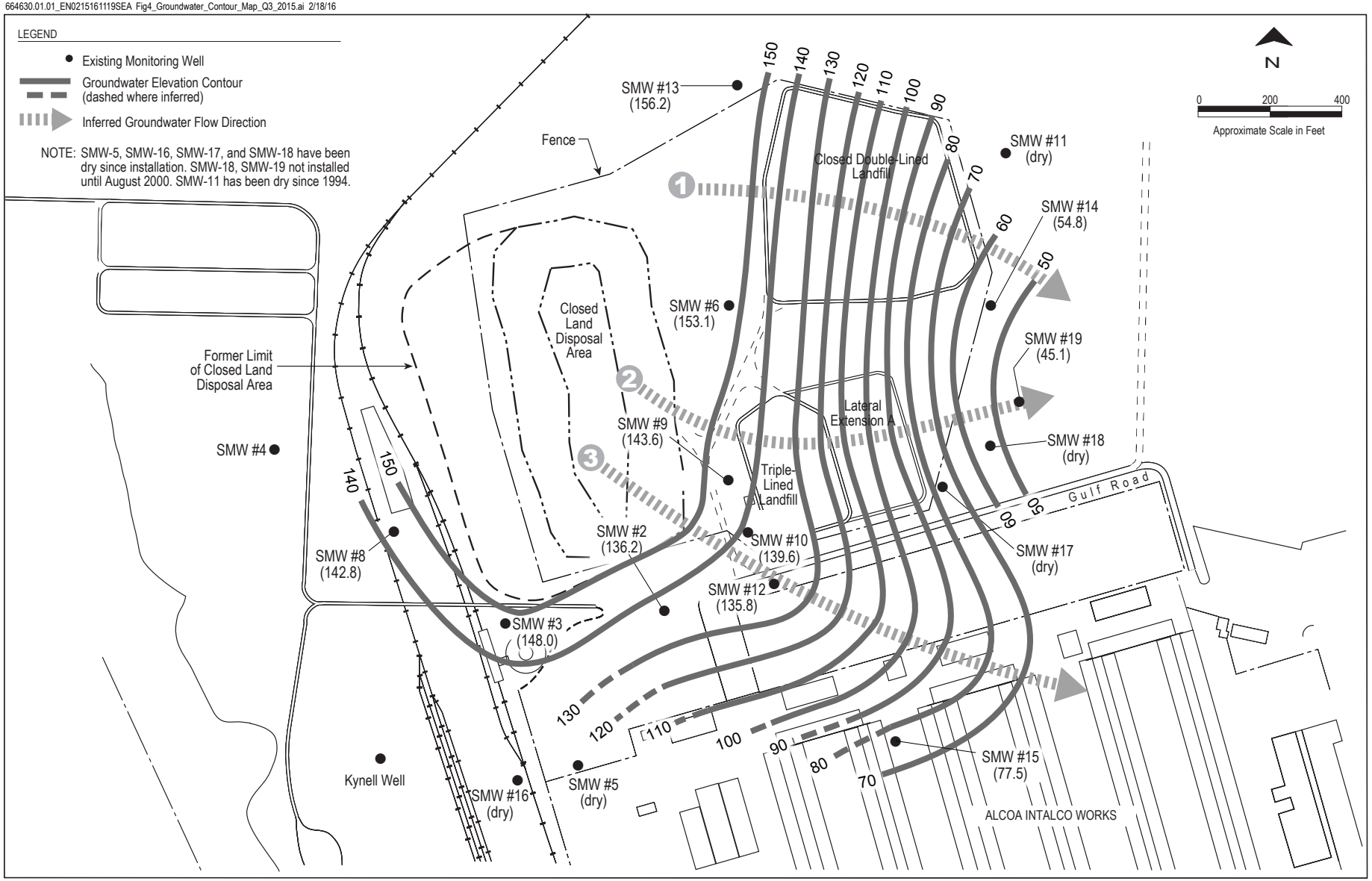

Figure 4
Groundwater Elevation Contour Map
Third Quarter 2015
ALCOA Intalco Works, Ferndale, WA

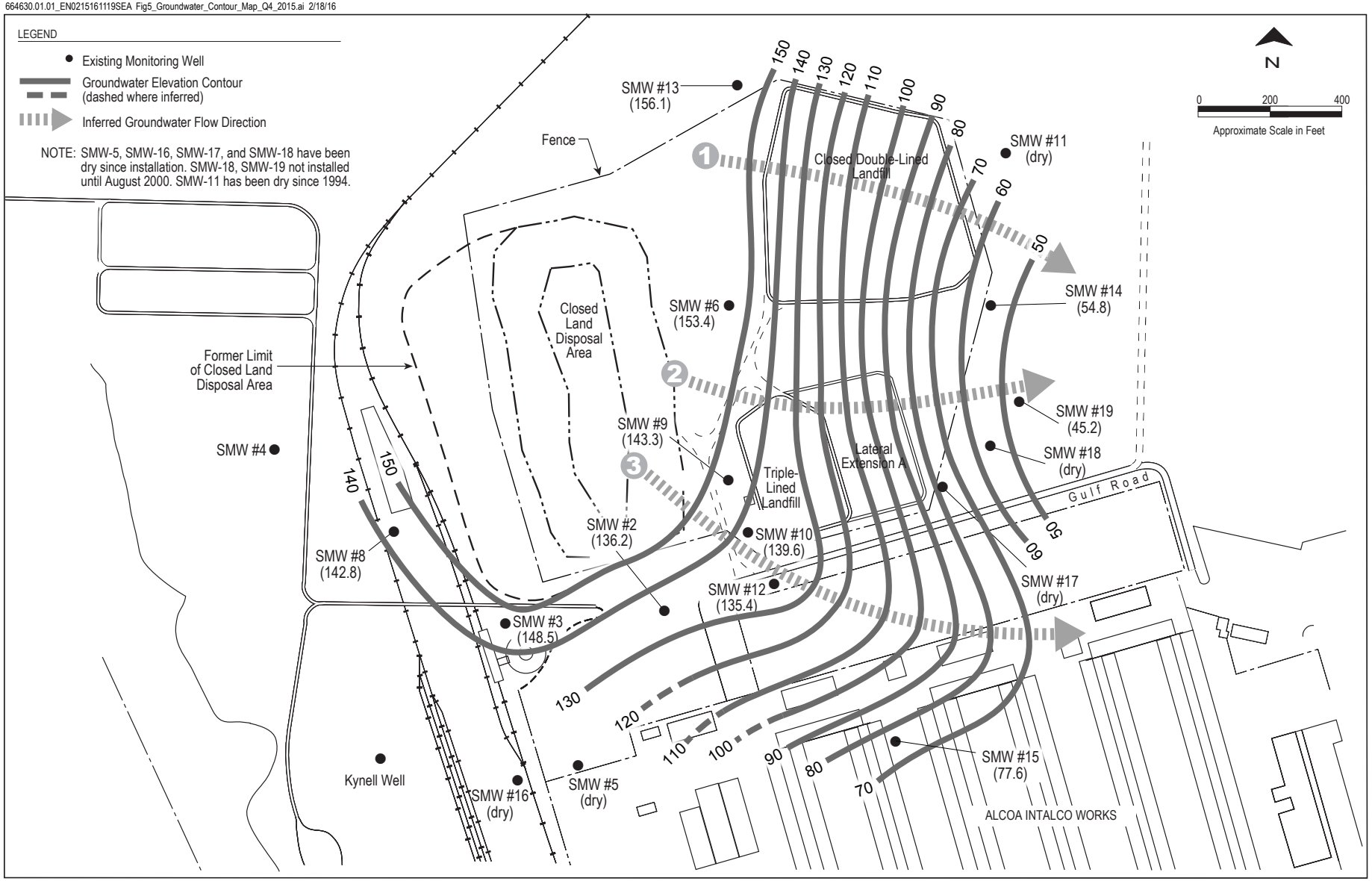

Figure 5
Groundwater Elevation Contour Map
Fourth Quarter 2015
ALCOA Intalco Works, Ferndale, WA

SECTION 5

Summary and Recommendations

Intalco completed the closure of the double-lined landfill in 2007 per the July 2006 Ecology Cleanup Action Plan (CAP). The triple-lined landfill was in operation through approximately July 2011 when closure construction activities began. Closure of the triple-lined landfill was completed in November 2011, and the 30- year post-closure period began in 2012.This 2015 annual report is the first post-closure groundwater monitoring report. The data from the 2015 monitoring year are consistent with previous years regarding the MCL or GWQS exceedances; there were no new constituents exceeding groundwater standards for 2015, which hadn't exhibited historic exceedances. Eleven monitoring wells are monitored as part of the Intalco post-closure groundwater monitoring program. Of these eleven wells, four had concentrations below the secondary MCLs for all constituents. For the remaining seven wells, the following parameters exceeded the secondary MCLs for one or more quarterly monitoring events in 2015:

- Chloride (secondary MCL) in well SMW-12.
- The pH levels (secondary GWQS; below the lower limit of 6.5) in wells SMW-06, SMW-10, SMW-12, SMW-14, and SMW-15.
- Specific conductance (secondary MCL) in wells SMW-03, SMW-12, and SMW-13 (background well).

There are no changes recommended at this time to the Ecology approved post-closure groundwater monitoring program. There have been no significant changes in either groundwater flow direction or flow velocities during 2015 and the monitoring network is appropriately positioned downgradient to detect a release from the landfill area to the uppermost aquifer at the site.

SECTION 6

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MFG, Inc. 2002. Groundwater Monitoring 2001 Annual Report, Intalco Aluminum Corporation, Ferndale, Washington. February.

Appendix A
Tabulated Analytical Results
Quarterly Groundwater Sampling
March 2015 through December 2015

Appendix A
INTALCO QUARTERLY GROUNDWATER MONITORING RESULTS
1st Through 4th Quarter 2015

Monitoring Well	Date Sampled	Temperature (oC)	Total Aluminum (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Total Cyanide (mg/L)	Total Fluoride (mg/L)	pH (Std. Units)	Potassium (mg/L)	Sodium (mg/L)	Specific Conductance (µmhos/cm)	Sulfate (mg/L)
Maximum		**--**	**--**	**--**	**250[2]**	**0.2[1]**	**4[1]**	**6.5 - 8.5[2]**	**--**	**--**	**700[2]**	**250[2]**
SMW002	3/24/2015	15.1	0.01	44.2	55	0.0019 U	0.14	6.76	3.7	15.6	457	11
SMW002	6/25/2015	17.9	0.01	42.3	56	0.019 U	0.12	7.93	3.3	14.5	497	10.9
SMW002	9/24/2015	19	0.02	48.4	77.4	0.049 U	0.18	6.61	4.7	16.5	538	11.5
SMW002	12/2/2015	18.9	0.015	43.1	78.5	0.004 U	0.21	7.64	3.3	14.7	491	10.6
SMW003	3/30/2015	11.1	0.02	67.9	110	0.009	0.28	7.15	5.7	36.1	**807**	9
SMW003	6/30/2015	13.3	0.02	60	81.6	0.003 J	0.17	7.96	3.6	27.1	**789**	8.5
SMW003	9/30/2015	12.5	0.02	76.9	161	0.007	0.19	6.9	5.97	42.4	951	9.4
SMW003	12/4/2015	10.8	0.02	53.1	94.1	0.0049 U	0.2	7.82	3.1	26.4	588	8.6
SMW006	3/25/2015	12	0.02	58.8	20	0.0019 U	0.1	**6.33**	2.1	16.3	555	17
SMW006	6/26/2015	14.9	0.02	59.9	19.9	0.0019 U	0.83	6.83	2.3	16.7	629	16.8
SMW006	9/25/2015	16.7	0.06	58	18.7	0.0049 U	1.15	6.63	2.4	16.4	567	17.6
SMW006	12/2/2015	12.1	0.02	55.7	20.5	0.005	1.11	7.29	2	15.7	508	17.7
SMW008	3/28/2015	13.3	0.02	32.1	33.1	0.0019 U	0.25	7.23	3.6	16.3	400	30.7
SMW008	6/24/2015	14.5	0.01	32.7	32.6	0.004 J	0.16	6.54	2.1	15	419	30.5
SMW008	9/24/2015	13.7	0.05	31.5	29.5	0.005	0.11	6.53	2.6	15.3	409	30
SMW008	12/3/2015	13.5	0.02	30	33.1	0.008	0.4	6.57	2	14.4	328	30.9
SMW009	3/31/2015	12.7	0.01	43.6	16	0.034	0.06 U	6.83	2.8	15.5	491	86
SMW009	6/24/2015	15.5	0.01	45.1	15.3	0.045	0.06 U	6.56	1.8	15	543	85.4
SMW009	9/24/2015	12.5	0.07	42.9	14.8	0.047	0.13	6.54	2.2	14.6	503	80.9
SMW009	11/20/2015	11.2	0.02	42.2	15	0.048	0.06 U	6.79	2.1	16.9	452	77
SMW010	3/26/2015	13.4	0.02	38.7	22	0.058	0.09	**6.17**	1.9	26.6	431	93
SMW010	6/27/2015	16.4	0.01	33.3	17.1	0.073	0.43	**6.37**	1.7	30	470	93.8
SMW010	9/18/2015	15.9	0.1	29.2	15.7	0.056	0.14	**6.35**	8.2	76.9	543	95.3
SMW010	12/2/2015	10.8	0.02	46.4	31.9	0.038	0.06 U	6.79	1.7	22.4	482	111
SMW012	3/26/2015	16.9	0.02	68	167.3	0.0118	0.06 U	**6.07**	2.2	38.2	**850**	58.5
SMW012	6/25/2015	13.4	0.01	49.6	107.9	0.079	0.06 U	**6.21**	1.7	32.2	**737**	52.1
SMW012	9/25/2015	13.3	0.02	76.4	183	0.132	0.06 U	**6.3**	2.7	39.7	**987**	62.7
SMW012	12/1/2015	12.5	0.02	96	**273**	0.175	0.06 U	6.66	2.4	44.8	**1,177**	64

INTALCO QUARTERLY GROUNDWATER MONITORING RESULTS
1st Through 4th Quarter 2015

Monitoring Well	Date Sampled	Temperature (oC)	Total Aluminum (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Total Cyanide (mg/L)	Total Fluoride (mg/L)	pH (Std. Units)	Potassium (mg/L)	Sodium (mg/L)	Specific Conductance (µmhos/cm)	Sulfate (mg/L)
Maximum		**--**	**--**	**--**	**250[2]**	**0.2[1]**	**4[1]**	**6.5 - 8.5[2]**	**--**	**--**	**700[2]**	**250[2]**
SMW014	3/26/2015	13.3	0.01	29	7.5	0.0019 U	0.06 U	**6.29**	3.4	11	325	32
SMW014	6/25/2015	10.9	0.01	30.1	8.2	0.003 J	0.06 U	6.53	3.1	11	322	35.8
SMW014	9/25/2015	11	0.01	30.6	8	0.009	0.06 U	6.62	3.5	11.4	306	36.9
SMW014	12/1/2015	10.8	0.01	27.7	8.2	0.0049 U	0.06 U	**6.43**	2.9	10.6	272	35.9
SMW015	3/27/2015	20.4	0.02	29.1	15	0.0019 U	0.16	**6.02**	2.6	15.2	329	96
SMW015	6/27/2015	21.8	0.02	28.7	14.5	0.0019 U	0.02	7.68	1.7	14.8	347	93.2
SMW015	9/30/2015	21.7	0.02	28.5	13.5	0.006	0.10	7.33	1.7	15	332	92.5
SMW015	12/10/2015	18.8	0.016	25.8	14.5	0.0049 U	0.06 U	6.98	1.4	13.1	377	92.8
SMW019	3/25/2015	10.3	0.06	25.1	7.7	0.0019 U	0.06 U	7.2	4.7	11	312	40
SMW019	6/24/2015	13.5	0.01	23.2	7.5	0.003 J	0.06 U	8.03	4.6	11.1	311	34.8
SMW019	9/18/2015	10.9	0.04	21.8	7.1	0.004	0.06 U	6.82	8.8	35.9	310	36.5
SMW019	11/19/2015	9.8	0.015	22.9	7.8	0.0049 U	0.06 U	7.27	4.6	12.1	252	39
USMW013	3/26/2015	15.9	0.02	78.7	8.9	0.005	0.06 U	6.52	3.6	19.5	**714**	19
USMW013	6/24/2015	13.1	0.01	74.5	8.8	0.0019 U	0.06 U	6.89	3.3	18.6	**738**	17.2
USMW013	9/29/2015	12.6	0.01	76.8	8.3	0.0049 U	0.06	6.56	3.7	19.5	688	16.4
USMW013	12/1/2015	11.8	0.02	70.8	8.8	0.008	0.06 U	7.02	3.1	17.8	628	17.4

Notes:

[1] Primary MCL

[2] Secondary MCL

The drinking water standards per WAC 246-290-310 and groundwater quality standards per WAC 173-200.

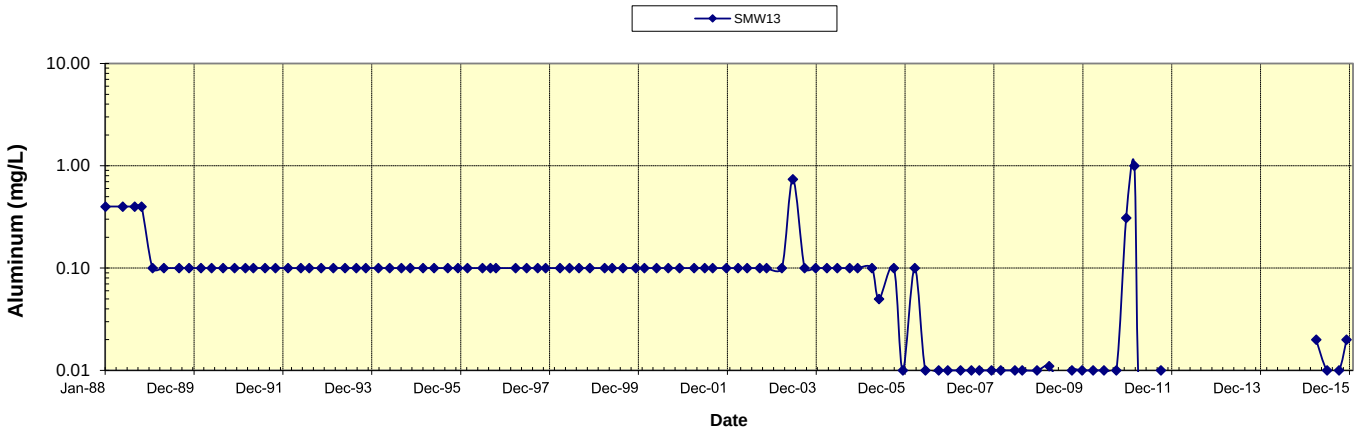
U - Analyte was not detected above the laboratory practical quantitation limit (PQL) or not above the Method Detection Limit (MDL).
The result is the method detection or other reporting limit

Shade/Bold = detected result exceeds MCL. For pH, detected results is outside of the secondary MCL limits between 6.5 to 8.5

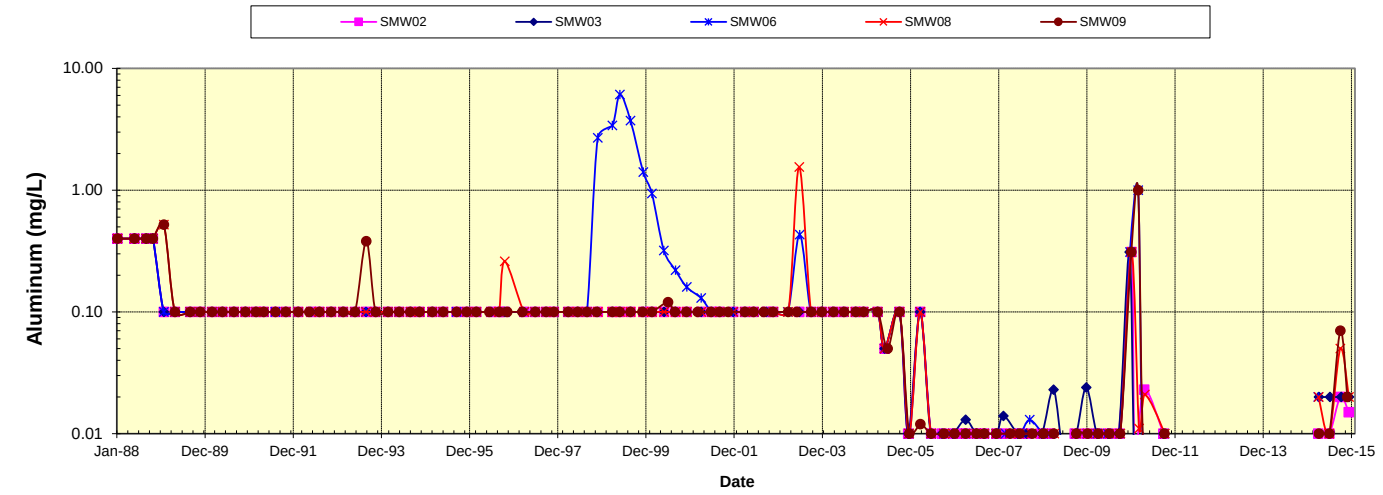
J - Indicates an estimated concentration. This occurs when an analyte concentration is below the calibration curve but is above the method detection limit.

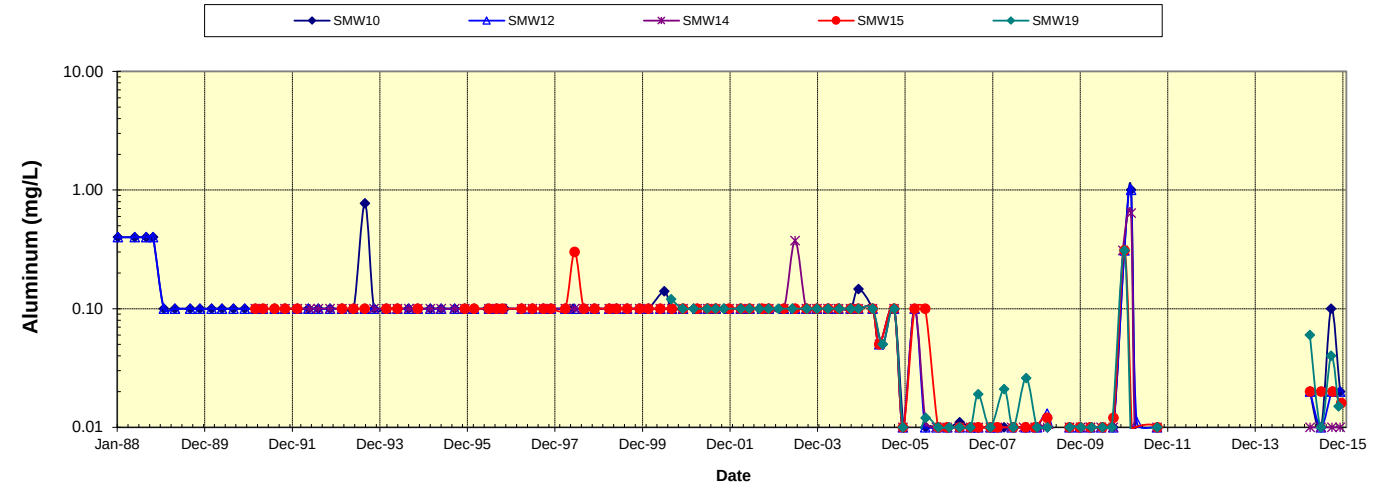
Appendix B
Time Series Plots
Quarterly Groundwater Sampling Results
From Earliest Sampling Date through December 2015

UPGRADIENT WELL:



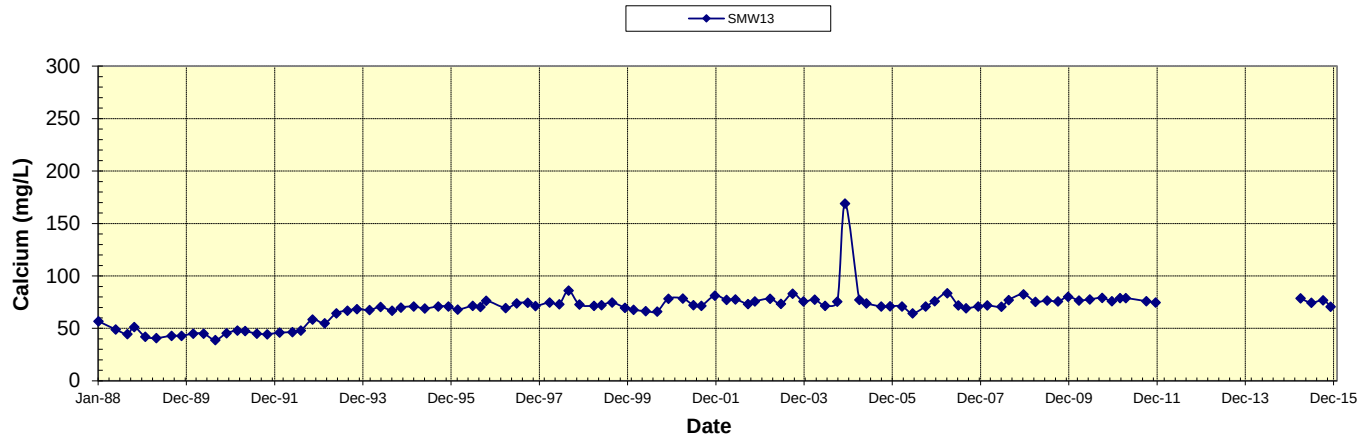
DOWNGRADIENT WELLS:



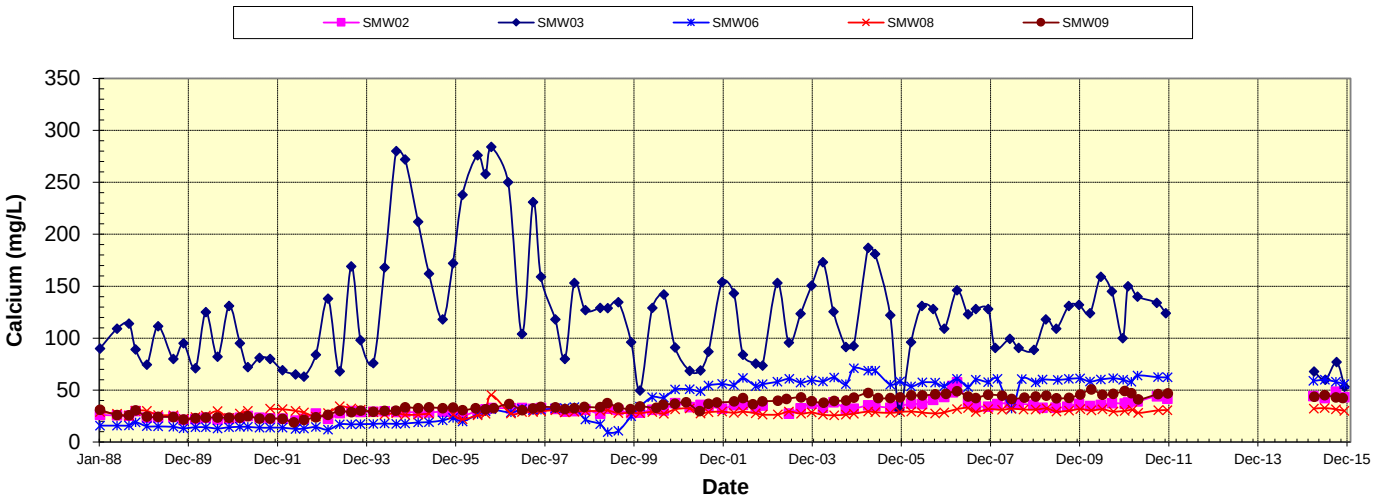


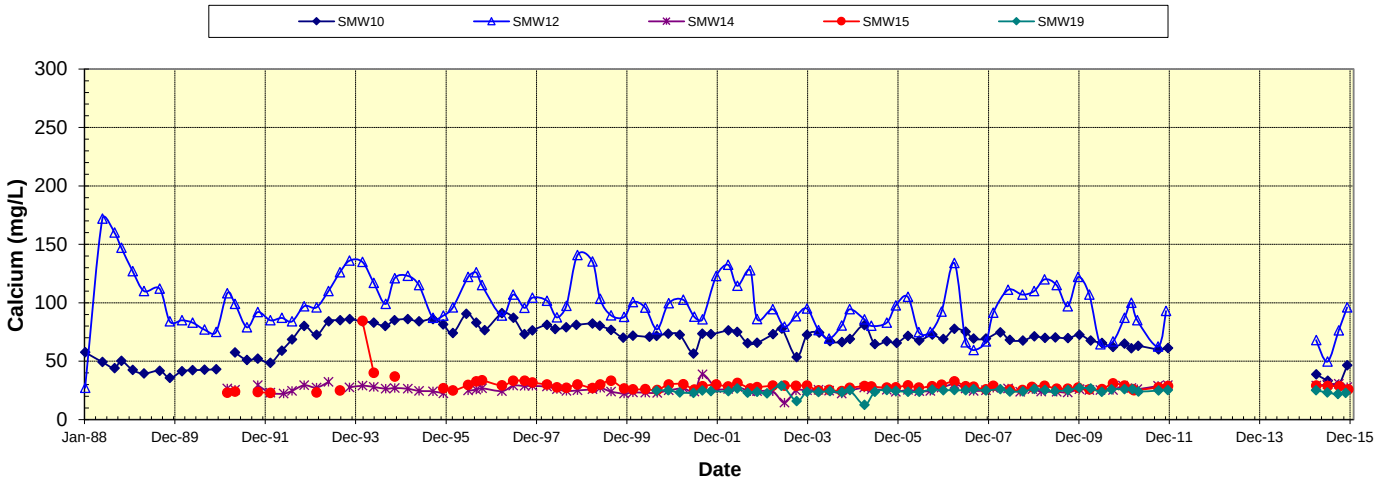
Time Series Plots
Aluminum (mg/L)

UPGRADIENT WELL:



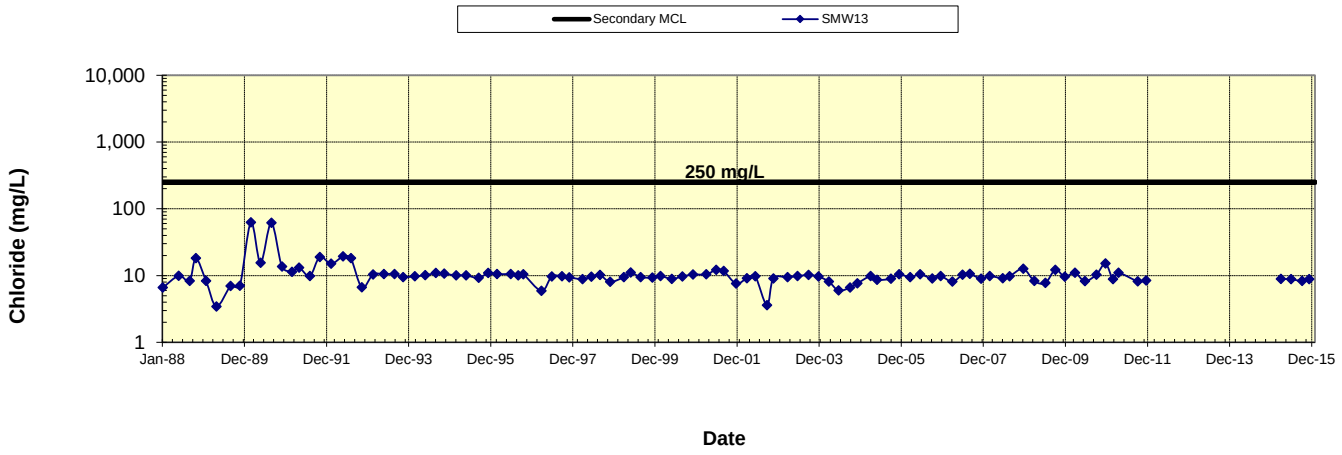
DOWNGRADIENT WELLS:



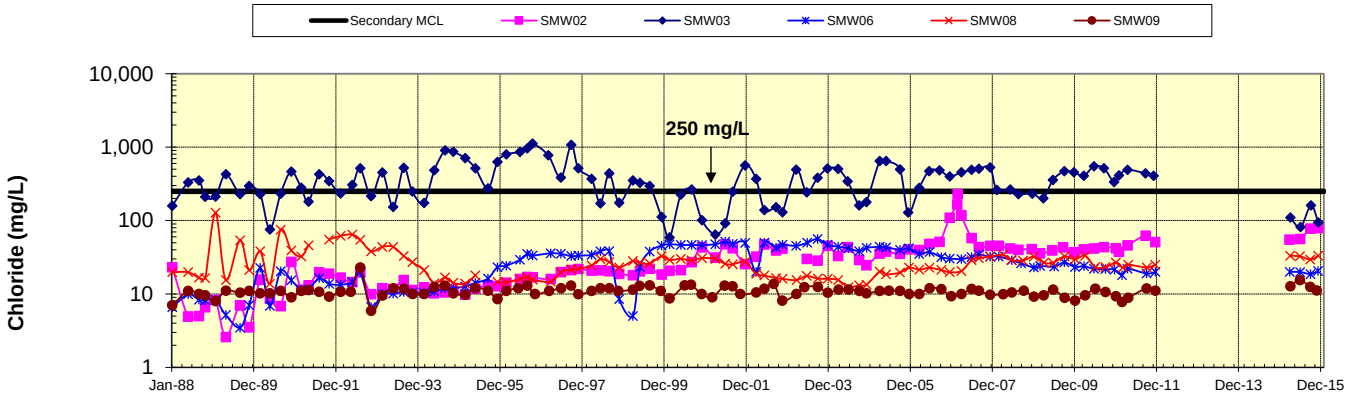


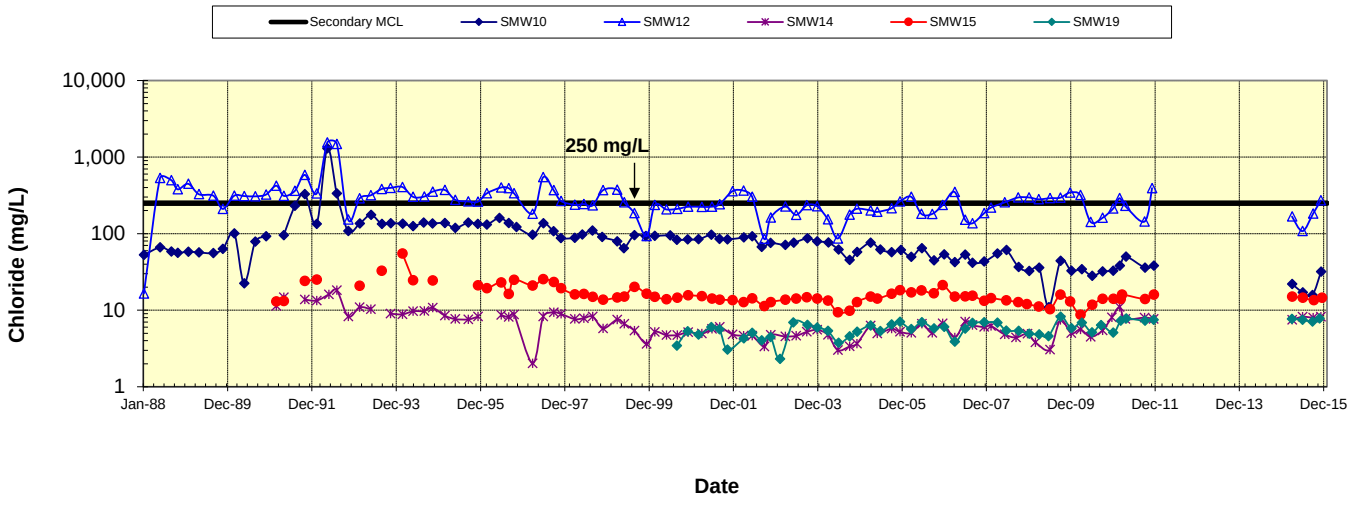
Time Series Plots
Calcium (mg/L)

UPGRADIENT WELL:



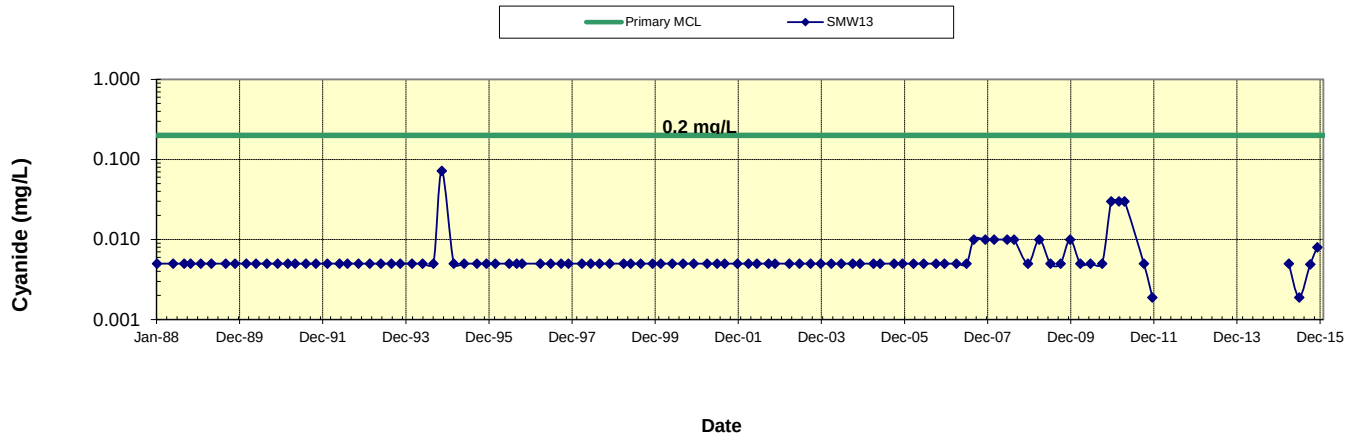
DOWNGRADIENT WELLS:



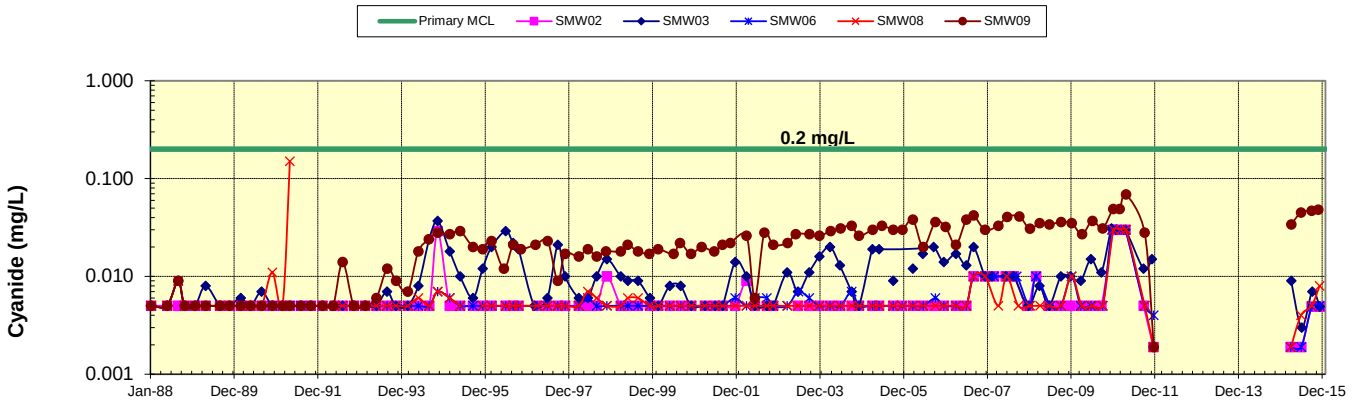


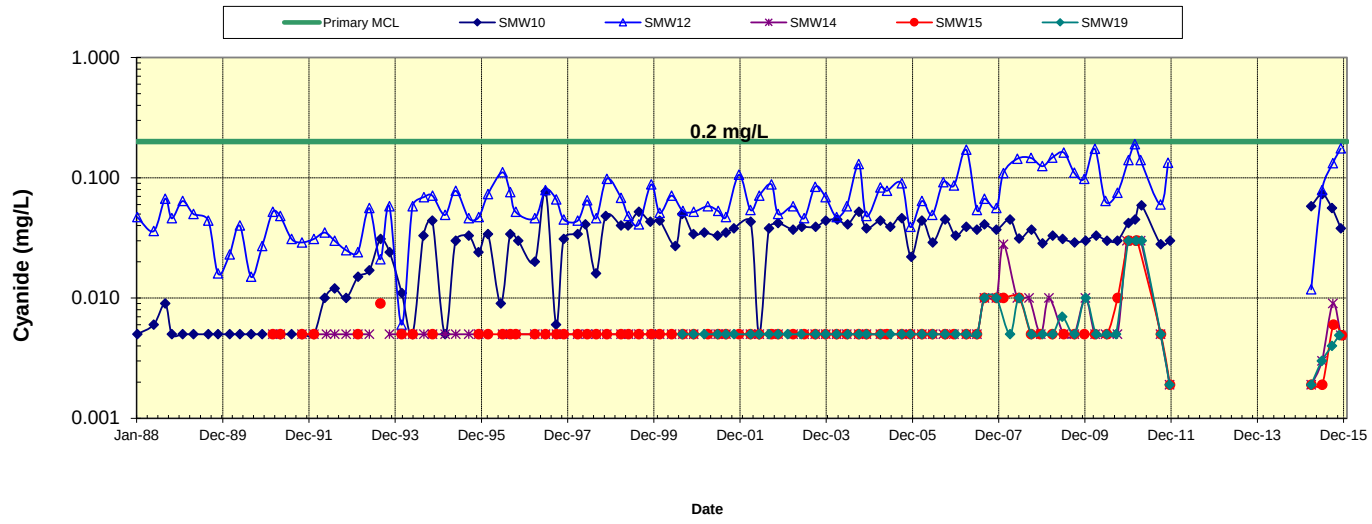
Time Series Plots
Chloride (mg/L)

UPGRADIENT WELL:



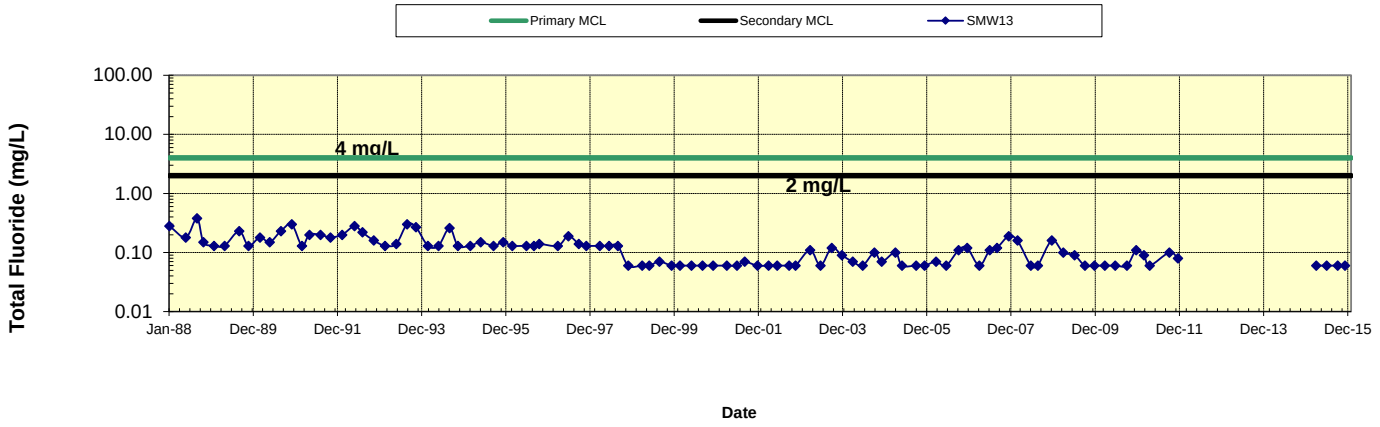
DOWNGRADIENT WELLS:



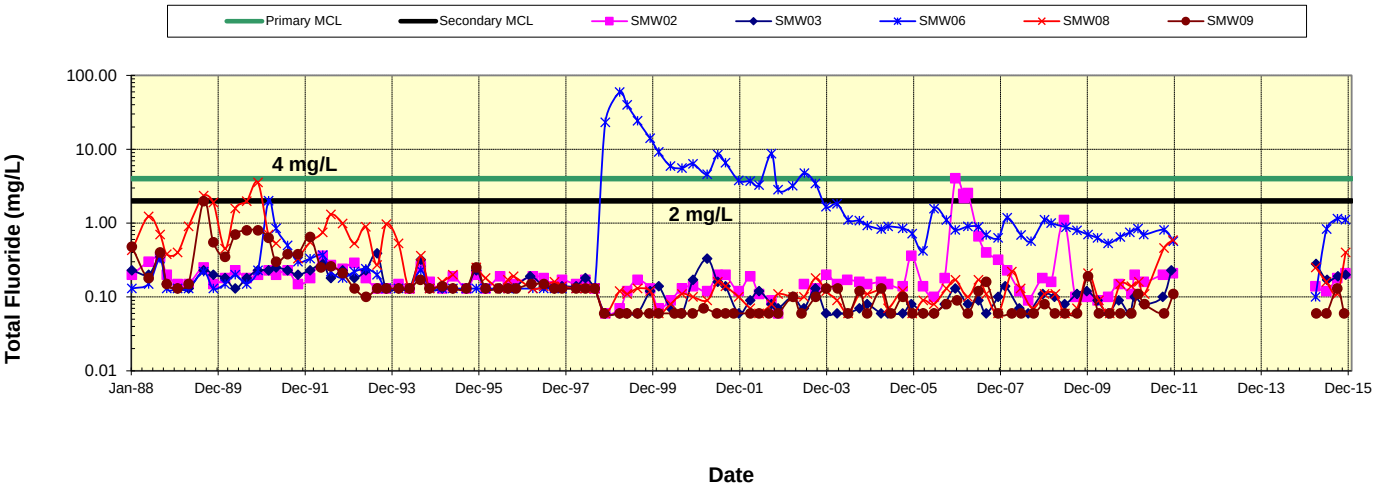


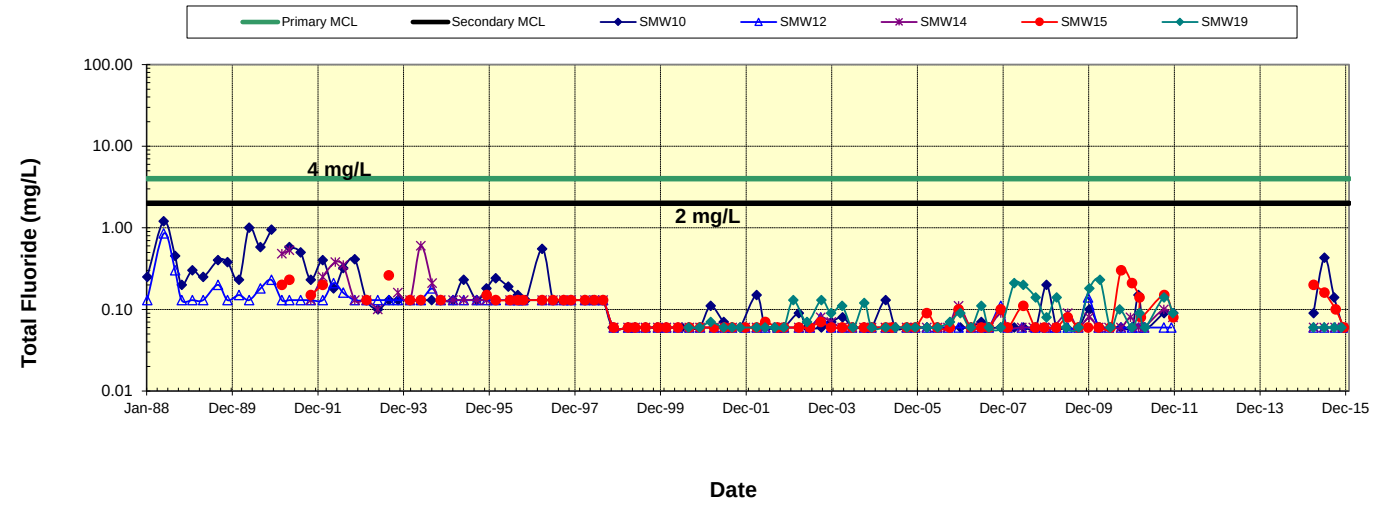
Time Series Plots
Cyanide (mg/L)

UPGRADIENT WELL:



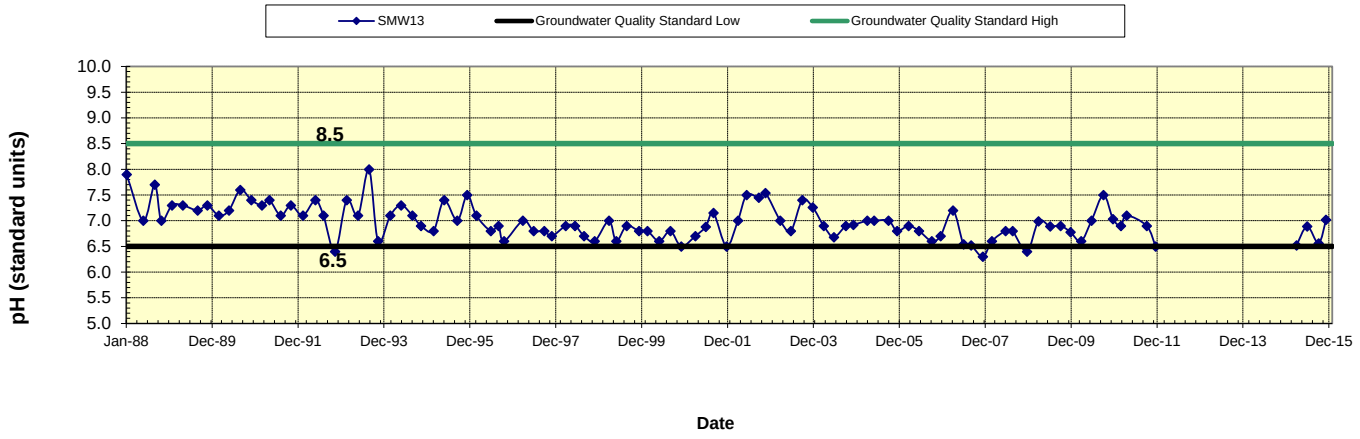
DOWNGRADIENT WELLS:



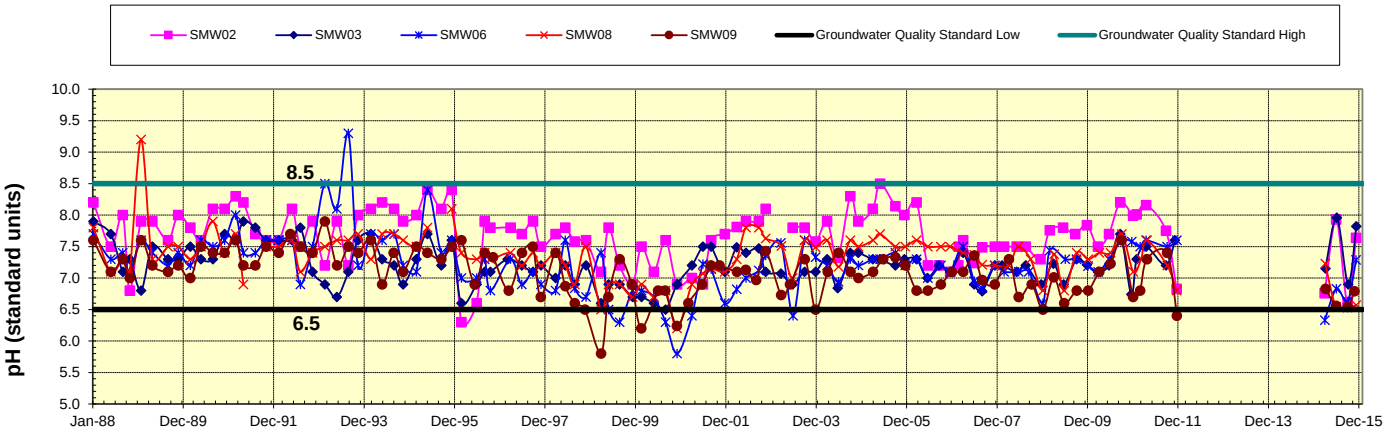


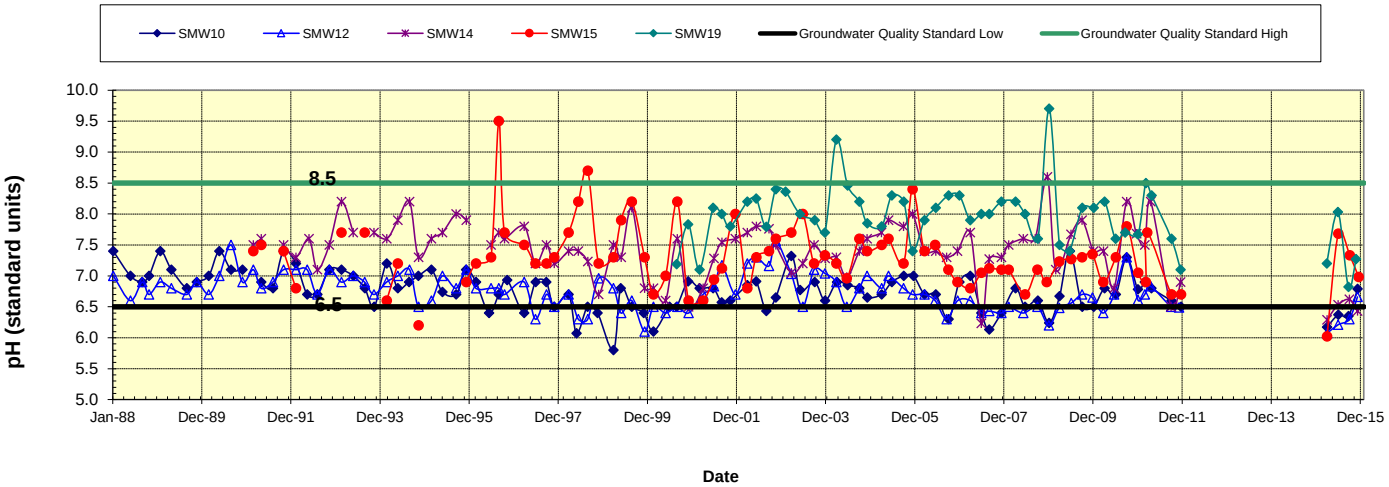
Time Series Plots
Fluoride (mg/L)

UPGRADIENT WELL:



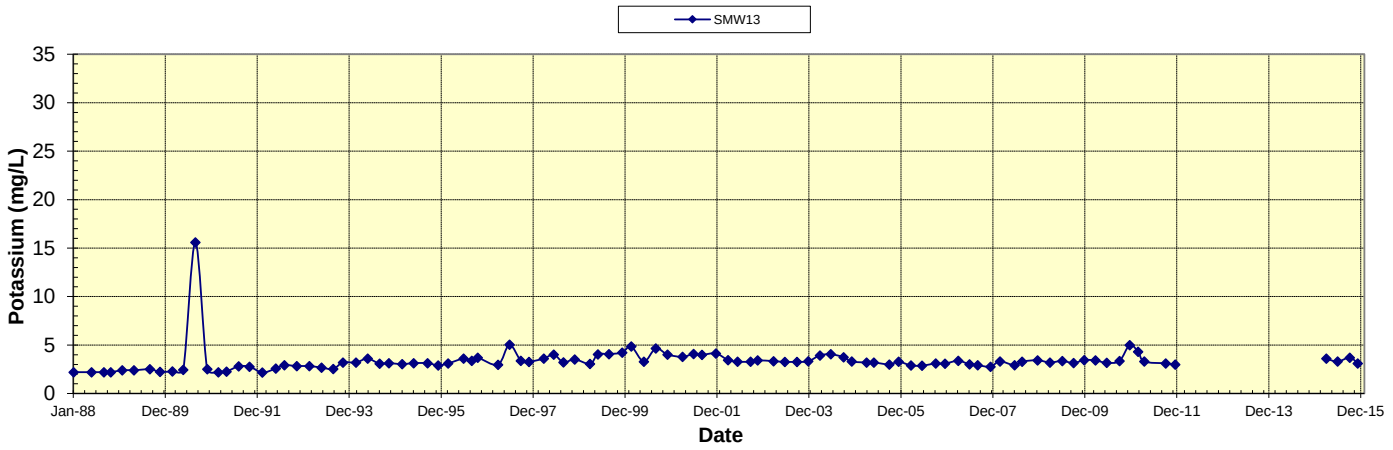
DOWNGRADIENT WELLS:



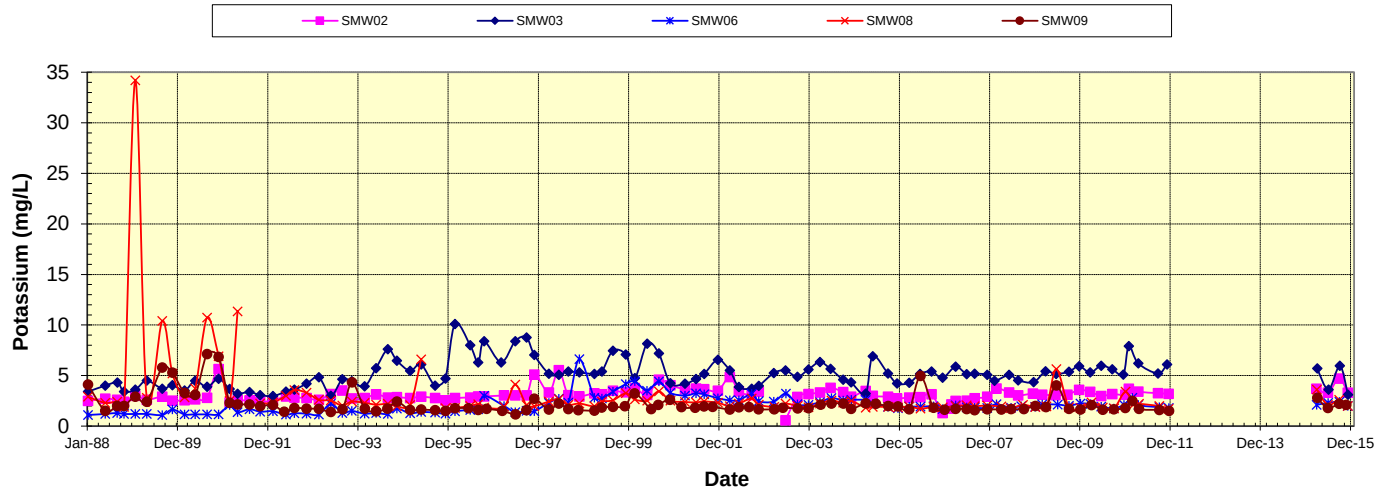


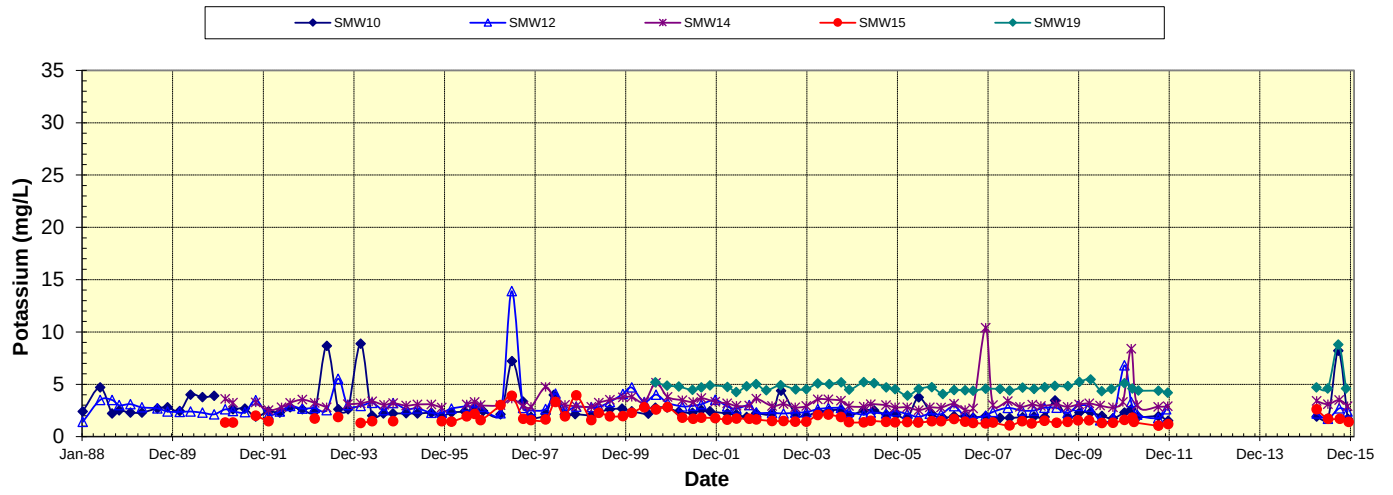
Time Series Plots
pH (Standard Units)

UPGRADIENT WELL:



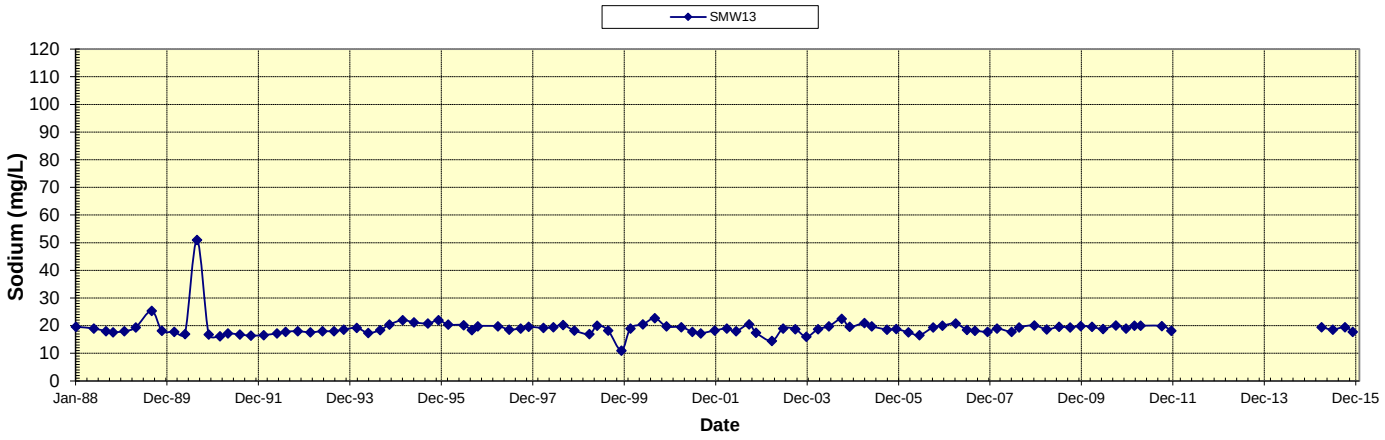
DOWNGRADIENT WELLS:



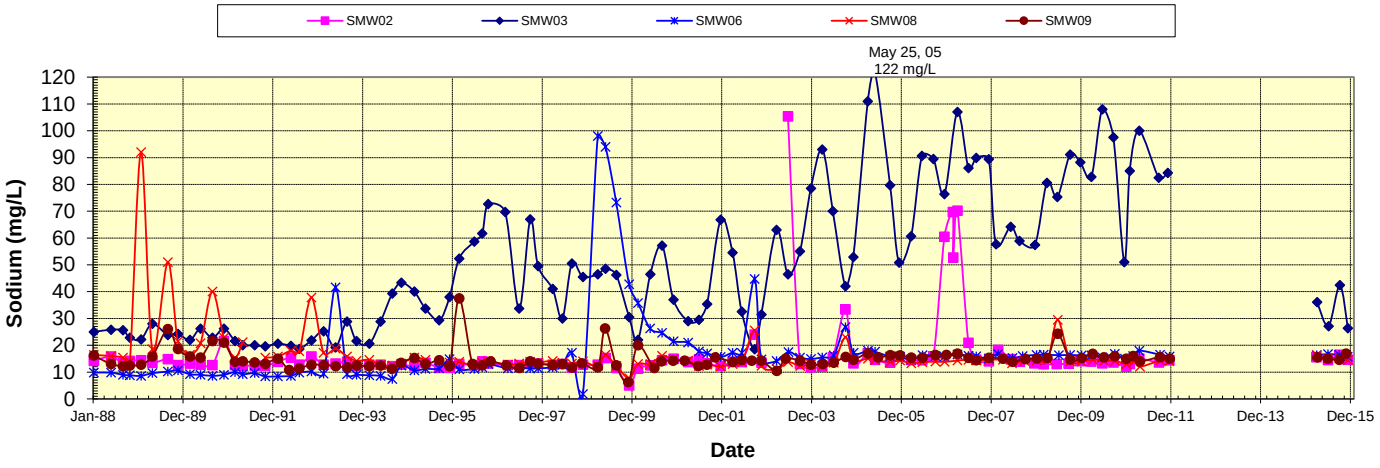


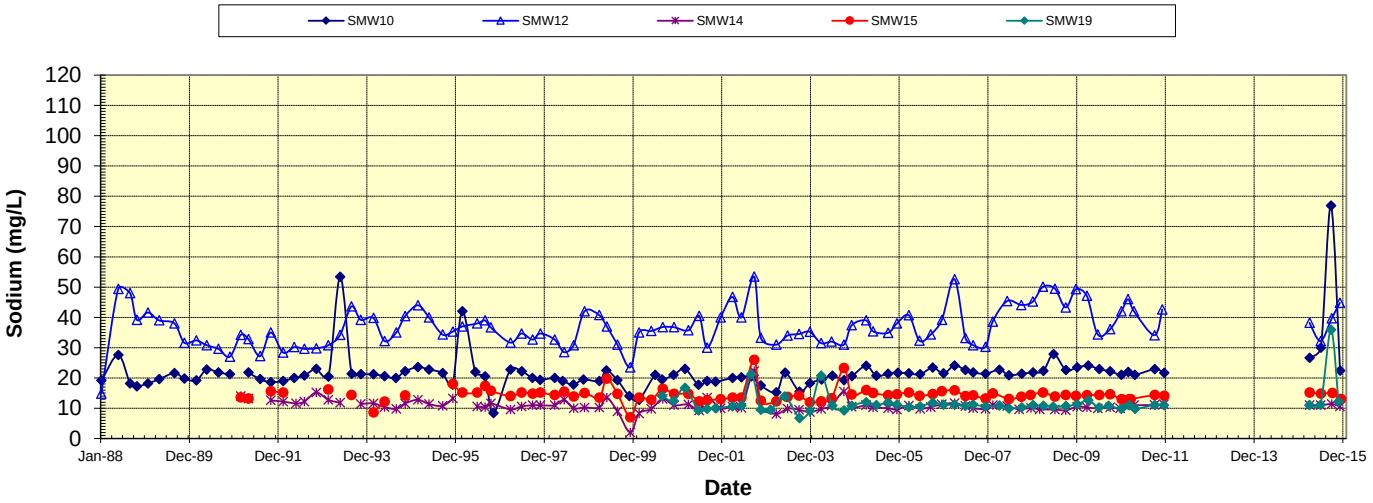
Time Series Plots
Potassium (mg/L)

UPGRADIENT WELL:



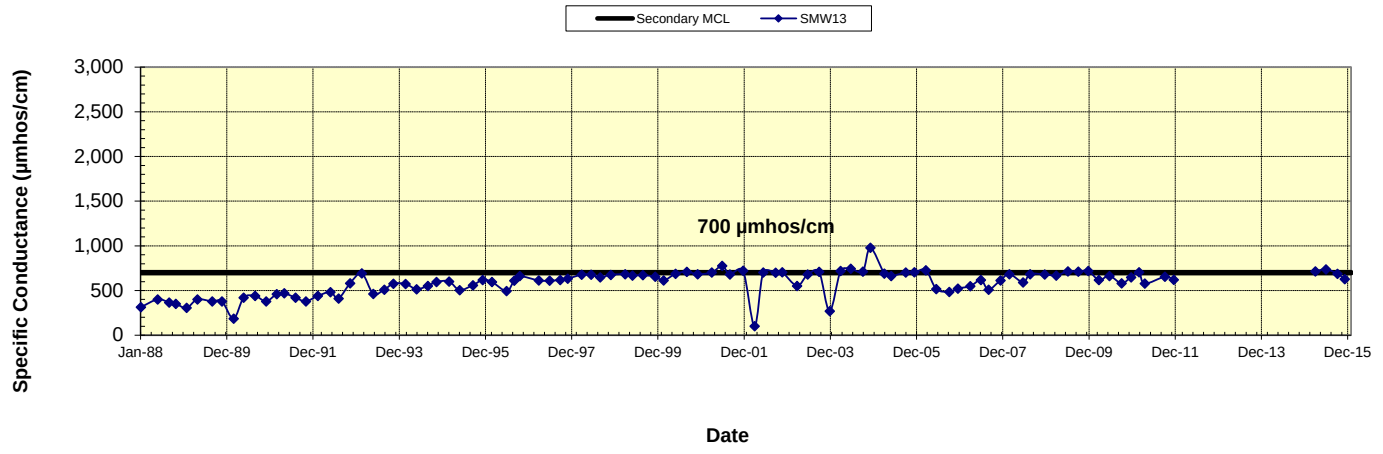
DOWNGRADIENT WELLS:



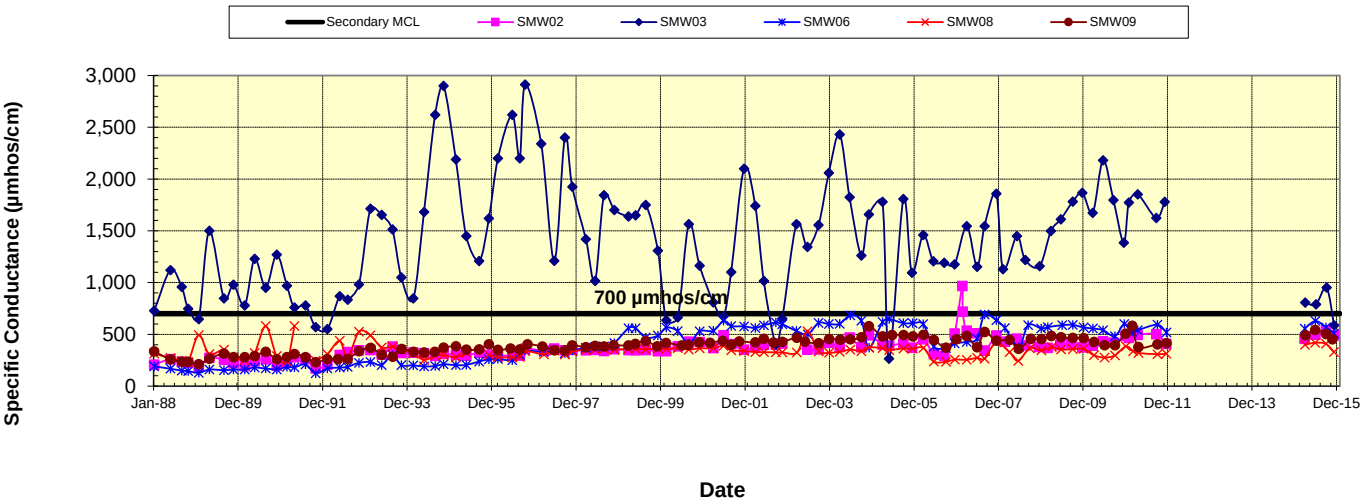


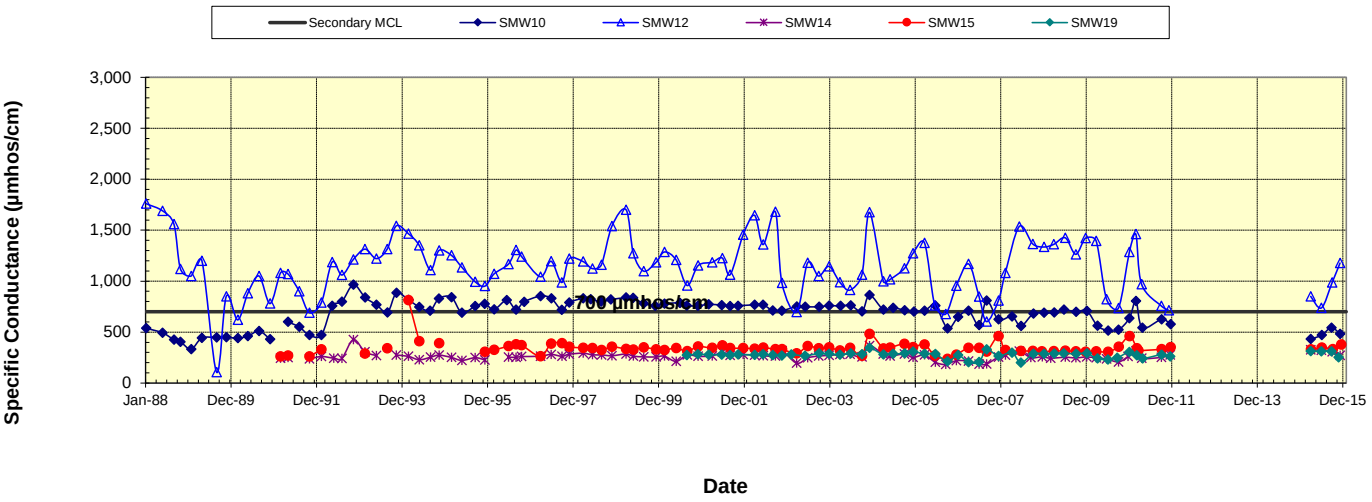
Time Series Plots
Sodium (mg/L)

UPGRADIENT WELL:



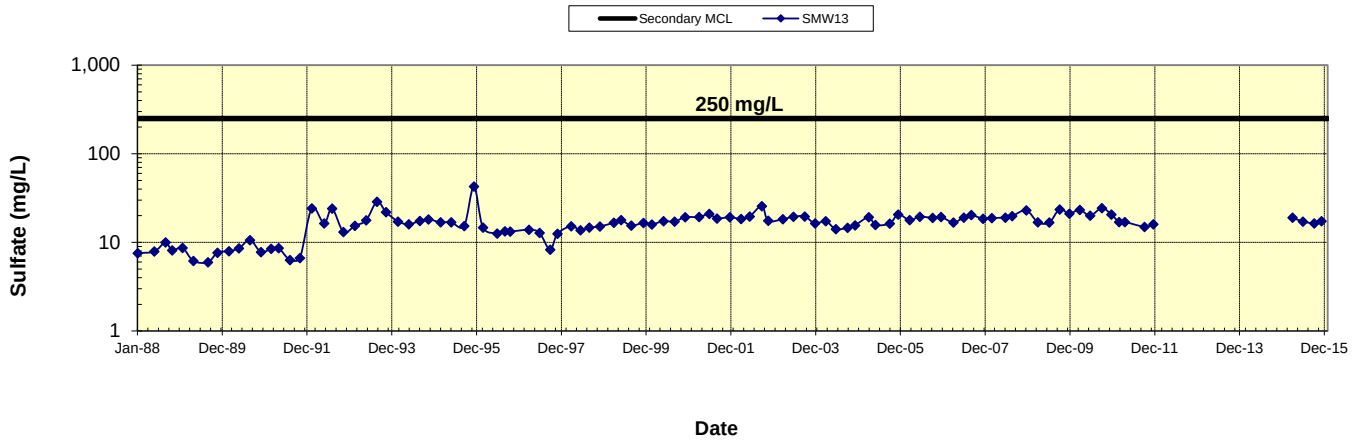
DOWNGRADIENT WELLS:



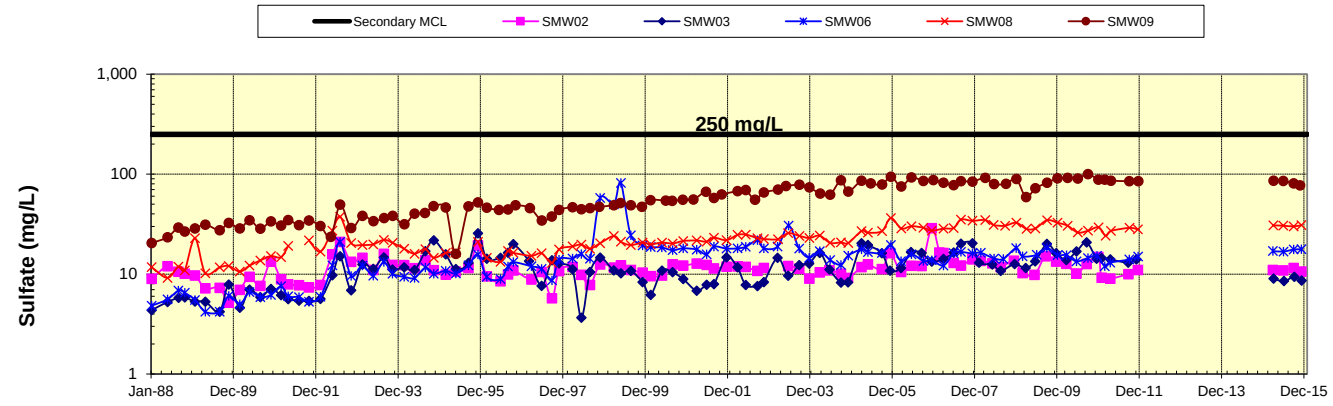


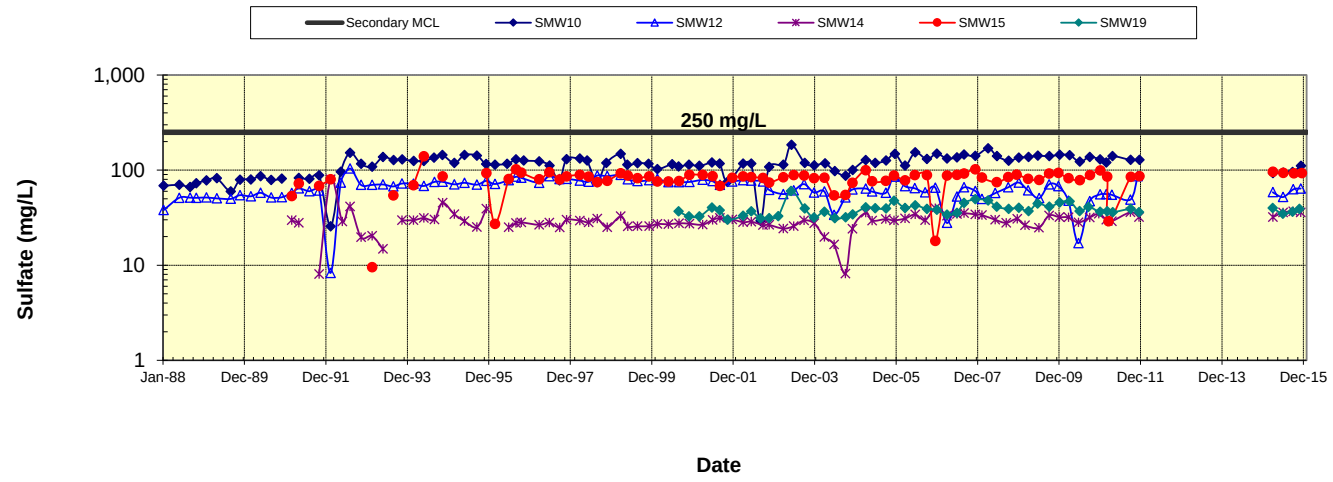
Time Series Plots
Specific Conductance (µmhos/cm)

UPGRADIENT WELL:



DOWNGRADIENT WELLS:





Time Series Plots
Sulfate (mg/L)

Appendix C
Leak Detection System Monitoring Results

WEST TRIPLE-LINED CELL LEAK DETECTOR PIPE
1st Quarter 2015 Through 4th Quarter 2015

Date Sampled	Temperature (oC)	Total Aluminum (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Total Cyanide (mg/L)		Total Fluoride (mg/L)	pH (Std. Units)	Potassium (mg/L)	Sodium (mg/L)	Specific Conductance (µmhos/cm)	Sulfate (mg/L)
24-Mar-15	12.6	0.55	39.9	1.6	0.0019	U	7.7	6.85	8.6	22.5	383	36
24-Jun-15	22.1	0.18	42.4	3.2	0.004	J	8	7.56	4.6	19.1	400	36.7
18-Sep-15	15.8	0.18	40.2	3.2	0.012		9.4	6.49	4.8	18.9	473	37.3
19-Nov-15	12.1	0.96	48.7	9	0.006		10.5	6.63	8.7	25	470	79.1

Notes:

U - Analyte was analyzed for, but not detected. The associated numerical value is at or below the laboratory practical quantitation limit (PQL) or the Method Detection Limit (MDL).

J - Indicates an estimated concentration. This occurs when an analyte concentration is below the calibration curve but is above the method detection limit.

EAST TRIPLE-LINED CELL LEAK DETECTOR PIPE
1st Quarter 2015 Through 4th Quarter 2015

Date Sampled	Temperature (oC)	Total Aluminum (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Total Cyanide (mg/L)	Total Fluoride (mg/L)	pH (Std. Units)	Potassium (mg/L)	Sodium (mg/L)	Specific Conductance (µmhos/cm)	Sulfate (mg/L)
24-Mar-15	dry - no sample										
24-Jun-15	dry - no sample										
18-Sep-15	dry - no sample										
19-Nov-15	dry - no sample										

LANDFILL PUMP STATION
1st Quarter 2015 Through 4th Quarter 2015

Date Sampled	Temperature (oC)	Total Aluminum (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Total Cyanide (mg/L)	Total Fluoride (mg/L)	pH (Std. Units)	Potassium (mg/L)	Sodium (mg/L)	Specific Conductance (µmhos/cm)	Sulfate (mg/L)
24-Mar-15	11.7	0.37	17	1,281	0.491	2,900	9.53	263.9	3,251	14,810	1,720
24-Jun-15	19.6	0.08	0.36 J	43	1.45	825	9.83	828.5	10,900	39,700	54.8
18-Sep-15	15.9	0.16	0.5	3,525	3.12	4,275	10	590	1,304	47,000	5,499
19-Nov-15	10.7	0.46	11.1	2,582	0.45	900	9.78	537	5,209	16,660	2,885

Notes:

J - Indicates an estimated concentration. This occurs when an analyte concentration is below the calibration curve but is above the method detection limit.

Appendix D
Groundwater Monitoring Network Documentation

One groundwater monitoring network encompasses the area covering the closed Double-lined Landfill and closed Triple-lined Landfill, as well as the closed unlined spent potliner landfill that was closed and capped in 1986. The network was designed, installed, and operated per the solid waste permit and regulations since 1988. Site characterization data and site groundwater monitoring system design data for the Intalco facility landfill area are presented in the following documents that have been prepared over time:

Site Characterization Data

Solid Waste Operating Permit Application (1986);
RCRA Part B Permit Application (1992);
Subpart F Waiver Application (1999);
Monitoring Wells SMW-18 and SMW-19 Installation Report (2000); and
Annual Groundwater Monitoring Reports 1999 to date.

Site Groundwater Monitoring System Design Data

Solid Waste Operating Permit Application (1986);
RCRA Part B Permit Application (1992);
Subpart F Waiver Application (1999);
Monitoring Wells SMW-18 and SMW-19 Installation Report (2000);
Ecology letter of March 5, 2002; and
Annual Groundwater Monitoring Reports 1999 to 2011.

Site Groundwater Monitoring Data and Analysis

Annual reports from 1989-2011; and
Post-closure Groundwater Monitoring Reports 2015 to date.