King County

Department of Natural Resources

Hobart Closed Landfill

2008 Annual Groundwater Data Evaluation Report

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King County Department of Natural Resources & Parks
Solid Waste Division, Engineering Services Section

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EXECUTIVE SUMMARY

This annual report presents the Hobart Landfill evaluation of groundwater quality and water level data collected from October 1986 through June 2008.

Groundwater investigations in the mid 1980s led to remediation design and installation of a bentonite slurry wall to isolate the shallow groundwater beneath the refuse from the aquifer present below the landfill. The groundwater beneath the site was pumped out and a lower water level inside the slurry wall has been maintained since 1989. Final closure of the north half of the landfill was completed in 1990 and of the south half in 1994, with the placement of a High Density Polyethylene (HDPE) cap, drainage layer, and vegetative layer over the refuse.

Groundwater quality and water level data were collected and reviewed to summarize and evaluate water quality in groundwater monitoring wells located at the Hobart Landfill. Water quality data includes samples collected from nine monitoring wells.

Water quality data were entered into the King County environmental database to assist with data evaluation. Subsequent statistical analyses were performed on the data to generate and evaluate water quality trends in individual wells and to compare these trends between wells and hydrogeologic units. The influence of groundwater remediation, completed in April 1989 (slurry wall and water level drawdown), has been considered in this data evaluation.

Groundwater flow beneath the landfill has been evaluated by a licensed hydrogeologist. The report is included as Appendix B. The groundwater beneath the landfill occurs in two aquifers, the shallow aquifer and the deep aquifer. In both zones, the water generally flows in a southwesterly direction.

During the current evaluation period, water quality continued to demonstrate the improvements that have been apparent since remediation and closure. The demonstrated quality improvements together with the maintained head differential across the slurry wall provide indications that the slurry wall is continuing to function as designed. Monitoring at the landfill will continue throughout the required post closure period.

Engineered controls at the landfill will continue to be maintained. These controls include the cover system, a landfill gas collection system, and a leachate extraction system. The water levels inside and outside the slurry wall are monitored monthly. The leachate extraction system will be reactivated if water levels rise above the levels outside of the slurry wall.

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CHAPTER 1

1.1. OBJECTIVES

The objectives of the Hobart Landfill groundwater quality evaluation are as follows:

- Assemble groundwater quality data from September 1986 through August 2008.
- Review data and perform statistical analyses to evaluate any water quality trends, and to compare water quality between monitoring wells.
- Compare water quality data with water quality standards in effect at the time of sampling. Document any exceedances of water quality standards.
- Determine whether impacts to groundwater quality recorded in monitoring wells can be attributed to the landfill.

1.2. SITE SUMMARY

Hobart Landfill is located on 276th Street Southeast, between the towns of Hobart and Ravensdale, about 25 miles southeast of Seattle (Figure 1). The landfill is owned by King County and was operated and is maintained by the King County Solid Waste Division (KCSWD). It occupies approximately 75 acres, of which about 35 acres have been used for refuse disposal.

Prior to the early 1950s, the Hobart Landfill site was utilized as a sand and gravel pit. Landfill activities began in the 1950s, with refuse being placed in the former sand and gravel pit. Open burning of refuse occurred until the early 1960s. From the early 1960s to 1990, refuse was placed in a controlled manner, including compaction and later placement of a daily cover.

A site characterization investigation in August 1983 included construction and sampling of four groundwater monitoring wells and characterization of surficial soils. Expanded site characterization investigations were performed between August 1985 and March 1986 and consisted of additional three wells installed in solid waste, and 22 wells installed in native soils surrounding the landfill. Quarterly groundwater monitoring is currently performed in nine wells, of which six are in the Shallow Aquifer and three are in the Deep Aquifer (Table 1.1). The landfill site map (Figure 2) shows the monitoring well locations.

Water quality impacts to the Shallow Aquifer were detected on site, triggering remedial activities in the Shallow Aquifer. Site remediation occurred during 1988 and 1989, including

construction of a low permeability soil and bentonite slurry cutoff wall around the landfill. Site remediation is further described in Section 1.2.2.

In 1990, an HDPE final cover with a gas collection system was installed over 14 acres of the solid waste at the northern half of the fill (Phase 1 closure).

In 1994, the remaining southern portion of the landfill was closed under the Phase 2 closure project. This included: construction of a final cover and landfill gas collection field over the south half of the landfill, modifications and repairs to the existing landfill gas flare system and utilization of existing infiltration basins for stormwater runoff.

1.2.1. GEOLOGY AND HYDROGEOLOGY

Hobart Landfill site characterization, including history, hydrogeology, and details regarding the slurry cutoff wall, has been documented in the reports listed in References. This section presents a summary.

The Hobart Landfill is located within the Puget Sound lowlands of western Washington. Geologic studies at the Hobart Landfill have identified four lithologic units at the site. These units are recessional outwash, glacial till, advance outwash, and older undifferentiated deposits (OUD). Figure 3 (Harding, 1992) is a north-south cross section depicting the occurrence and variations in thickness of these units at the landfill.

Two groundwater systems have been identified beneath the site: a local or Shallow Aquifer in the recessional and advance outwash deposits, and a regional or Deep Aquifer in the pre-Vashon deposits. Beneficial use of groundwater in the vicinity of the landfill is limited to domestic wells withdrawing from the deep aquifer.

Shallow Aquifer: The Shallow Aquifer occurs continuously below the landfill site in recessional and advance outwash deposits. The aquifer is perched and unconfined, ranges from 5 to 36 feet below ground surface and is between 35 and 50 feet thick. The perching layer is the highly oxidized, low hydraulic conductivity, upper surface of the OUD. Below the highly oxidized upper surface of the OUD, unsaturated conditions occur for over 70 feet before the Deep Aquifer is encountered. There are currently 12 monitoring wells installed in the Shallow Aquifer, of which six are monitored on a quarterly basis. The six wells were selected for representativeness and location. Two additional wells are used to measure water levels only.

Deep Aquifer: The Deep Aquifer occurs between 130 and 150 feet below ground surface (average groundwater elevation of 510-feet msl). The aquifer occurs in the pre-Vashon sand and gravel deposits and appears to be unconfined. There are currently three monitoring wells installed in the Deep Aquifer, one up-gradient (MW-25), and two down-gradient (MW-3 and MW-7). MW-9 was decommissioned in 2001 after it was damaged in the Nisqually earthquake. MW-25 was installed at that time to provide upgradient monitoring. The Deep Aquifer is believed to discharge to the Cedar River located southwest of the site.

1.2.2. SITE REMEDIATION

A low permeability bentonite slurry wall was installed in 1989 around the refuse and keyed into the Shallow Aquifer perching unit. Three extraction wells were installed in the Shallow Aquifer beneath the refuse. Groundwater extraction commenced from the Shallow Aquifer within the slurry wall to reduce hydraulic heads 10 to 20 feet below those immediately outside of the slurry wall and maintain an inward hydraulic gradient. This maintains the water table surface below the level of deposited waste and maintains an inward hydraulic gradient around the site minimizing the potential for migration of contaminants.

The Walsh Lake Diversion Ditch, flowing upgradient of the landfill, was lined in selected areas around the same time that the slurry wall was constructed to reduce Shallow Aquifer recharge and thereby reduce hydraulic head in the vicinity of the solid waste.

After the 1994 final closure, the infiltration through refuse has been sufficiently reduced such that extraction is no longer necessary. The water levels on the interior of the slurry wall are monitored monthly together with four selected monitoring wells outside of the slurry wall. A comparison of these water levels monthly provides verification that water levels inside the slurry wall remain well below outside levels, insuring that the slurry wall and impermeable cap are functioning properly.

Figure 4 shows the historical levels of hydraulic head in monitoring wells located outside the slurry wall and water level measurements obtained inside the slurry wall.

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CHAPTER 2

DATA EVALUATION

2.1 GROUNDWATER ELEVATIONS AND FLOW DIRECTION

Groundwater levels in individual wells have been plotted as a function of time (Figures 5 & 6). Groundwater flow directions were estimated based on water elevations recorded in monitoring wells screened in similar water-bearing zones (Appendix B). Upgradient and downgradient wells are determined by flow direction.

Shallow Aquifer: Piezometric flow maps, based on water levels recorded in the on-site monitoring wells, indicate a general aquifer flow to the southwest (Appendix B). The slurry wall is constructed of low permeability materials that prevent inward flow. The measured water levels for wells outside the slurry wall and piezometers inside the slurry wall are shown in Figure 4. Up to 8 feet of variation in water level measurements have been observed for individual wells (Figure 5).

Deep Aquifer: Piezometric surface maps (Appendix B) based on the three monitoring wells indicate a westerly to southwesterly hydraulic flow direction depending on the season. A seasonal water level fluctuation up to 6 feet has been recorded in the three on-site monitoring wells. Water level fluctuation in these wells has lagged behind that of the shallow wells by about one month (Figure 6).

2.2 DATA EVALUATION METHODS

The King County Solid Waste Division (KCSWD) assembled the analyte list from parameters listed in WAC 173-200 Ground Water Criteria, WAC 173-351-990 Appendices I and II and 40 CFR 141 and 143, National Primary and Secondary Drinking Water Standards. Some of these analytes are useful in characterizing groundwater quality, as indicators of impacts to groundwater from landfill gas and leachate, or in screening for potentially harmful effects to human health and the environment. It is these analytes that the data evaluation focuses on.

Environmental samples are collected, analyzed and evaluated by the procedures described in the Environmental Monitoring Quality Assurance Project Plan and Sampling Analysis Plan for Cedar Falls, Enumclaw and Hobart Closed Landfills (QAPP/SAP). The QAPP/SAP describes activities undertaken to ensure analytical results meet data quality objectives and that they are representative of actual groundwater conditions. For this report, the graphical representation includes those parameters that have exceeded regulatory limits or/and have a visual trend. The water quality discussion is focused on exceedances, trend table, graphs, and potentiometric maps.

2.3 GROUNDWATER CHEMISTRY RESULTS

This section presents results and interpretation of water chemistry evaluations performed for each groundwater monitoring well at the Hobart Landfill. The results are presented according to aquifer and location relative to the principal groundwater flow direction. Discussion emphasis is on results obtained since the last groundwater evaluation report and mid 2008. Statistical comparisons have been compiled for three time periods: prior to slurry wall construction (October 1986 to April 1989), post slurry wall construction (April 1989 to early, 2006), and the current reporting period (mid 2006 to mid 2008).

Exceedances of primary and secondary drinking water standards (DWS) as well as exceedances of water quality criteria (WQC), which have occurred during this reporting period (the last eight samples), are listed in Table 2-1. Descriptive Statistical and Trend Tables of field and analytical data are presented in Appendix C for the shallow and deep aquifer. Graphical representations of parameters with exceedances and/or have visual trends are presented in Appendices D and E. Raw data are contained in Appendix F.

The results are used collectively to indicate the possibility of groundwater contamination. Corroboration by several indicators is necessary before impacts from landfill operations can be considered a reasonable conclusion.

2.3.1 SHALLOW AQUIFER MONITORING WELL RESULTS

Quarterly groundwater monitoring has been performed by KCSWD in six wells since 1986. Field and laboratory analysis results are discussed in this section. Wells are located north, south, and west of the landfill (Figure 2).

MW-11

MW-11 is located near the northeast corner of the site. It is also located near the Walsh Lake Diversion ditch, which may be a source of recharge to the Shallow Aquifer. This well was installed as an upgradient monitoring well for the shallow water bearing zone (see Figure 2).

Data collected from MW-11 indicate that slightly acidic conditions prevail with consistent exceedances of the field pH lower standard limit. Specific conductance, total dissolved solids, alkalinity, chloride, sulfate, nitrate, ammonia, iron, and manganese are low and relatively stable. There are no short term trends in any monitored parameters.

MW-11 has no detections of volatile compounds in recent sampling events.

Showing no signs of impacts, MW-11 is a good representation of ambient groundwater quality upgradient of the landfill and is an adequate upgradient monitoring well.

MW-1, MW-4, MW-6, MW-10, & MW-18

MW-6 is located in the southeast corner of the site and is located side gradient to the landfill. MW-1 is located near the southern boundary of the site. MW-10 is located southwest of the landfill while MW-18 and MW-4 are located west (see Figure 2). Piezometric head data indicate these last four wells are hydraulically downgradient of the landfill.

The water in these five wells tends to be slightly acidic to neutral. Chloride concentrations have decreased and stabilized at levels similar to upgradient conditions. Most of the wells exhibit long term decreasing trends for specific conductance, alkalinity, sulfate, iron, manganese, calcium, magnesium, potassium and sodium. With the exception of MW-4, nitrate is at lower magnitude in concentration and detection frequency in these wells compared to conditions in MW-11.

In general, water samples from MW-1, MW-6 and MW-10 have relatively higher levels of specific conductance, total dissolved solids, sulfate, alkalinity, calcium, iron, and manganese than upgradient groundwater. However, most of these parameters have long term decreasing trends. MW-18 has short term statistically significant decreasing trends for total dissolved solids and calcium. No other short term trends are evident in the current sampling period.

MW-4 and MW-18 parameter concentrations have declined and stabilized at levels similar to those upgradient for most parameters. The water quality conditions found in MW-4 are nearly identical to those at MW-11 and indicate no remaining impacts from landfilling activities.

The only volatile organic compounds detected in shallow wells for the current evaluation period are benzene in MW-10 and carbon disulfide in MW-4. Benzene has been detected in MW-10 seven times since mid 1992 at concentrations below the WQC of 1 ug/L, and was last detected in May of 1996. Carbon disulfide is an analyte occasionally detected in samples and blanks, believed to be an artifact of laboratory instrument operating parameters and as such, is not indicative of groundwater quality.

Primary Drinking Water Standards (DWS) are exceeded for field pH in all wells except MW-6. Arsenic was exceeded in all MW-10 samples. Iron regularly exceeded in MW-1 and MW-10, and once in MW-6. Manganese exceeded DWS in all samples from MW-1, MW-10, and MW-18. No other DWS and WQC are exceeded during this period.

2.3.2 DEEP AQUIFER MONITORING WELL RESULTS

Quarterly groundwater monitoring has been performed by KCSWD in three wells since 1986. Field and laboratory analysis results are discussed in this section. Wells are located north, south, and west of the landfill (Figure 2).

MW-25

MW-25 is located north and, based on piezometric head data, is hydraulically upgradient of the site. This well was installed in 2001 to replace MW-9, which was damaged in the Nisqually earthquake.

Water in MW-25 is slightly alkaline and has a statistically significant decreasing short term trend for field pH. Specific conductance, total dissolved solids, alkalinity, chloride, sulfate, and iron levels are low and stable. Nitrate and arsenic are regularly detected in MW-25.

Arsenic has exceeded the Water Quality Criteria in all recent samples. No other DWS or WQC are exceeded.

No volatile organic compounds are detected during the current evaluation period.

The conditions found in MW-25 are considered representative of background water quality in the deep water bearing.

MW-7 & MW-3

MW-7 is located south and MW-3 is located west of the landfill. Based on piezometric head data these two wells are hydraulically down gradient of the site.

Water in MW-7 and MW-3 varies from neutral to slightly alkaline. Specific conductance, total dissolved solids, alkalinity, chloride, sulfate, calcium, magnesium, potassium, sodium and iron levels in MW-7 are higher than those in upgradient well MW-25. However, most of these parameters have significant long term decreasing trends except for sulfate and iron which are increasing long term.

In MW-3, significant increasing long term trends are detected for specific conductance, alkalinity, ammonia, chloride and calcium. Concentrations of these parameters remain relatively low, much closer to upgradient (MW-25) levels than to downgradient well MW-7. Short term, only alkalinity has an increasing trend. These increases, while statistically significant, are generally within the limits of analytical variability. Appropriate monitoring will continue in MW-3.

Arsenic is undetected for this period in both wells.

The only volatile organic compound detected downgradient is 1,1-Dichloroethane in MW-7 . This compound, previously detected regularly at low concentrations (no detections since August of 2005) has a long term decreasing trend.

2.3.3 SHALLOW AQUIFER REMEDIATION

The slurry wall containment isolates the Shallow Aquifer beneath the landfill from the local groundwater flow system. Pumping wells installed beneath the solid waste and inside the slurry wall have lowered the groundwater table below the base of refuse. The water elevation outside of the slurry wall has remained consistently above the water elevation inside (See Figure 4). As a result, an inward hydraulic gradient has been created resulting in a system which reduces the possibility of breakthrough of contaminants and off-site transport.

Concurrent with the construction of the slurry wall, the northern half of the landfill was closed with an HDPE final cover. The southern half was later closed in 1994. Consequently, local recharge to the aquifer has been reduced.

Six indicators have been used to evaluate the site remediation: chloride, arsenic, manganese, cis-1,2-Dichloroethene, 1,1-Dichloroethane, and 1,1,1-Trichloroethane. Chloride and manganese are both early indicators of leachate, but their movement through groundwater is controlled by different chemical processes. Chloride migration is not retarded by such processes as adsorption, cation exchange, biological uptake or redox processes. The distribution of manganese, however, is strongly controlled by redox processes. Reducing conditions permit manganese to dissolve and be transported in groundwater. One way that reducing conditions can occur in a leachate plume is when oxygen is depleted by bacteria which are feeding on organic compounds in the plume. Thus, manganese may be an indicator of the migration of organic compounds.

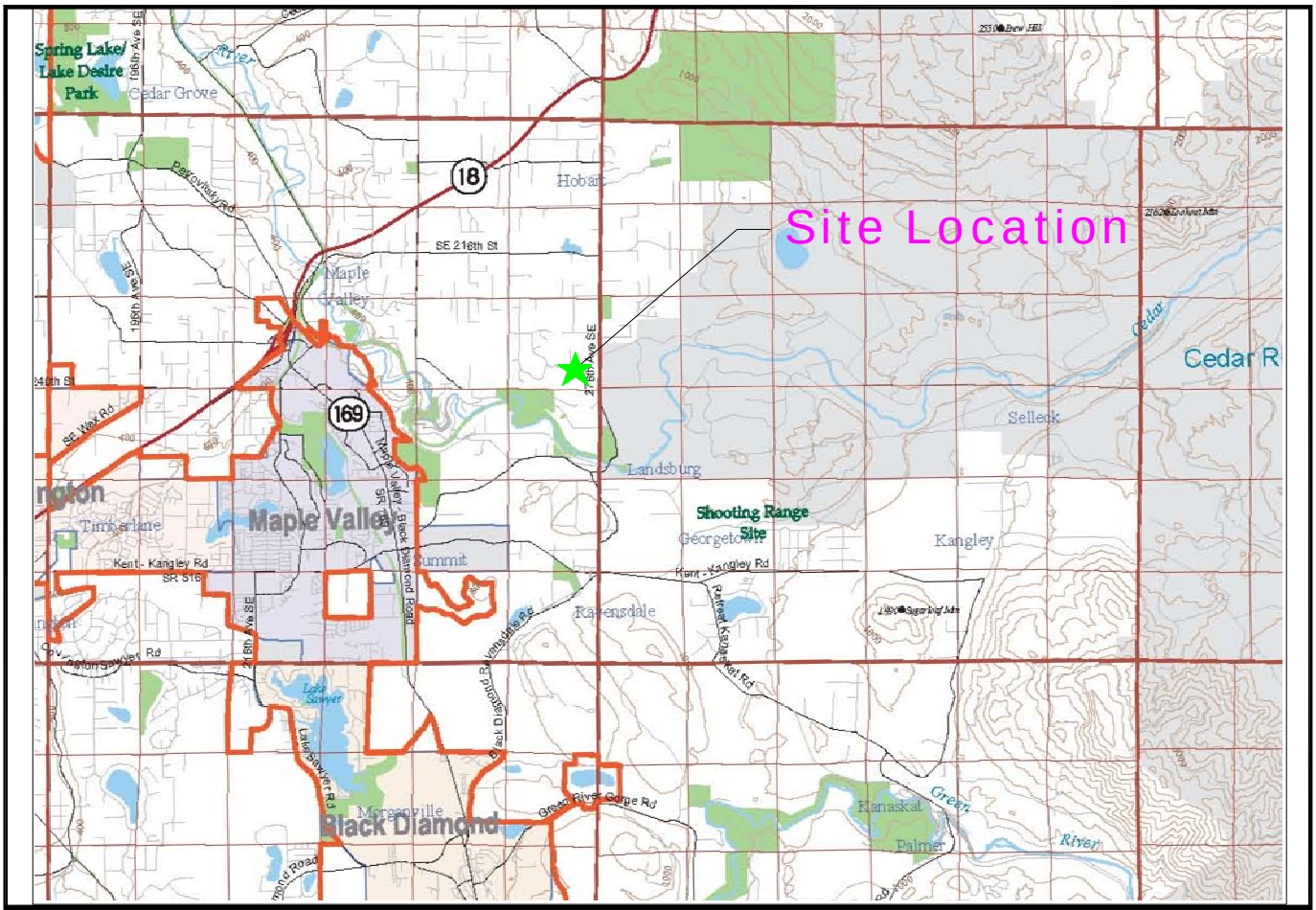
Chloride in all of the down and side gradient wells has been reduced to levels found in MW-11. Manganese levels have been reduced in all wells, but remain elevated relative to MW-11 in MW-1, MW-10 and MW-18.

Arsenic has been detected in 2 of 6 wells in the shallow aquifer. The highest median concentration was found in MW-10 at 0.007 mg/L, which is within the general range expected in this geologic area and is below the MCL of 0.010 mg/L.

Organic compounds have been detected with relatively low frequency and at low level both prior to and since construction of the slurry wall. The concentration levels for cis-1,2-dichloroethene, 1,1 dichloroethane, and 1,1,1-trichloroethane have been used to evaluate the success of remediation indicated by their decrease over time. Wells screened in the shallow aquifer have no continuing organic compound detections in recent sampling events (see Section 2.31. discussion).

A summary of the performance of the slurry wall and drawdown wells showing water quality prior to remediation and after remediation are presented in Table 2-2.

This water quality evaluation in conjunction with water level data shown in the potentiometric mapping and the trend analyses demonstrates that the slurry wall is functioning as designed. It is maintaining groundwater elevation separation below the waste and preventing groundwater migration within the wall perimeter.



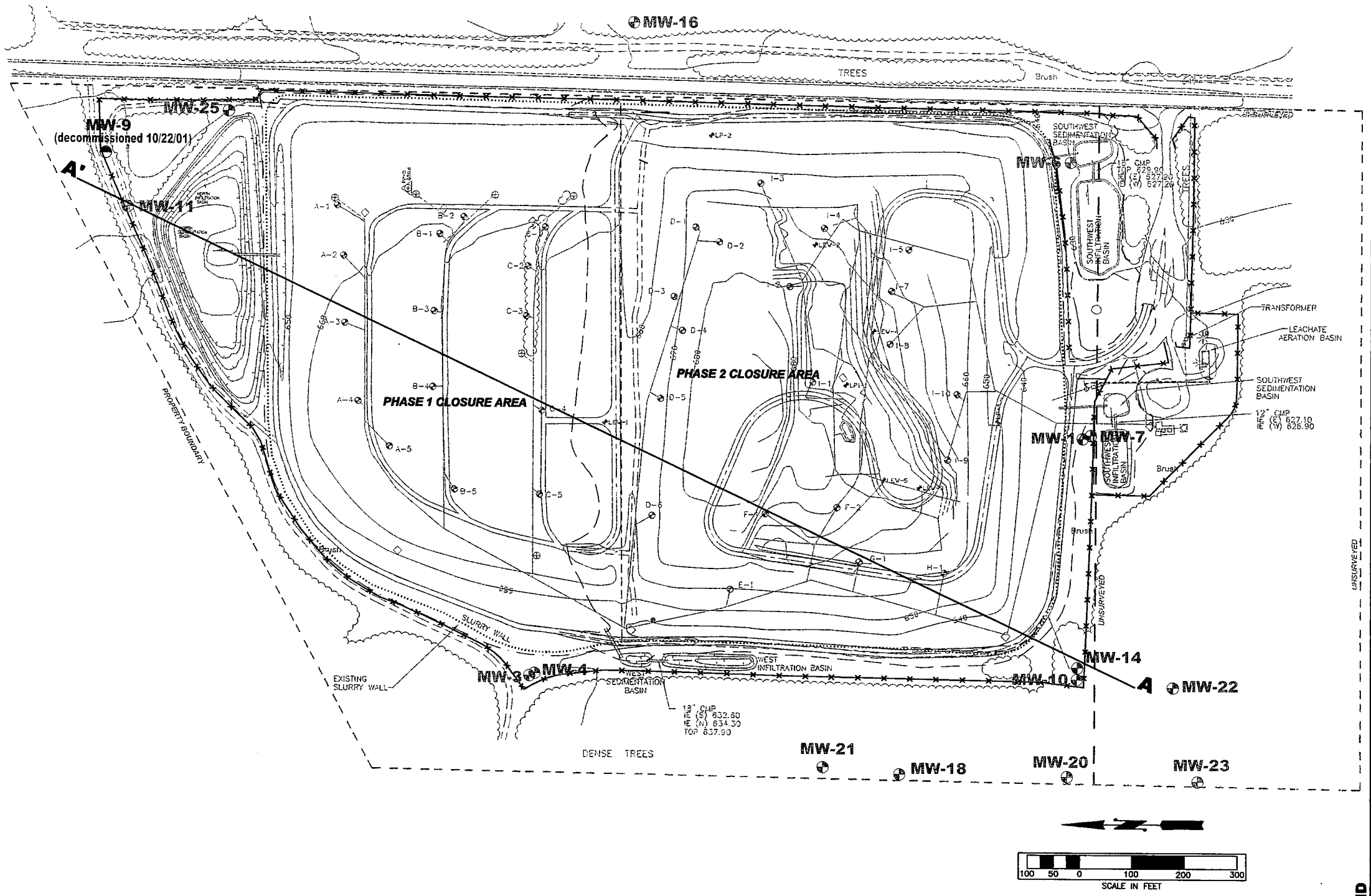
KING COUNTY

Dept. of Natural Resources & Parks
Solid Waste Division
Hobart Landfill

Project Location Map

Hobart Landfill
King County, Washington

Dec. 2004	PROJECT NO.
DESIGNED BY: IM	
DRAWN BY: GU	FIGURE NO.
REVISED BY: IM	1



Topography prepared by *DEGROSS AERIAL MAPPING* from photogrammetric methods (11-23-92)
Topography updated by *Einconi Northwest Inc.* (04-20-94)

LEGEND

MW-9 Monitoring Well

MW-8 Decommissioned Monitoring Well

PROJECT NO. 010099

FIGURE NO. 2

SITE MAP
Hobart Landfill
Hobart, Washington

King County Solid Waste Division

DATE:

DESIGNED/DWN:

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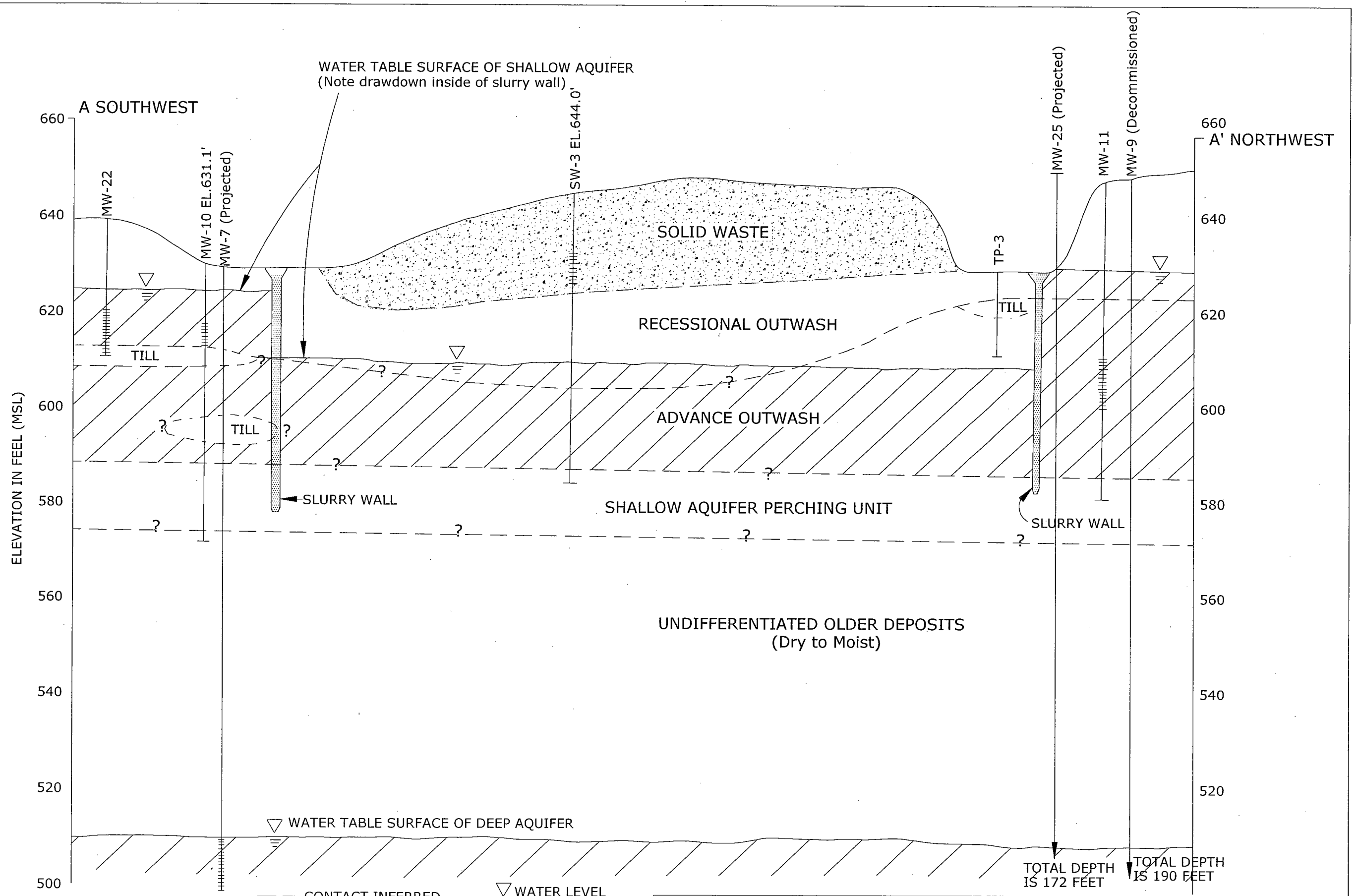

HYDROGELOLGIC CROSS SECTION
(1990)
Hobart Landfill

FIGURE 3

APPROVED	DATE	REVISED DATE
	3/92	9/07

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Figure 4
HOBART LANDFILL
SLURRY WALL DRAWDOWN

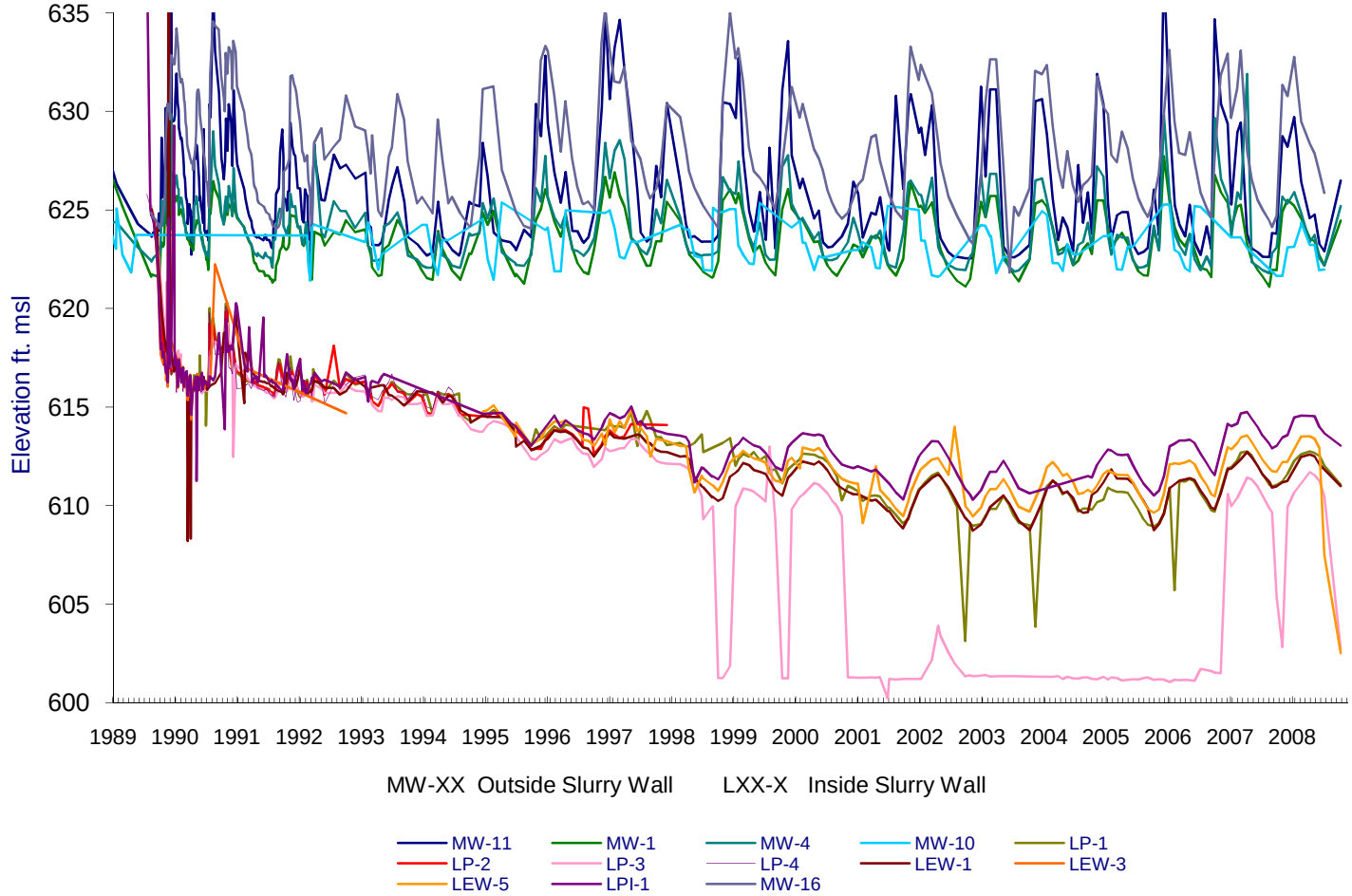


FIGURE 5. HOBART LANDFILL
SHALLOW GROUNDWATER ELEVATIONS

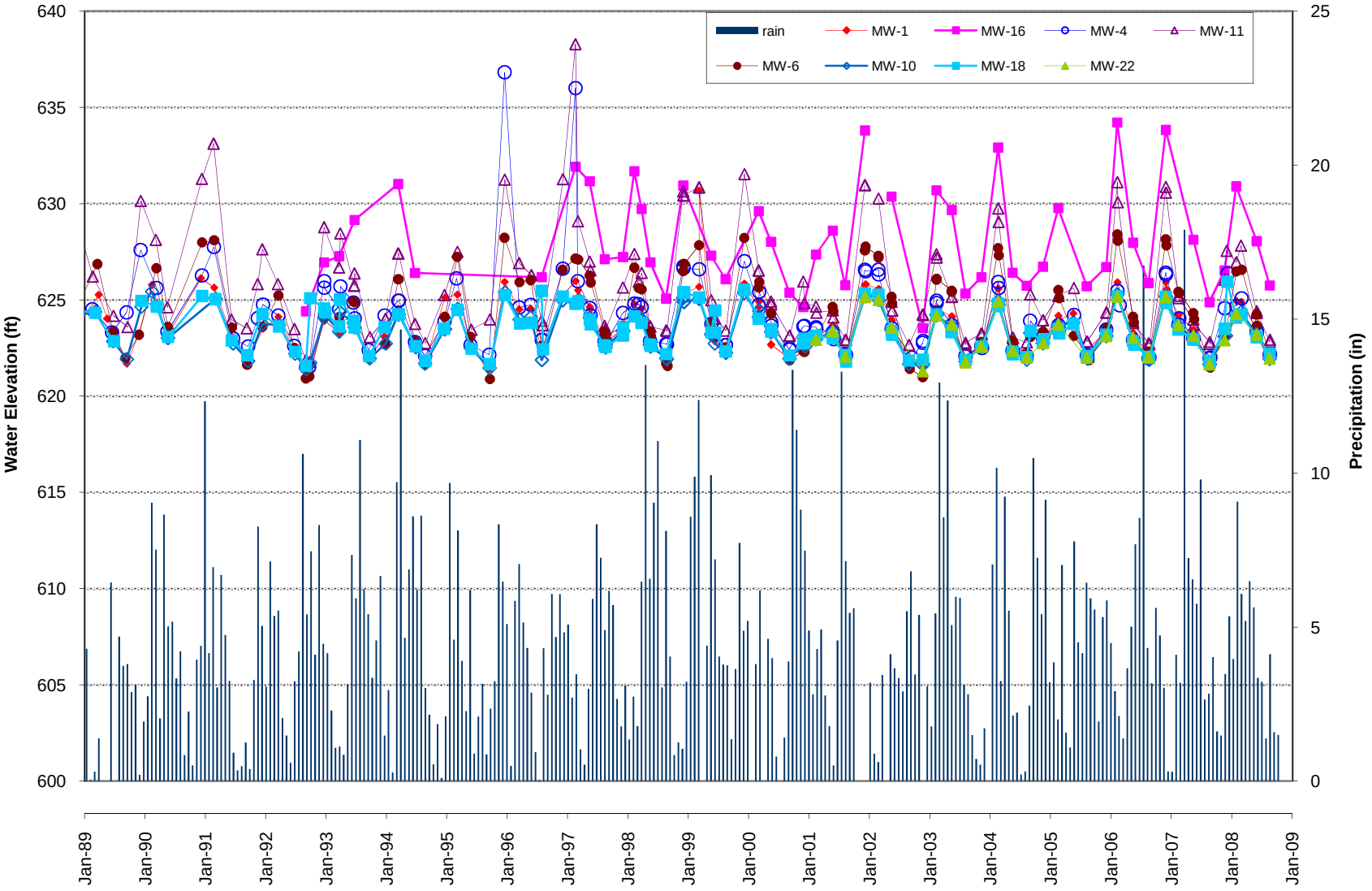
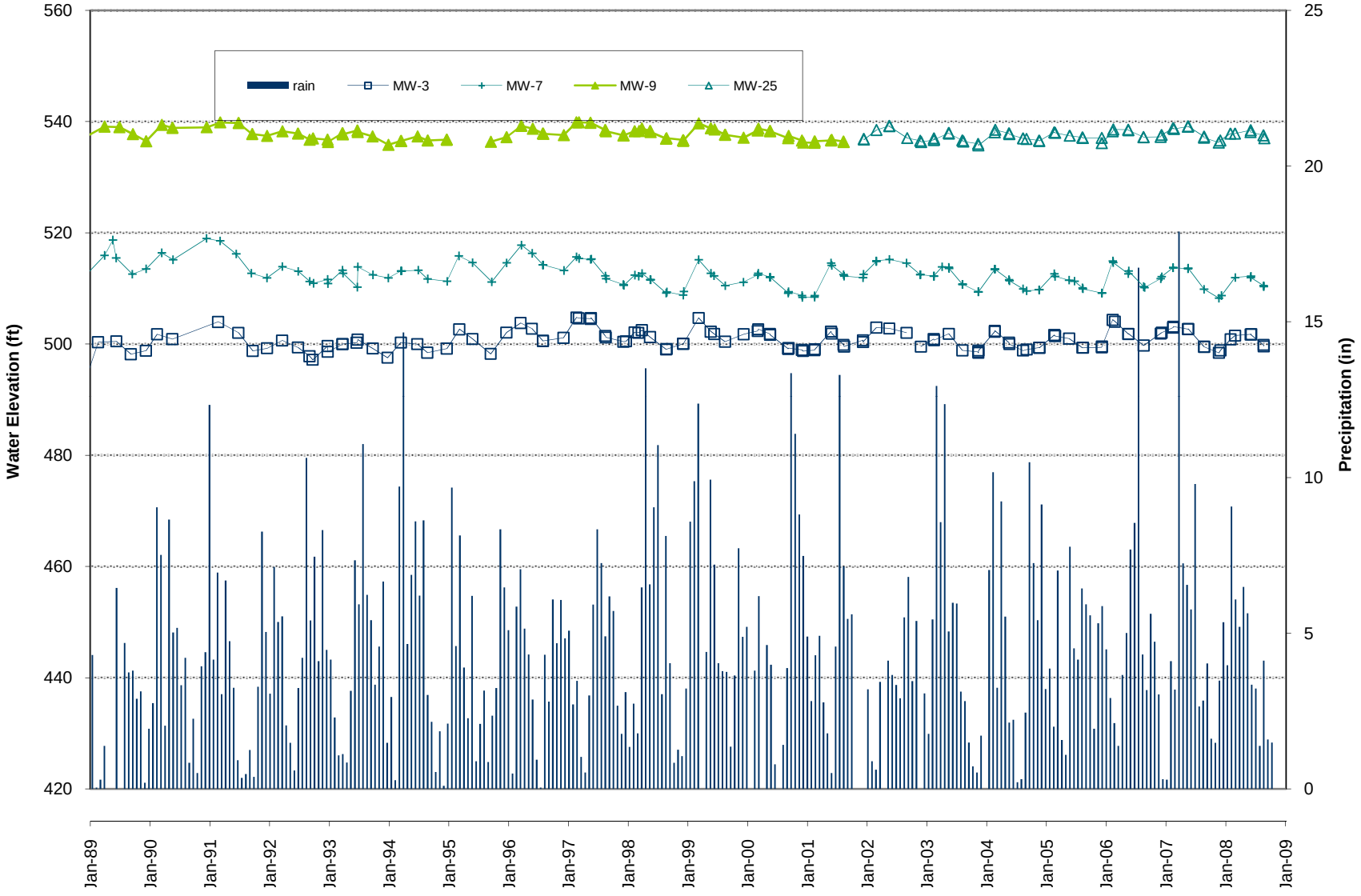


FIGURE 6. HOBART LANDFILL
DEEP GROUNDWATER ELEVATIONS



CHAPTER 3

SUMMARY AND CONCLUSIONS

The conclusions of this groundwater data evaluation are presented according to aquifer and time period.

3.1 SHALLOW AQUIFER

The shallow perched aquifer is an unconfined water table aquifer that has historically saturated lower portions of the solid waste beneath certain areas of the site. Since completion of the Shallow Aquifer remediation in 1989, the shallow water table no longer comes into contact with solid waste, and the groundwater gradient around the site has been altered to minimize off-site transport from beneath the landfill.

Information presented in this report suggests that on-site monitoring wells installed in the Shallow Aquifer and located hydraulically downgradient of the landfill may have historically been influenced by landfill activities. When monitoring began in 1986, the downgradient wells had elevated levels of some leachate indicator constituents with respect to the upgradient wells. Since 1986, these constituents have become progressively less concentrated in downgradient wells, as a result of improved landfill site conditions and Shallow Aquifer remediation activities, particularly installation of the low permeability bentonite slurry wall.

Wells in the shallow water-bearing zone displaying impacts from landfilling activities consisted of MW-1, MW-10, MW-6, and to a lesser extent, MW-18 and MW-4. These wells are located along the west and south perimeter of the fill. Concentrations were greatest prior to completion of the slurry wall. Trend analyses show that statistically significant decreases in long term trends of indicator parameters have occurred in the side and down gradient wells. In general, water quality in this aquifer continues to improve.

None of the volatile organic compounds associated with shallow aquifer impact prior to and in the early remediation phase have been detected since September of 2004. Reductions in the laboratory detection limits have confirmed concentrations have declined and are undetectable in current samples.

Current water quality conditions in the Shallow Aquifer continue to approach background and future increases in contaminant levels appear to be unlikely with the current site control.

3.2 DEEP AQUIFER

The refuse is located in excess of 100 feet above the deeper water bearing zone separated by about 80 feet of dry or moist soils. A low permeability (10^{-6} cm/sec) perching layer of the older undifferentiated deposits (OUD) is continuous beneath the site and separates the two hydrogeologic systems. The lack of moisture in the soils indicates that hydraulic connection between the fill and the groundwater is not strong and the soil capacity to retard contaminants is enhanced because it is not saturated.

General geochemistry parameters at MW-7 are elevated relative to the upgradient well, but have shown decreasing trends over the short term (mid 2006 - mid 2008). The concentrations of these parameters are below regulatory standards. Frequency of volatile detections in the deep aquifer has decreased considerably and the levels are close to detection limits.

The groundwater quality in the deep aquifer has improved over time.

3.3 RECOMMENDATIONS

Recommendations for the Hobart landfill are:

- Continue the maintenance of engineered controls.
- Continue monitoring water level and field parameters on a quarterly basis at all wells in the current monitoring network.

Due to continuing stability in the groundwater at this facility, the following two actions are also recommended:

- Continue regular reporting of exceedances and volatile organic detections, currently on a quarterly schedule.
- Change reporting to:
  - a) Annual brief update of any major changes from previous year (one or two pages) attached with laboratory result data and field data.
  - b) Every three years report complete results (as present report format) unless annual update indicates significant changes.
- Continue monitoring quarterly field parameters.
- Adjust water quality sampling to a schedule based on groundwater velocities and modify parameter lists to focus on known concerns while maintaining overall water quality characterization.

The Solid Waste Division plans to discuss the recommendations on sampling and reporting frequency with the pertinent regulatory agencies.

REFERENCES

Aspect Consulting, *Monitoring Well MW-25 Installation Memorandum*, August 2002.

Baedecker, M.J. and W. Back, 1979, *Modern Marine Sediments as a Natural Analog to the Chemically Stressed Environment of a Landfill.* Journal of Hydrology, 43:393-414.

Blalock, Jr., H.M., 1972, *Social Statistics*, New York, McGraw-Hill.

EMCON and Gary Struthers & Associates, January 1996, *Hobart Landfill Construction Report for Phase 2 Closure,* report for King County Solid Waste Division, Seattle.

Fisher, S.R., and Potter, K.W., 1989, *Methods for Determining Compliance with Groundwater Quality Regulations at Waste Disposal Facilities, Final Report*, Wisconsin Department of Natural Resources.

Harding Lawson Associates, April 1992, *Evaluation of Groundwater Quality Adjacent to Hobart Landfill* report for EMCON Northwest Inc. and King County Solid Waste Division, Seattle.

Kiernan, K., Hansen, S., and Sagstad, S., 1990, *Slurry Cutoff Wall Meets Landfill Liner Regulations for Continued Operation and Pollution Control*, presented in the Thirteenth Annual Madison Waste Conference, University of Wisconsin-Madison, September 1990.

King County Solid Waste Division, January 1994, *1992 Annual Groundwater Data Evaluation for Hobart Landfill*,.

King County Solid Waste Division, November 1995, *1993 Annual Groundwater Data Evaluation for Hobart Landfill*.

.

King County Solid Waste Division, June 1996, *1995 Annual Groundwater Data Evaluation for Hobart Landfill*.

King County Solid Waste Division, August 1998, *1997 Annual Groundwater Data Evaluation for Hobart Landfill*.

King County Solid Waste Division, Fall 2001, *1998 Annual Groundwater Data Evaluation for Hobart Landfill*.

King County Solid Waste Division, July 2003, *2002 Annual Groundwater Data Evaluation for Hobart Landfill*.

King County Solid Waste Division, December 2004, *2003 Annual Groundwater Data Evaluation for Hobart Landfill*.

King County Solid Waste Division, December 2005, *Hobart Closed Landfill 2005 Annual Groundwater Data Evaluation Report.*

King County Solid Waste Division, December 2006, *Hobart Closed Landfill 2005 Annual Groundwater Data Evaluation Report.*

King County Solid Waste Division, November 2007, *Hobart Closed Landfill 2005 Annual Groundwater Data Evaluation Report.*

Rekow, K.H., and Chapra, S.C., 1983, *Engineering Approaches for Lake Management, Volume 1, Data Analysis and Empirical Modeling*, Boston, Butterworth, p. 340.

R.W. Beck and Associates, and Sweet, Edwards & Associates, 1984, *Groundwater Geology/Quality Investigations for the Rural Landfills*, report for the King County Solid Waste Division, Seattle.

R.W. Beck and Associates, 1986, *Hobart Landfill Final Draft Geotechnical Report*, report for the King County Solid Waste Division, Seattle.

R.W. Beck and Associates, EMCON Associates, and Sweet, Edwards and Associates, 1987, *Hobart Landfill Draft Engineering Report, Technical Appendices*, Prepared for King County Solid Waste Division, Seattle.

R.W. Beck and Associates, 1988, *Slurry Wall Design Report*, Prepared for King County Solid Waste Division, Seattle.

Smayda, T.J. and R.J. Owes, 1991. *Unlined Landfills in the Pacific Northwest: Leachate Composition and Groundwater Impacts, in Proceedings: Nonpoint Source. Pollution: The Unfinished Agenda for the Protection of our Water Quality*, Tacoma, WA.

Sweet, Edwards & Associates, Inc., 1986, *Hobart Landfill Final Draft Geotechnical Report*, submitted to King County Solid Waste Division, Seattle, September 1986.

Sweet-Edwards/EMCON, Inc., 1988, *Slurry Wall Design Report, Hobart Landfill, King County, Washington*, Prepared for R.W. Beck and Associates and King County Solid Waste Division, Seattle.

U.S. Environmental Protection Agency, 1989, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities*, Office of Solid Waste, Waste Management Division, PB-89-151047.

APPENDIX A

Groundwater Drinking Water Standards and Groundwater Quality Criteria

Water Quality Standards

Analyte	CAS No.	Eff. Date	Federal Drinking Water Standards MCL		Ref.	Ground Water Quality Criteria Criterion*		Eff. Date	Ref.
Primary Standards									
A. Inorganics									
Antimony	7440-36-0	17-Jan-94	0.006	mg/L	FR v. 57 No.138	0.006	mg/L	17-Jan-94	WAC 173-200
Arsenic c	7440-38-2	23-Jan-06	0.01	mg/L	66 FR 28342	0.00005	mg/L	01-Dec-90	WAC 173-200
Asbestos	132207-33-1	30-Jul-92	7	mf/L	FR v. 56 No. 20	7	mf/L	30-Jul-92	WAC 173-200
Barium	7440-39-3	1-Jan-93	2.0	mg/L	FR v. 56 No. 126	1.0	mg/L	01-Dec-90	WAC 173-200
Beryllium	7440-41-7	17-Jan-94	0.004	mg/L	FR v. 57 No.138	0.004	mg/L	17-Jan-94	WAC 173-200
Cadmium	7440-43-9	30-Jul-92	0.005	mg/L	FR v. 56 No. 20	0.005	mg/L	01-Dec-90	WAC 173-200
Chromium	7440-47-3	30-Jul-92	0.1	mg/L	FR v. 56 No. 20	0.05	mg/L	01-Dec-90	WAC 173-200
Copper	7440-50-8	7-Dec-92	1.3**	mg/L	FR v. 57 No. 125	1.0	mg/L	01-Dec-90	WAC 173-200
Cyanide	57-12-5	17-Jan-94	0.2	mg/L	FR v. 57 No.138	0.2	mg/L	17-Jan-94	WAC 173-200
Fluoride	16984-48-8	2-Oct-87	4.0	mg/L	40 CFR 141	4.0	mg/L	01-Dec-90	WAC 173-200
Lead	7439-92-1	7-Dec-92	0.015**	mg/L	FR v. 57 No. 125	0.015	mg/L	01-Dec-90	WAC 173-200
Mercury	7439-97-6	2-Apr-86	0.002	mg/L	40 CFR 141	0.002	mg/L	01-Dec-90	WAC 173-200
Nickel	7440-02-0	17-Jan-94	0.1	mg/L	FR v. 57 No.138	0.1	mg/L	17-Jan-94	WAC 173-200
Nitrate	14797-55-8	2-Apr-86	10.0	mg/L	FR v. 56 No. 20	10.0	mg/L	01-Dec-90	WAC 173-200
Nitrate and Nitrite	14797-55-8+147	30-Jul-92	10.0	mg/L	FR v. 56 No. 20	10.0	mg/L	30-Jul-92	WAC 173-200
Nitrite	14797-65-0	30-Jul-92	1	mg/L	FR v. 56 No. 20	1.0	mg/L	30-Jul-92	WAC 173-200
Selenium	7782-49-2	30-Jul-92	0.05	mg/L	FR v. 56 No. 20	0.01	mg/L	01-Dec-90	WAC 173-200
Silver	7440-22-4		--			0.05	mg/L	01-Dec-90	WAC 173-200
Sodium	7440-23-5	20-Sep-04	20***	mg/L		20***	mg/L	03-Jul-04	WAC 246-290
Thallium	7440-28-0	17-Jan-94	0.002	mg/L	FR v. 57 No.138	0.002	mg/L	17-Jan-94	WAC 173-200
Total Coliforms		24-Dec-75	1/100	mL	40 CFR 141	1/100	mL	01-Dec-90	WAC 173-200
Turbidity		24-Dec-75	1	NTU	40 CFR 141	--	--	--	--
B. Organic Chemicals									
Alachlor	15972-60-8	30-Jul-92	2	ug/L	FR v. 56 No. 20	2	ug/L	30-Jul-92	WAC 173-200
Atrazine	1912-24-9	30-Jul-92	3	ug/L	FR v. 56 No. 20	3	ug/L	30-Jul-92	WAC 173-200
Benzene c	71-43-2	9-Jan-89	5	ug/L	40 CFR 141	1	ug/L	01-Dec-90	WAC 173-200
Bis(2-ethylhexyl)phthalate	117-81-7	17-Jan-94	6	ug/L	FR v. 57 No.138	6	ug/L	01-Dec-90	WAC 173-200
Bromodichloromethane c	75-27-4		--			0.3	ug/L	01-Dec-90	WAC 173-200
Bromoform c	75-25-2		--			5	ug/L	01-Dec-90	WAC 173-200
Carbofuran	1563-66-2	30-Jul-92	40	ug/L	FR v. 56 No. 20	40	ug/L	30-Jul-92	WAC 173-200
Carbon Tetrachloride c	56-23-5	9-Jan-89	5	ug/L	40 CFR 141	0.3	ug/L	01-Dec-90	WAC 173-200
Chlordane c	5103-71-9	30-Jul-92	2	ug/L	FR v. 56 No. 20	0.06	ug/L	01-Dec-90	WAC 173-200
Chlorobenzene	108-90-7	30-Jul-92	100	ug/L	FR v. 56 No. 20	100	ug/L	30-Jul-92	WAC 173-200
Chlorodibromomethane c	124-48-1		--			0.5	ug/L	01-Dec-90	WAC 173-200
Chloroform c	67-66-3		--			7	ug/L	01-Dec-90	WAC 173-200
2,4-D	94-75-7	30-Jul-92	70	ug/L	FR v. 56 No. 20	70	ug/L	01-Dec-90	WAC 173-200
Dalapon	75-99-0	17-Jan-94	200	ug/L	FR v. 57 No.138	200	ug/L	17-Jan-94	WAC 173-200
1,2-Dibromo-3-chloropropane	96-12-8	30-Jul-92	0.2	ug/L	FR v. 56 No. 20	0.2	ug/L	30-Jul-92	WAC 173-200
1,2-Dichlorobenzene	95-50-1	30-Jul-92	600	ug/L	FR v. 56 No. 20	600	ug/L	30-Jul-92	WAC 173-200
1,4-Dichlorobenzene c	106-46-7	9-Jan-89	75	ug/L	40 CFR 141	4	ug/L	01-Dec-90	WAC 173-200
1,1-Dichloroethane c	75-34-3		--			1	ug/L	01-Dec-90	WAC 173-200
1,2-Dichloroethane c	107-06-2	9-Jan-89	5	ug/L	40 CFR 141	0.5	ug/L	01-Dec-90	WAC 173-200
1,1-Dichloroethene	75-35-4	9-Jan-89	7	ug/L	40 CFR 141	7	ug/L	01-Dec-90	WAC 173-200
c-1,2-Dichloroethene	156-59-2	30-Jul-92	70	ug/L	FR v. 56 No. 20	70	ug/L	30-Jul-92	WAC 173-200
t-1,2-Dichloroethene	156-60-5	30-Jul-92	100	ug/L	FR v. 56 No. 20	100	ug/L	30-Jul-92	WAC 173-200
1,2-Dichloropropane c	78-87-5	30-Jul-92	5	ug/L	FR v. 56 No. 20	0.6	ug/L	01-Dec-90	WAC 173-200
1,3-Dichloropropene tot. c	542-75-6		--			0.2	ug/L	01-Dec-90	WAC 173-200
Di(ethylhexyl)adipate	103-23-1	17-Jan-94	400	ug/L	FR v. 57 No.138	400	ug/L	17-Jan-94	WAC 173-200
Dinoseb	88-85-7	17-Jan-94	7	ug/L	FR v. 57 No.138	7	ug/L	17-Jan-94	WAC 173-200
Diquat	231-36-7	17-Jan-94	20	ug/L	FR v. 57 No.138	20	ug/L	17-Jan-94	WAC 173-200
Endothall	145-73-3	17-Jan-94	100	ug/L	FR v. 57 No.138	100	ug/L	17-Jan-94	WAC 173-200
Endrin	72-20-8	17-Jan-94	2	ug/L	40 CFR 141	0.2	ug/L	01-Dec-90	WAC 173-200
Ethylbenzene	100-41-4	30-Jul-92	700	ug/L	FR v. 56 No. 20	700	ug/L	30-Jul-92	WAC 173-200
Ethylene dibromide c	106-93-4	30-Jul-92	0.05	ug/L	FR v. 56 No. 20	0.001	ug/L	01-Dec-90	WAC 173-200
Glyphosate	1071-83-6	17-Jan-94	70	ug/L	FR v. 57 No.138	70	ug/L	17-Jan-94	WAC 173-200
Heptachlor c	76-44-8	30-Jul-92	0.4	ug/L	FR v. 56 No. 20	0.02	ug/L	01-Dec-90	WAC 173-200
Heptachlor epoxide c	1024-57-3	30-Jul-92	0.2	ug/L	FR v. 56 No. 20	0.009	ug/L	01-Dec-90	WAC 173-200
Hexachlorobenzene	118-74-1	17-Jan-94	1	ug/L	FR v. 57 No.138	0.05	ug/L	01-Dec-90	WAC 173-200
Hexachlorocyclopentadiene (HEX)	77-47-4	17-Jan-94	50	ug/L	FR v. 57 No.138	50	ug/L	17-Jan-94	WAC 173-200
Lindane c	58-89-9	30-Jul-92	0.2	ug/L	FR v. 56 No. 20	0.06	ug/L	01-Dec-90	WAC 173-200

Water Quality Standards

Analyte	CAS No.	Eff. Date	Federal Drinking Water Standards MCL		Ref.	Ground Water Quality Criteria Criterion*		Eff. Date	Ref.
Methoxychlor	72-43-5	30-Jul-92	40	ug/L	FR v. 56 No. 20	40	ug/L	30-Jul-92	WAC 173-200
Methylene Chloride c	75-09-2	17-Jan-94	5	ug/L	FR v. 57 No.138	5	ug/L	17-Jan-94	WAC 173-200
Oxamyl (vydate)	23135-22-0	17-Jan-94	200	ug/L	FR v. 57 No.138	200	ug/L	17-Jan-94	WAC 173-200
PAHs [Benzo(a)pyrene]		17-Jan-94	0.2	ug/l	FR v. 57 No.138	0.01	ug/L	17-Jan-94	WAC 173-200
PCBs c	27323-18-8	30-Jul-92	0.5	ug/L	FR v. 56 No. 20	0.01	ug/L	01-Dec-90	WAC 173-200
Pentachlorophenol	87-86-5	1-Jan-93	1	ug/L	FR v. 56 No. 126	1	ug/L	01-Jan-93	WAC 173-200
Picloram	1918-02-1	17-Jan-94	500	ug/L	FR v. 57 No.138	500	ug/L	17-Jan-94	WAC 173-200
Simazine	122-34-9	17-Jan-94	4	ug/L	FR v. 57 No.138	4	ug/L	17-Jan-94	WAC 173-200
Styrene	100-42-5	30-Jul-92	10	ug/L	FR v. 56 No. 20	100	ug/L	30-Jul-92	WAC 173-200
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	17-Jan-94	3E-05	ug/L	FR v. 57 No.138	0.0000006	ug/L	01-Dec-90	WAC 173-200
Tetrachloroethylene c	127-18-4	30-Jul-92	5	ug/L	FR v. 56 No. 20	0.8	ug/L	30-Jul-92	WAC 173-200
Toluene	108-88-3	30-Jul-92	1000	ug/L	FR v. 56 No. 20	1000	ug/L	30-Jul-92	WAC 173-200
Total Trihalomethanes c	75-27-4, 75-25-2	29-Nov-79	100	ug/L	40 CFR 141	--	--	--	--
Toxaphene c	8001-35-2	30-Jul-92	3	ug/L	FR v. 56 No. 20	0.08	ug/L	01-Dec-90	WAC 173-200
2,4,5-TP	93-72-1	30-Jul-92	50	ug/L	FR v. 56 No. 20	100	ug/L	01-Dec-90	WAC 173-200
1,2,4-Trichlorobenzene	120-82-1	17-Jan-94	70	ug/L	FR v. 57 No.138	70	ug/L	17-Jan-94	WAC 173-200
1,1,1-Trichloroethane	71-55-6	9-Jan-89	200	ug/L	40 CFR 141	200	ug/L	01-Dec-90	WAC 173-200
1,1,2-Trichloroethane	79-00-5	17-Jan-94	5	ug/L	FR v. 57 No.138	5	ug/L	17-Jan-94	WAC 173-200
Trichloroethylene (TCE) c	79-01-6	9-Jan-89	5	ug/L	40 CFR 141	3	ug/L	01-Dec-90	WAC 173-200
Vinyl chloride c	75-01-4	9-Jan-89	2	ug/L	40 CFR 141	0.02	ug/L	01-Dec-90	WAC 173-200
Xylenes (total)	1330-20-7	30-Jul-92	10000	ug/L	FR v. 56 No. 20	10000	ug/L	30-Jul-92	WAC 173-200
C. Radionuclides and Radioactivity									
Radium 226 & Radium 228		9-Jul-76	5	pCi/L	FR v. 41 No. 133	5	pCi/L	01-Dec-90	WAC 173-200
Radium 226	13982-63-3		--			3	pCi/L	01-Dec-90	WAC 173-200
Radium 228	15262-20-1		--			5	pCi/L	01-Dec-90	WAC 173-200
Gross Alpha particle activity		9-Jul-76	15	pCi/L	FR v. 41 No. 133	15	pCi/L	01-Dec-90	WAC 173-200
Tritium	10028-17-8	9-Jul-76	20,000	pCi/L	FR v. 41 No. 133	20,000	pCi/L	01-Dec-90	WAC 173-200
Strontium	7440-24-6	9-Jul-76	8	pCi/L	FR v. 41 No. 133	8	pCi/L	01-Dec-90	WAC 173-200
Gross Beta particle activity		9-Jul-76	50	pCi/L	FR v. 41 No. 133	50	pCi/L	01-Dec-90	WAC 173-200
D. Additional Carcinogens Listed in Groundwater Criteria									
Acrylamide	79-06-1		--			0.02	ug/L	01-Dec-90	WAC 173-200
Acrylonitrile	107-13-1		--			0.07	ug/L	01-Dec-90	WAC 173-200
Aldrin	309-00-2		--			0.005	ug/L	01-Dec-90	WAC 173-200
Aniline	62-53-3		--			14	ug/L	01-Dec-90	WAC 173-200
Aramite	140-57-8		--			3	ug/L	01-Dec-90	WAC 173-200
Azobenzene	103-33-3		--			0.7	ug/L	01-Dec-90	WAC 173-200
Benzidine	92-87-5		--			0.0004	ug/L	01-Dec-90	WAC 173-200
Benzo(a)pyrene	50-32-8		--			0.008	ug/L	01-Dec-90	WAC 173-200
Benzotrichloride	98-07-7		--			0.007	ug/L	01-Dec-90	WAC 173-200
Benzyl chloride	100-44-7		--			0.5	ug/L	01-Dec-90	WAC 173-200
Bis(chloroethyl)ether	111-44-4		--			0.07	ug/L	01-Dec-90	WAC 173-200
Bis(chloromethyl)ether	542-88-1		--			0.0004	ug/L	01-Dec-90	WAC 173-200
Carbazole	86-74-8		--			5	ug/L	01-Dec-90	WAC 173-200
4-Chloro-2-methyl analine	95-69-2		--			0.1	ug/L	01-Dec-90	WAC 173-200
4-Chloro-2-methyl analine hydrochlor	3165-93-3		--			0.2	ug/L	01-Dec-90	WAC 173-200
o-Chloronitrobenzene	88-73-3		--			3	ug/L	01-Dec-90	WAC 173-200
p-Chloronitrobenzene	100-00-5		--			5	ug/L	01-Dec-90	WAC 173-200
Chlorthalonil	1897-45-6		--			30	ug/L	01-Dec-90	WAC 173-200
Diallate	2303-16-4		--			1	ug/L	01-Dec-90	WAC 173-200
DDT (includes DDE and DDD)	50-29-3, 72-55-9, 72-54-8		--			0.3	ug/L	01-Dec-90	WAC 173-200
1,2-Dibromomethane	106-93-4		--			0.001	ug/L	01-Dec-90	WAC 173-200
3,3'-Dichlorobenzidine	91-94-1		--			0.2	ug/L	01-Dec-90	WAC 173-200
Dichlorovos	62-73-7		--			0.3	ug/L	01-Dec-90	WAC 173-200
Dieldrin	60-57-1		--			0.005	ug/L	01-Dec-90	WAC 173-200
3,3'-Dimethoxybenzidine	119-90-4		--			6.0	ug/L	01-Dec-90	WAC 173-200
3,3-Dimethylbenzidine	119-93-7		--			0.007	ug/L	01-Dec-90	WAC 173-200
1,2-Dimethylhydrazine	540-73-8		--			60	ug/L	01-Dec-90	WAC 173-200
2,4-Dinitrotoluene	121-14-2		--			0.1	ug/L	01-Dec-90	WAC 173-200
2,6-Dinitrotoluene	606-20-2		--			0.1	ug/L	01-Dec-90	WAC 173-200
1,4-Dioxane	123-91-1		--			7	ug/L	01-Dec-90	WAC 173-200
1,2-Diphenylhydrazine	122-66-7		--			0.09	ug/L	01-Dec-90	WAC 173-200

Water Quality Standards

Analyte	CAS No.	Eff. Date	Federal Drinking Water Standards MCL		Ref.	Ground Water Quality Criteria Criterion*		Eff. Date	Ref.
Direct Black 38	1937-37-7		--			0.009	ug/L	01-Dec-90	WAC 173-200
Direct Blue 6	2602-46-2		--			0.009	ug/L	01-Dec-90	WAC 173-200
Direct Brown 95	16071-86-6		--			0.009	ug/L	01-Dec-90	WAC 173-200
Epichlorohydrin	106-89-8		--			8	ug/L	01-Dec-90	WAC 173-200
Ethyl acrylate	140-88-5		--			2	ug/L	01-Dec-90	WAC 173-200
Ethylene thiourea	96-45-7		--			2	ug/L	01-Dec-90	WAC 173-200
Folpet	133-07-3		--			20	ug/L	01-Dec-90	WAC 173-200
Furazolidone	67-45-8		--			0.02	ug/L	01-Dec-90	WAC 173-200
Furium	531-82-8		--			0.002	ug/L	01-Dec-90	WAC 173-200
Furmecyclox	60568-05-0		--			3	ug/L	01-Dec-90	WAC 173-200
Hexachlorocyclohexane (alpha)	319-84-6		--			0.001	ug/L	01-Dec-90	WAC 173-200
Hexachlorocyclohexane (technical)	608-73-1		--			0.05	ug/L	01-Dec-90	WAC 173-200
Hexachlorodibenzo-p-dioxin, mix	34465-46-8		--			0.00001	ug/L	01-Dec-90	WAC 173-200
Hydrazine/hydrazine sufate	302-01-2/10034-93-2		--			0.03	ug/L	01-Dec-90	WAC 173-200
2-Methoxy-5-nitroanaline	99-59-2		--			2.0	ug/L	01-Dec-90	WAC 173-200
2-Methylanaline	95-53-4		--			0.2	ug/L	01-Dec-90	WAC 173-200
2-Methylanaline hydrochloride	636-21-5		--			0.5	ug/L	01-Dec-90	WAC 173-200
4,4'-Methylene bis(N,N'-dimethyl) ani	101-61-1		--			2.0	ug/L	01-Dec-90	WAC 173-200
Mirex	2385-85-5		--			0.05	ug/L	01-Dec-90	WAC 173-200
Nitrofurazone	59-87-0		--			0.06	ug/L	01-Dec-90	WAC 173-200
N-Nitrosodiethanolamine	1116-54-7		--			0.03	ug/L	01-Dec-90	WAC 173-200
N-Nitrosodiethylamine	55-18-5		--			0.0005	ug/L	01-Dec-90	WAC 173-200
N-Nitrosodimethylamine	62-75-9		--			0.002	ug/L	01-Dec-90	WAC 173-200
N-Nitrosodiphenylamine	86-30-6		--			17.0	ug/L	01-Dec-90	WAC 173-200
N-Nitroso-di-n-propylamine	621-64-7		--			0.01	ug/L	01-Dec-90	WAC 173-200
N-Nitrosopyrrolidine	930-55-2		--			0.04	ug/L	01-Dec-90	WAC 173-200
N-Nitroso-di-n-butylamine	924-16-3		--			0.02	ug/L	01-Dec-90	WAC 173-200
N-Nitroso-N-methylethylylamine	10595-95-6		--			0.004	ug/L	01-Dec-90	WAC 173-200
PBBs	59536-65-1		--			0.01	ug/L	01-Dec-90	WAC 173-200
o-Phenylenediamine	95-54-5		--			0.005	ug/L	01-Dec-90	WAC 173-200
Propylene oxide	75-56-9]		--			0.01	ug/L	01-Dec-90	WAC 173-200
p,a,a,a-Tetrachlorotoluene	5216-25-1		--			0.004	ug/L	01-Dec-90	WAC 173-200
2,4-Toluenediamine	95-80-7		--			0.002	ug/L	01-Dec-90	WAC 173-200
o-Toluidine	95-53-4		--			0.2	ug/L	01-Dec-90	WAC 173-200
2,4,6-Trichlorophenol	88-06-2		--			4.0	ug/L	01-Dec-90	WAC 173-200
Trimethyl phosphate	512-56-1		--			2.0	ug/L	01-Dec-90	WAC 173-200
Secondary Standards									
Aluminum	7429-90-5	30-Jul-92	0.05-0.2	mg/L	FR v. 56 No. 20	0.05-0.2	mg/L	30-Jul-92	WAC 173-200
Copper	7440-50-8	7-Dec-92	1.0	mg/L	FR v. 57 No. 125	1.0	mg/L	01-Dec-90	WAC 173-200
Iron	7439-89-6	2-Apr-86	0.3	mg/L	40 CFR 143	0.3	mg/L	01-Dec-90	WAC 173-200
Manganese	7439-96-5	2-Apr-86	0.05	mg/L	40 CFR 143	0.05	mg/L	01-Dec-90	WAC 173-200
Color		2-Apr-86	15	units	40 CFR 143	15	units	01-Dec-90	WAC 173-200
pH	12408-02-5	2-Apr-86	6.5-8.5	units	40 CFR 143	6.5-8.5	units	01-Dec-90	WAC 173-200
Specific Conductivity			--			700	uS/cm		WAC 246-290
Total Dissolved Solids		2-Apr-86	500	mg/L	40 CFR 143	500	mg/L	01-Dec-90	WAC 173-200
Chloride	16887-00-6	2-Apr-86	250	mg/L	40 CFR 143	250	mg/L	01-Dec-90	WAC 173-200
Fluoride	16984-48-8	2-Apr-86	2.0	mg/L	40 CFR 143	p			
Silver	7440-22-4	30-Jul-92	0.1	mg/L	FR v. 56 No. 20	p			
Sulfate	14808-79-8	2-Apr-86	250	mg/L	40 CFR 143	250	mg/L	01-Dec-90	WAC 173-200
Surfactants		2-Apr-86	0.5	mg/L	40 CFR 143	0.5	mg/L	01-Dec-90	WAC 173-200
Corrosivity		2-Apr-86	non-corrosive		40 CFR 143	non-corrosive		01-Dec-90	WAC 173-200
Odor-Threshold		2-Apr-86	3	units	40 CFR 143	3	units	01-Dec-90	WAC 173-200
Zinc	7440-66-6	2-Apr-86	5.0	mg/L	40 CFR 143	5.0	mg/L	01-Dec-90	WAC 173-200

NOTES:
pCi/L=picocuries per liter
mg/L=milligrams per liter
mf/L=million fibers per liter
p=Listed as a Primary Standard
--'=no standard established
i=listed individually as groundwater criteria
c=Listed as a carcinogen in the Ground Water Criteria
MCL=Maximum Contaminant Level
*=Criteria shall be the most stringent concentration of the Federal MCLG, MCL; or State MCL
MCLG= Maximum Contaminant Level Goal
**=treatment technique in lieu of an MCL
***= A Drinking Water Advisory, not an enforceable standard.
Ground Water Quality Criteria=Water Quality Standards for Ground Waters of the State of Washington

Compiled by KCSWD 1/12/94. Revised 1/23/06

APPENDIX B

Potentiometric Groundwater Report

Aspect consulting
earth + water

King County
Department of
Natural Resources and Parks
Solid Waste Division

October 13, 2008

Mr. Sendy Jimenez
King County Solid Waste Division
King Street Center
201 South Jackson Street, Suite 701
Seattle, Washington 98104-3855

Re: Contract Number: E00065E07 H
Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation
Data Collected During 2007
Hobart Landfill
King County, Washington
Project No. 070074-001-01

Dear Mr. Jimenez:

This letter report presents an analysis of groundwater flow direction and rate during 2007 for the shallow and deep aquifers beneath the Hobart Landfill (landfill), in accordance with King County Department of Natural Resources, Solid Waste Division (KCSWD) Contract Number E00065E07 H. KCSWD personnel measured groundwater elevations in monitoring wells installed at the landfill quarterly (four times per year) in 2007. Measurements made during the first and third quarters were received by Aspect Consulting on September 12, 2008 and October 8, 2008 and were used to:

1. Evaluate the potentiometric groundwater surface elevation during the seasonally high and low water levels for the shallow and deep aquifers;
2. Determine the groundwater flow direction and horizontal gradient during the seasonally high and low water levels for the shallow and deep aquifers; and
3. Calculate the groundwater flow velocities during the seasonally high and low water levels in the shallow and deep aquifers.

No major changes in groundwater flow direction or velocity were observed for the deep aquifer since the last annual report was submitted. In the shallow aquifer, the high water level groundwater velocity in 2007 was similar compared to 2005 and less than the high water level groundwater velocities calculated in 2004 and 2006. These variations in groundwater velocity are likely related to variability in precipitation.

In addition, the changes in water levels from 2006 to 2007 were calculated for wells within the slurry wall. On average, seasonal high water levels in 2007 were 0.96 feet higher than in 2006,

and seasonal low water levels in 2007 were 0.88 feet higher than in 2006. One additional well within the slurry wall, LP-3, was added to the list of reported water levels during 2007.

Groundwater Elevation Data

KCSWD measured groundwater levels quarterly in 2007 at 11 on-site monitoring wells completed in the shallow or deep aquifers. Groundwater levels were also measured at five wells located inside the slurry wall which surrounds the landfill, including LP-3 which is a new monitoring point in 2007. Table 1 lists the well names, locations, reference point elevations, measured groundwater levels, and reported groundwater elevations for the shallow and deep aquifers, as well as for the water-bearing zone inside the slurry wall. High groundwater elevations were measured during the 1st quarter monitoring event performed on February 13 and 14, 2007 (February 13 for MW-16 and shallow wells inside the slurry wall and February 14 for other monitoring wells). Low groundwater elevations were measured during the 3rd quarter monitoring event performed August 17 and 22, 2007 (August 17 for shallow wells inside the slurry wall and August 22 for other monitoring wells). Table 1 also provides the changes in water levels from 2006 to 2007 calculated for wells within the slurry wall.

Figures 1 and 2 show well locations, groundwater elevations, inferred groundwater potentiometric surface contours, and inferred local groundwater flow directions in the shallow aquifer for high and low groundwater levels, respectively.

Figures 3 and 4 show well locations, groundwater elevations, groundwater potentiometric surface contours, and interpreted regional groundwater flow directions in the deep aquifer for high and low groundwater levels, respectively.

Direction of Groundwater Flow

Groundwater elevations from measurements made during 2007 indicate that groundwater in the shallow aquifer flowed generally southwest and around the slurry wall. Groundwater elevations at MW-16 were substantially higher than elevations observed at other shallow aquifer wells, and may indicate groundwater mounding upgradient of the landfill. It is inferred that as groundwater approaches the relatively impermeable slurry wall, it mounds near MW-16 and flows laterally around the north and south sides of the slurry wall. Groundwater levels measured inside the slurry wall ranged from approximately 9 to 20 feet below groundwater levels outside the wall, indicating good hydraulic separation from the shallow aquifer.

Groundwater elevations from measurements made during 2007 indicate that groundwater in the deep aquifers generally flowed west under both high and low groundwater level conditions.

Groundwater Velocity

Horizontal groundwater velocity was calculated using the following formula:

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

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

Horizontal groundwater velocity was calculated for the shallow aquifer outside the slurry wall and for the deep aquifers below the landfill. Table 2 presents a summary of the hydraulic parameters that were used to calculate groundwater velocities for both aquifers during the seasonal high and low groundwater level conditions.

The shallow aquifer hydraulic conductivity was provided in the annual report for measurements made in 2002 (HWA GeoSciences Inc., 2003). The deep aquifer hydraulic conductivity of 7×10^{-5} centimeters per second (cm/sec) or 0.2 feet per day (ft/day) was calculated from a single well pumping test conducted at MW-3 as reported in R.W. Beck and Associates, and Sweet, Edwards & Associates (1984). This value is in the middle of the range of permeability reported for pre-Vashon deposits of 10^{-7} to 10^{-3} cm/sec (Galster and Laprade, 1991).

The hydraulic gradient in the shallow aquifer was determined from groundwater elevations measured in wells completed along the north, west and south sides of the slurry wall. The gradient in the deep aquifer was determined from three wells, and did not change between high and low groundwater levels.

The velocity calculated in the shallow aquifer was approximately 2.2 ft/day during high groundwater levels in 1st Quarter 2007, and 1.6 ft/day, during low groundwater levels in 3rd Quarter 2007. The velocity calculated in the deep aquifer was approximately 0.03 ft/day, during high and low groundwater level conditions in 2007.

References

Galster, R. W. and Laprade, W. T., 1991, Geology of Seattle, Washington, United States of America, Bulletin of the Association of Engineering Geologists, v. 28 no. 3, pp. 235-302.

HWA GeoSciences Inc., 2003, Potentiometric surface maps and aquifer flow calculations, Hobart Landfill, King County, Washington**,** submitted July 15, 2003.

R.W. Beck and Associates, and Sweet, Edwards & Associates, 1984, Groundwater geology/quality investigations for the rural landfills: Report for the King County Solid Waste Division.

Thank you for the opportunity to provide hydrogeologic consulting services to the King County Solid Waste Division. Please contact us if you have any questions.

Sincerely,

Aspect consulting, LLC

Peter S. Bannister, PE
Senior Project Engineer
pbannister@aspectconsulting.com

John J. Strunk, LHG
Senior Associate Geologist
jstrunk@aspectconsulting.com

Attachments:
- Table 1: High and Low Groundwater Elevations – 2007
- Table 2: Groundwater Velocity Calculations – 2007
- Figure 1: Groundwater Potentiometric Surface Map – Shallow Aquifer – High Groundwater Levels – 2007
- Figure 2: Groundwater Potentiometric Surface Map – Shallow Aquifer – Low Groundwater Levels – 2007
- Figure 3: Groundwater Potentiometric Surface Map – Deep Aquifer – High Groundwater Levels – 2007
- Figure 4: Groundwater Potentiometric Surface Map – Deep Aquifer – Low Groundwater Levels – 2007

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Table 1 - High and Low Groundwater Elevations - 2007

Hobart Landfill - King County, Washington

					High Groundwater Levels 1st Quarter 2007			Low Groundwater Levels 3rd Quarter 2007		
	Well Name	Northing (ft)	Easting (ft)	Reference Point Elevation (ft MSL)	Measured Depth to Groundwater (ft)	Groundwater Elevation (ft MSL)	Change Compared to 2006 (ft)	Measured Depth to Groundwater (ft)	Groundwater Elevation (ft MSL)	Change Compared to 2006 (ft)
Shallow Aquifer	MW-1	143198	1717159	635.52	11.30	624.22		13.84	621.68	
	MW-4	144243	1716704	644.41	20.70	623.71		22.45	621.96	
	MW-6	143223	1717688	631.64	6.22	625.42		10.11	621.53	
	MW-10	143208	1716699	632.73	9.11	623.62		11.08	621.65	
	MW-11	145023	1717591	651.17	25.95	625.22		28.45	622.72	
	MW-16	143886	1717910	635.16	5.50	629.66		10.28	624.88	
	MW-18	143545	1716517	639.22	15.76	623.46		17.46	621.76	
	MW-22	143024	1716684	638.93	15.23	623.70		17.29	621.64	
Inside Slurry Wall	LEW-1	144110	1717185	668.49	56.61	611.88	1.00	56.92	611.57	0.81
	LEW-5	143578	1717078	687.51	74.65	612.86	0.77	75.19	612.32	0.84
	LPI-1	143650	1717260	688.94	74.92	614.02	1.01	75.40	613.54	0.90
	LP-1	144190	1716920	662.97	51.02	611.95	1.04	51.38	611.59	0.96
	LP-3	144520	1717460	662.40	53.02	609.38		52.48	609.92	
Deep Aquifer	MW-3	144252	1716700	644.16	141.23	502.93		144.67	499.49	
	MW-7	143182	1717166	634.17	120.46	513.71		124.32	509.85	
	MW-25	144832	1717775	652.84	114.02	538.82		115.74	537.10	

Notes:

1. Water level measurements made during 2007 by KCSWD personnel.
2. Coordinates are in feet based on Washington State Plane grid system.
3. Elevations in feet above mean sea level (ft MSL) based on the National Geodetic Vertical Datum, 1929.
4. High groundwater levels reflect the maximum of 2007 quarterly groundwater level elevations, and were measured February 14, 2007. Groundwater levels inside the slurry wall and at MW-16 were measured February 13, 2007.
5. Low groundwater levels reflect the minimum of 2007 quarterly groundwater level elevations, and were measured August 22, 2007. Groundwater levels inside the slurry wall were measured August 17, 2007.
6. Coordinates at MW-25 and all locations inside the slurry wall were estimated from maps.
7. Change in water level compared to same quarter 2006 provided at the request of KCSWD personnel. A positive change indicates a higher water level in 2007 compared to 2006. A negative change indicates a lower water level in 2007 compared to 2006.

King County

Table 2 - Groundwater Velocity Calculations - 2007

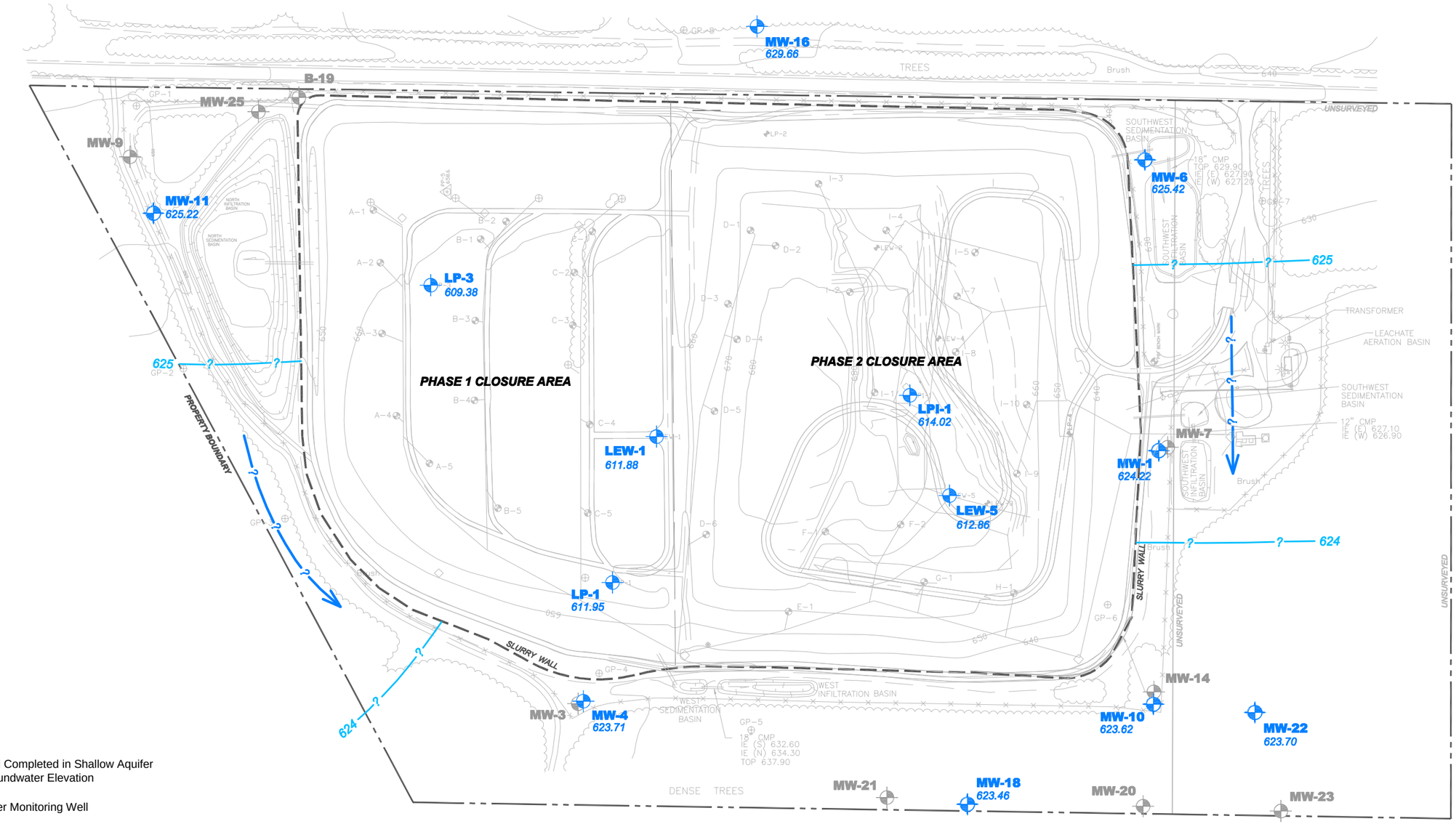
Hobart Landfill - King County, Washington

Groundwater Zone Adjacent to or Beneath Landfill	Seasonal Groundwater Level	Horizontal Hydraulic Conductivity (cm/sec)	Horizontal Hydraulic Conductivity (ft/day)	Horizontal Hydraulic Gradient (ft/ft)	Effective Porosity	Horizontal Groundwater Velocity (ft/day)	General Direction of Groundwater Flow
Shallow Aquifer	High (Wet)	0.3	800	0.0007	25%	2.2	Southwest
	Low (Dry)	0.3	800	0.0005	25%	1.6	
Deep Aquifer	High (Wet)	0.00007	0.2	0.03	25%	0.03	West
	Low (Dry)	0.00007	0.2	0.03	25%	0.03	

Notes:

1. Shallow aquifer parameters obtained from *Potentiometric Surface Maps and Aquifer Flow Calculations: Hobart Landfill* , July 15, 2003, HWA GeoSciences Inc.
2. Deep aquifer hydraulic conductivity obtained from *Groundwater Geology/Quality Investigations for the Rural Landfills: Report for the King County Solid Waste Division,* 1984*,* R.W. Beck and Associates, and Sweet, Edwards & Associates.
3. Horizontal hydraulic gradient is estimated based on groundwater elevations observed along the North, West, and South sides of the landfill.
4. High groundwater levels reflect the maximum of 2007 quarterly groundwater level elevations, and were measured February 13-14, 2007.
5. Low groundwater levels reflect the minimum of 2007 quarterly groundwater level elevations, and were measured August 22, 2007.

King County



Legend

- **MW-4** *XXX.XX* — Well Completed in Shallow Aquifer Groundwater Elevation
- **MW-3** — Other Monitoring Well
- *625* —?— Inferred Shallow Aquifer Groundwater Elevation Contour *(feet MSL)*
- ?— Inferred Horizontal Groundwater Flow Path
- Slurry Wall

Note:
Groundwater level measurements outside of slurry wall made on February 14, 2007.
Groundwater level measurements inside of slurry wall and at MW-16 made on February 13, 2007.

N

0 200 400
Feet

Topography prepared by ***DEGROSS AERIAL MAPPING*** from photogrammetric methods (11-23-92).
Topography updated by ***Emcon Northwest Inc.*** (04-20-94).

King County

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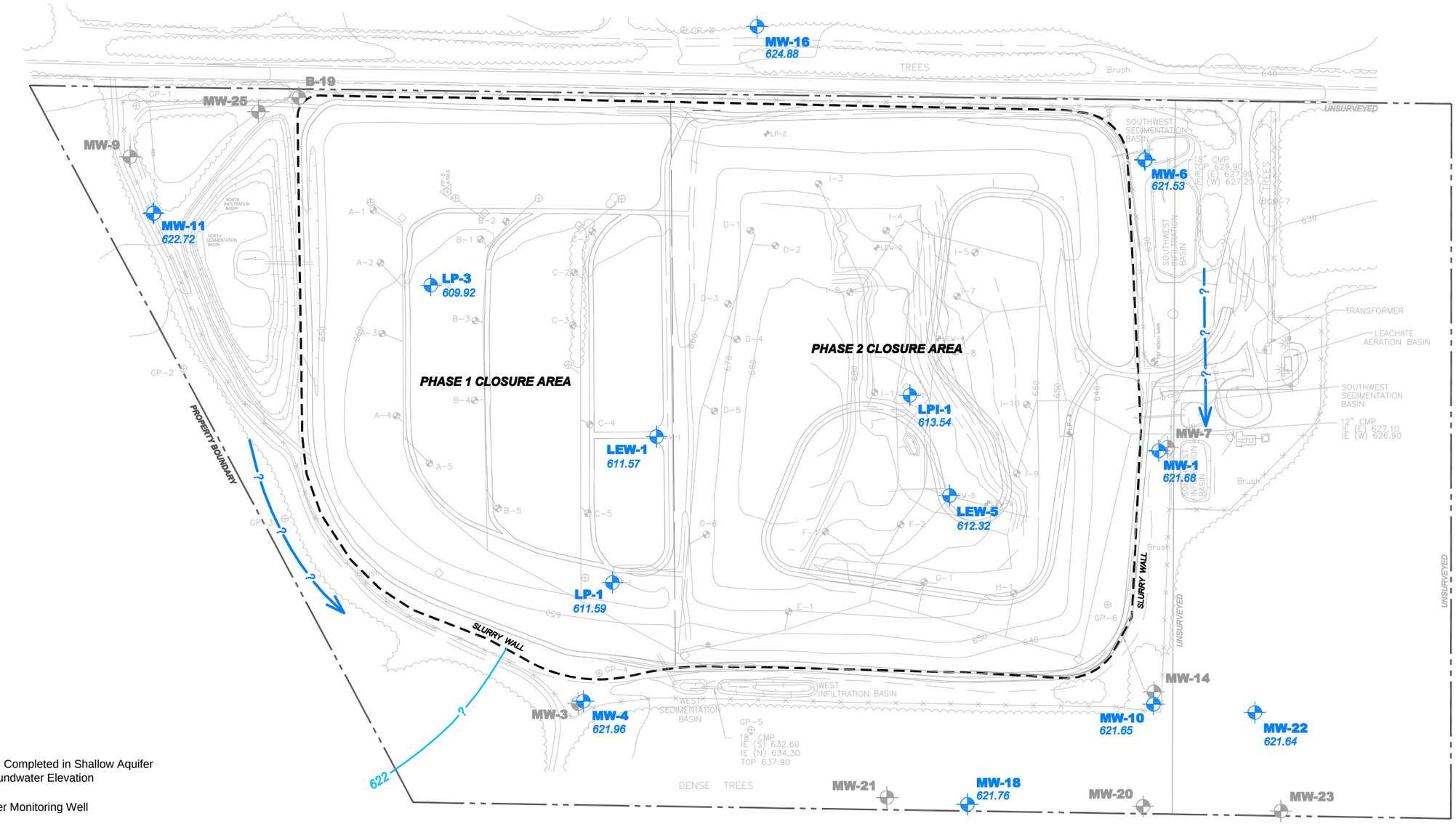
Groundwater Potentiometric Surface Map
Shallow Aquifer - High Groundwater Levels - 2007
Hobart Landfill
King County, Washington

DATE: Sept 2008	PROJECT NO. 070074
DESIGNED BY: PSB/JJS	
DRAWN BY: PMB	FIGURE NO. 1
REVISED BY: -	

Q:\King County\070074 Groundwater Flow Analysis\2008-09 Hobart\HO_2007_SA_Fig 1.dwg



Legend

- **MW-4** *XXX.XX* — Well Completed in Shallow Aquifer Groundwater Elevation
- **MW-3** — Other Monitoring Well
- *622* — ? — Inferred Shallow Aquifer Groundwater Elevation Contour *(feet MSL)*
- ? — Inferred Horizontal Groundwater Flow Path
- Slurry Wall

Note:
Groundwater level measurements outside of slurry wall made on August 22, 2007.
Groundwater level measurements inside of slurry wall made on August 17, 2007.

N

0 200 400
Feet

Topography prepared by ***DEGROSS AERIAL MAPPING*** from photogrammetric methods (11-23-92).
Topography updated by ***Emcon Northwest Inc.*** (04-20-94).

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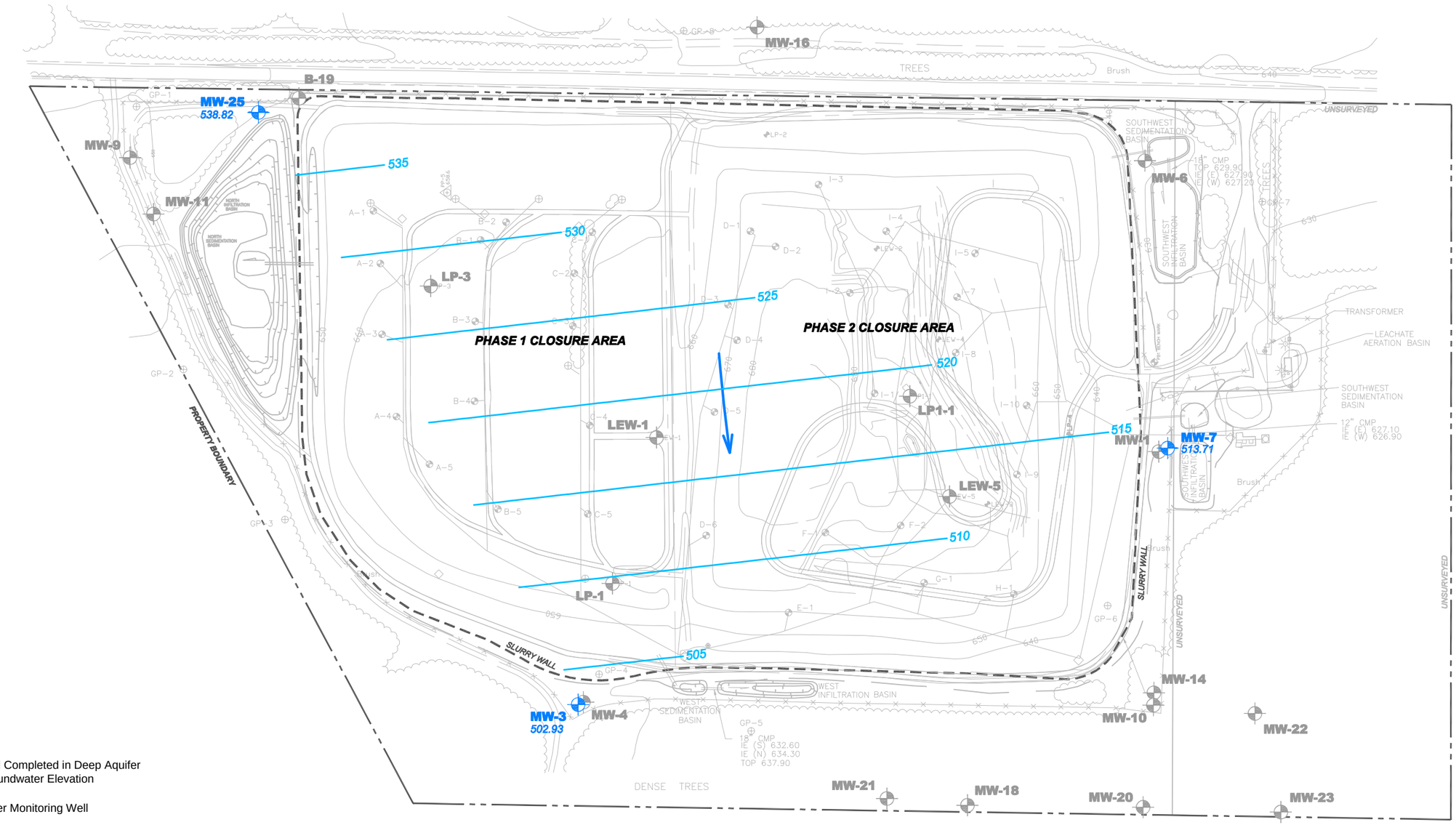
Groundwater Potentiometric Surface Map
Shallow Aquifer - Low Groundwater Levels - 2007
Hobart Landfill
King County, Washington

DATE: Sept 2008	PROJECT NO. 070074
DESIGNED BY: PSB/JJS	
DRAWN BY: PMB	FIGURE NO. 2
REVISED BY: -	

Q:\King County\070074 Groundwater Flow Analysis\2008-09 Hobart\HO_2007_SA_Fig 2.dwg



Legend

- **MW-3** *XXX.XX* — Well Completed in Deep Aquifer Groundwater Elevation
- **MW-4** — Other Monitoring Well
- *535* — Inferred Deep Aquifer Groundwater Elevation Contour *(feet MSL)*
- Inferred Horizontal Groundwater Flow Path
- Slurry Wall

Note:
Groundwater level measurements made on February 14, 2007.

N

0 200 400
Feet

Topography prepared by ***DEGROSS AERIAL MAPPING*** from photogrammetric methods (11-23-92).
Topography updated by ***Emcon Northwest Inc.*** (04-20-94).

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Groundwater Potentiometric Surface Map
Deep Aquifer - High Groundwater Levels - 2007
Hobart Landfill
King County, Washington

DATE: Sept 2008	PROJECT NO. 070074
DESIGNED BY: PSB/JJS	
DRAWN BY: PMB	FIGURE NO. 3
REVISED BY: -	

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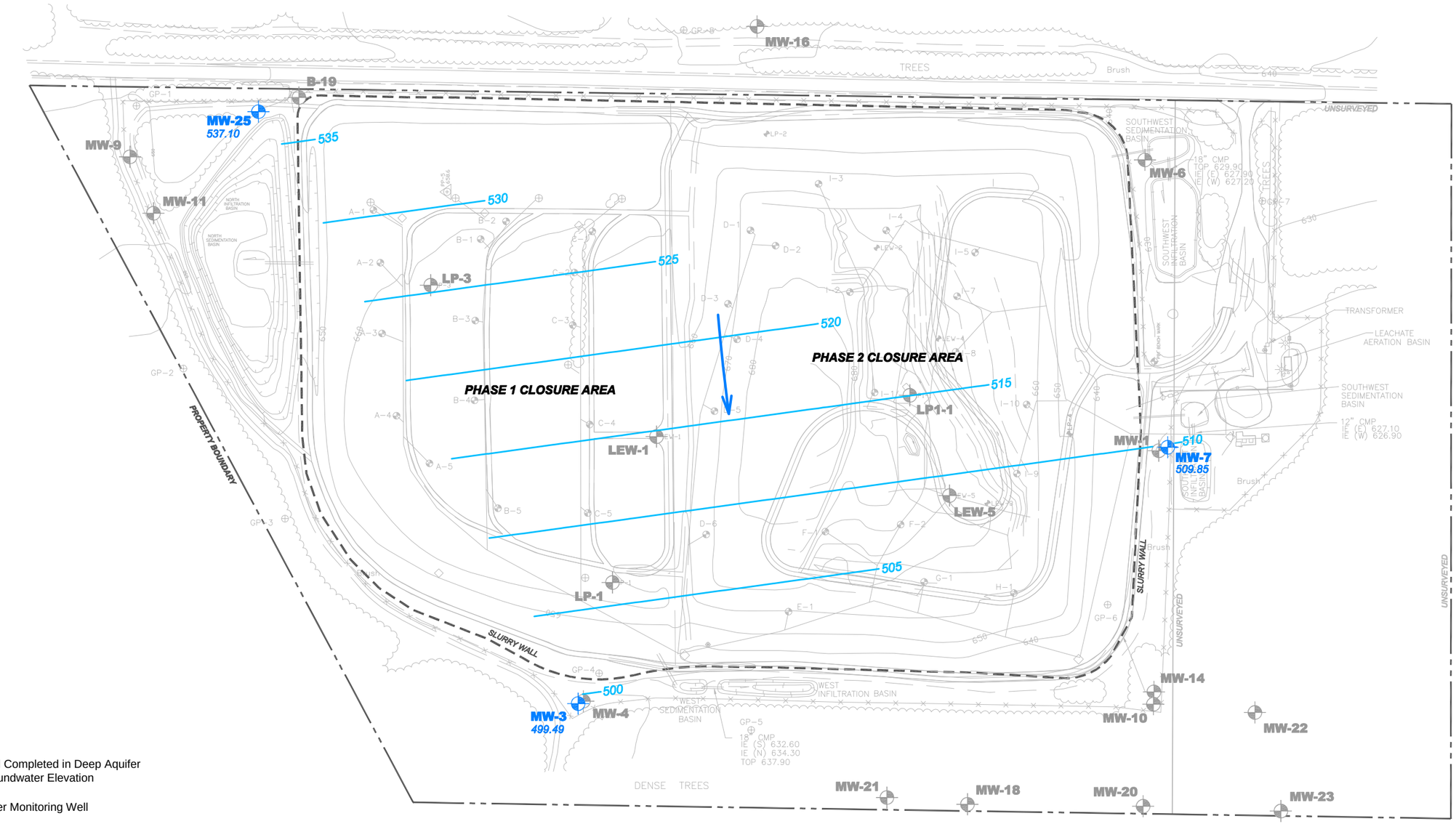

Legend

MW-3 *XXX.XX* — Well Completed in Deep Aquifer Groundwater Elevation

MW-4 — Other Monitoring Well

535 — Inferred Deep Aquifer Groundwater Elevation Contour *(feet MSL)*

Inferred Horizontal Groundwater Flow Path

Slurry Wall

Note:
Groundwater level measurements made on August 22, 2007.

N

0 200 400
Feet

Topography prepared by ***DEGROSS AERIAL MAPPING*** from photogrammetric methods (11-23-92).
Topography updated by ***Emcon Northwest Inc.*** (04-20-94).

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Groundwater Potentiometric Surface Map
Deep Aquifer - Low Groundwater Levels - 2007
Hobart Landfill
King County, Washington

DATE: Sept 2008	PROJECT NO. 070074
DESIGNED BY: PSB/JJS	
DRAWN BY: PMB	FIGURE NO. 4
REVISED BY: -	

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APPENDIX C

Statistical Tables

Summary of Statistical Analyses for Shallow Aquifer
Summary of Statistical Analyses for Deep Aquifer
Trend Table for Shallow Aquifer
Trend Table for Deep Aquifer

Hobart Landfill
Summary of Statistical Analyses for Groundwater Well Samples 1986 - August 2008

Pre-9/4/1986 to 4/12/1989 Post- 4/13/1989 to Current Current - Last 8 reportable results (dates vary)

SHALLOW AQUIFER

Well Location	**MW-11**			**MW-6**			**MW-1**			**MW-4**			**MW-10**			**MW-18**		
Gradient Location	Up			Side			Down			Down			Down			Down		
	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current
pH, Standard Units - Lab Measurement																		
No. of Analyses	6	72	8	6	73	8	7	69	8	9	72	8	8	70	8	6	71	8
No. of Detections	6	72	8	6	73	8	6	69	8	10	72	8	12	70	8	6	71	8
Minimum	5.8	5.6	6.0	6.2	6.0	6.6	ND	5.8	6.4	5.8	5.4	5.6	5.8	6.1	5.9	5.7	5.9	5.8
Maximum	7.4	8.1	6.7	6.7	7.3	7.4	6.9	8.2	7.0	7.8	7.5	6.3	6.5	7.7	6.9	6.7	7.7	6.8
Mean	6.5	6.3	6.3	6.4	6.9	6.9	6.4	6.6	6.6	6.4	6.1	6.0	6.3	6.5	6.5	6.1	6.6	6.4
Standard Deviation	0.6	0.4	0.2	0.2	0.2	0.3	0.3	0.3	0.2	0.6	0.3	0.3	0.3	0.2	0.3	0.4	0.3	0.3
Median	6.2	6.2	6.2	6.3	6.9	6.9	6.5	6.6	6.6	6.3	6.1	6.1	6.4	6.5	6.6	6.1	6.6	6.6
pH, Standard Units - Field Measurement																		
No. of Analyses	6	71	8	6	70	8	6	64	8	6	72	8	6	68	8	6	68	8
No. of Detections	6	71	8	6	70	8	6	64	8	6	72	8	6	68	8	6	68	8
Minimum	6.2	5.4	5.5	6.5	5.9	6.7	6.4	5.7	6.2	5.9	5.0	5.6	6.3	5.6	6.2	6.3	5.6	6.1
Maximum	7.4	8.9	6.1	7.3	7.9	7.0	6.8	8.3	6.7	6.5	7.8	5.9	6.7	7.4	6.8	7.7	8.4	6.5
Mean	6.6	6.4	5.9	6.9	7.0	6.8	6.6	6.7	6.3	6.1	6.2	5.7	6.5	6.6	6.4	6.7	6.7	6.4
Standard Deviation	0.5	0.7	0.2	0.3	0.4	0.1	0.2	0.4	0.2	0.2	0.5	0.1	0.1	0.3	0.2	0.6	0.5	0.1
Median	6.4	6.3	5.9	6.9	7.1	6.8	6.7	6.7	6.3	6.0	6.1	5.7	6.6	6.6	6.4	6.4	6.6	6.4
Specific Conductance, micromhos/cm																		
No. of Analyses	6	72	8	6	71	8	6	65	8	6	72	8	6	69	8	6	68	8
No. of Detections	6	72	8	6	71	8	6	65	8	6	72	8	6	69	8	6	68	8
Minimum	40	8	45	120	8	10	210	6	100	80	8	38	360	8	100	320	8	51
Maximum	63	12	57	390	13	10	480	14	130	230	13	49	560	14	130	450	13	60
Mean	54	10	52	267	10	10	321	11	110	145	10	44	460	10	111	400	10	55
Standard Deviation	9	1	5	92	1	0	90	2	9	51	1	4	85	1	9	50	1	3
Median	57	10	53	272	10	10	309	11	108	143	10	43	465	10	110	406	10	55
Total Dissolved Solids, mg/L																		
No. of Analyses	ID	67	8	ID	68	8	ID	65	8	ID	68	8	ID	67	8	ID	67	8
No. of Detections	ID	65	8	ID	67	8	ID	65	8	ID	66	7	ID	67	8	ID	66	8
Minimum	ID	ND	9	ID	ND	48	ID	26	6	ID	ND	ND	ID	17	36	ID	ND	28
Maximum	ID	95.0	60	ID	190	87	ID	286	85	ID	96	51	ID	230	81	ID	160	57
Mean	ID	36.7	37.6	ID	89.1	68.3	ID	93.0	56.4	ID	36.3	32.9	ID	97.9	62.6	ID	50.9	41.9
Standard Deviation	ID	17.6	15.7	ID	28.9	11.3	ID	37.3	26.3	ID	15.4	16.1	ID	42.7	16.6	ID	24.1	9.1
Median	ID	38.0	38	ID	87	70	ID	86	60	ID	35	32	ID	90	61	ID	49	43

Hobart Landfill
Summary of Statistical Analyses for Groundwater Well Samples 1986 - August 2008

Pre-9/4/1986 to 4/12/1989 Post- 4/13/1989 to Current Current - Last 8 reportable results (dates vary)

SHALLOW AQUIFER

Well Location	**MW-11**			**MW-6**			**MW-1**			**MW-4**			**MW-10**			**MW-18**		
Gradient Location	Up			Side			Down			Down			Down			Down		
	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current
Ammonia as N, mg/L																		
No. of Analyses	7	72	8	7	73	8	8	69	8	10	72	8	9	70	8	7	71	8
No. of Detections	1	10	0	1	16	0	8	67	8	2	11	0	9	68	8	5	22	1
Minimum	ND	ND	ND	ND	ND	ND	4.4	ND	0.0	ND	ND	ND	3.5	ND	0.6	ND	ND	ND
Maximum	0.1	0.4	ND	0.1	1.0	ND	8.4	5.4	0.3	0.3	0.2	ND	8.4	6.8	0.9	0.3	0.3	0.0
Mean	ID	0.0	ID	ID	0.03	ID	5.8	1.3	0.2	ID	0.02	ID	6.9	1.6	0.8	0.1	0.02	ID
Standard Deviation	ID	0.0	ID	ID	0.12	ID	1.3	1.5	0.1	ID	0.03	ID	1.5	1.2	0.1	0.1	0.05	ID
Median	ID	0.0	ID	ID	0.01	ID	5.6	0.7	0.2	ID	0.01	ID	7.4	1.2	0.8	0.1	0.01	ID
Chloride, mg/L																		
No. of Analyses	7	72	8	7	73	8	8	69	8	10	72	8	9	70	8	7	71	8
No. of Detections	7	69	8	7	73	8	8	55	7	10	69	8	9	52	3	7	71	8
Minimum	1.0	ND	1.4	4.0	1.4	2.2	5.0	ND	ND	2.0	ND	1.1	6.0	ND	ND	11.0	1.0	1.8
Maximum	3.0	9.0	3.3	8.1	41.7	2.6	16.0	9.0	3.4	18.0	3.5	3.1	18.0	24.0	1.4	25.0	12.0	2.5
Mean	1.9	2.0	2.3	6.3	2.9	2.4	9.5	2.4	2.3	4.3	1.7	2.1	11.1	2.3	0.8	17.7	2.3	2.0
Standard Deviation	0.6	1.1	0.7	1.7	4.6	0.1	3.5	1.8	0.9	5.2	0.6	0.6	3.7	3.2	0.4	4.9	1.5	0.2
Median	2.0	2.0	2.6	6.0	2.1	2.4	8.5	2.0	2.6	2.0	2.0	2.0	12.0	1.0	0.5	17.0	2.0	2.0
Nitrate as N, mg/L																		
No. of Analyses	7	72	8	7	73	8	8	69	8	10	72	8	9	70	8	7	71	8
No. of Detections	6	71	8	2	49	8	2	14	1	8	71	8	2	16	0	7	39	6
Minimum	ND	ND	0.2	ND	ND	0.1	ND	ND	ND	ND	ND	0.3	ND	ND	ND	0.1	ND	ND
Maximum	0.7	1.2	0.9	0.2	0.4	0.3	0.2	0.5	0.14	1.4	3.6	0.6	0.8	0.6	ND	3.3	0.5	0.19
Mean	0.4	0.5	0.5	ID	0.08	0.2	ID	0.04	ID	0.4	0.81	0.4	ID	0.05	ID	1.0	0.06	0.09
Standard Deviation	0.2	0.3	0.2	ID	0.07	0.1	ID	0.07	ID	0.4	0.62	0.1	ID	0.08	ID	1.1	0.08	0.06
Median	0.3	0.4	0.4	ID	0.05	0.3	ID	0.03	ID	0.3	0.70	0.5	ID	0.03	ID	0.7	0.05	0.10
Sulfate, mg/L																		
No. of Analyses	7	72	8	7	73	8	8	69	8	10	72	8	9	70	8	7	71	8
No. of Detections	7	67	8	7	73	8	8	68	7	10	71	8	6	70	8	7	71	8
Minimum	3.0	ND	2.5	5.0	4.0	4.2	2.0	ND	ND	4.0	ND	2.1	ND	3.0	4.8	2.0	2.0	2.7
Maximum	4.0	18.0	2.9	11	13.0	4.9	24.0	130	10	58.0	13	2.6	4.0	68.2	6.5	4.9	20.1	3.5
Mean	3.5	3.1	2.7	7.9	6.6	4.5	7.3	15.3	5.7	12.0	4.0	2.4	1.6	15	5.7	2.8	4.8	3.0
Standard Deviation	0.5	2.3	0.1	2.3	2.0	0.2	7.1	16.5	2.7	16.4	2.3	0.2	1.3	12.4	0.7	1.0	2.9	0.2
Median	3.3	3.0	2.7	7.2	6.0	4.5	6.0	11.7	5.7	7.2	3.0	2.5	1.0	12	6.0	3.0	4.0	2.9

Hobart Landfill
Summary of Statistical Analyses for Groundwater Well Samples 1986 - August 2008

Pre-9/4/1986 to 4/12/1989 Post- 4/13/1989 to Current Current - Last 8 reportable results (dates vary)

SHALLOW AQUIFER

Well Location	**MW-11**			**MW-6**			**MW-1**			**MW-4**			**MW-10**			**MW-18**		
Gradient Location	Up			Side			Down			Down			Down			Down		
	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current
Alkalinity, mg/L																		
No. of Analyses	ID	47	8	ID	48	8	ID	45	8	ID	47	8	ID	47	8	ID	47	8
No. of Detections	ID	47	8	ID	48	8	ID	45	8	ID	47	8	ID	47	8	ID	47	8
Minimum	ID	12.0	12	ID	48	48	ID	30	40	ID	9	10	ID	16	39	ID	11	18
Maximum	ID	45.0	26	ID	110	52	ID	80	51	ID	60	26	ID	120	62	ID	44	22
Mean	ID	19.7	17.6	ID	58.9	50.3	ID	53.2	44.9	ID	15.8	15.9	ID	64.6	47.0	ID	27.2	20.3
Standard Deviation	ID	5.6	4.7	ID	9.7	1.7	ID	10.6	4.2	ID	7.3	4.9	ID	20.1	6.8	ID	6.4	1.7
Median	ID	19.0	16	ID	57	50	ID	52	45	ID	14	16	ID	60	46	ID	26	20
Arsenic, mg/L																		
No. of Analyses	6	72	8	6	73	8	7	69	8	9	72	8	8	70	8	6	71	8
No. of Detections	0	2	0	0	4	0	6	45	0	0	0	0	8	68	8	0	52	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.007	ND	0.006	ND	ND	ND
Maximum	ND	0.003	ND	ND	0.004	ND	0.010	0.012	ND	ND	ND	ND	0.012	0.011	0.008	ND	0.003	ND
Mean	ID	ID	ID	ID	0.001	ID	0.008	0.005	ID	ID	ID	ID	0.010	0.007	0.007	ID	0.001	ID
Standard Deviation	ID	ID	ID	ID	0.001	ID	0.003	0.004	ID	ID	ID	ID	0.002	0.001	0.001	ID	0.001	ID
Median	ID	ID	ID	ID	0.001	ID	0.009	0.005	ID	ID	ID	ID	0.011	0.007	0.006	ID	0.001	ID
Calcium, mg/L																		
No. of Analyses	ID	59	8	ID	60	8	ID	57	8	ID	59	8	ID	59	8	ID	59	8
No. of Detections	ID	48	7	ID	61	8	ID	57	8	ID	47	8	ID	59	8	ID	59	8
Minimum	ID	ND	ND	ID	5.6	10.0	ID	12	11.0	ID	ND	3.5	ID	4.6	10.0	ID	4.6	4.5
Maximum	ID	15	5.6	ID	28.2	13.0	ID	47	14.0	ID	6.9	4.2	ID	45.8	12.0	ID	9.5	5.7
Mean	ID	5.2	4.8	ID	15.2	11.5	ID	16.7	12.0	ID	4.5	3.9	ID	17.5	11.3	ID	6.5	5.0
Standard Deviation	ID	1.7	0.6	ID	3.9	0.9	ID	5.5	1.3	ID	1.0	0.3	ID	7.9	0.7	ID	1.4	0.4
Median	ID	4.7	4.8	ID	15	11.5	ID	15	11.5	ID	4.3	4.0	ID	15	11.0	ID	6.3	5.0
Magnesium, mg/L																		
No. of Analyses	ID	59	8	ID	60	8	ID	57	8	ID	59	8	ID	59	8	ID	59	8
No. of Detections	ID	59	8	ID	60	8	ID	57	8	ID	59	8	ID	59	8	ID	59	8
Minimum	ID	1.0	1.0	ID	1.6	3.6	ID	2.0	2.4	ID	0.6	0.7	ID	1.1	1.7	ID	0.1	0.9
Maximum	ID	3.7	1.5	ID	8.9	4.4	ID	8.1	3.2	ID	1.1	1.0	ID	6.4	2.4	ID	1.9	1.1
Mean	ID	1.4	1.2	ID	5.1	4.0	ID	3.5	2.7	ID	0.8	0.8	ID	2.6	2.0	ID	1.3	1.0
Standard Deviation	ID	0.5	0.2	ID	1.2	0.3	ID	1.1	0.3	ID	0.1	0.1	ID	1.0	0.2	ID	0.3	0.1
Median	ID	1.3	1.3	ID	5.1	4.0	ID	3.3	2.7	ID	0.8	0.8	ID	2.4	2.1	ID	1.2	1.1

Hobart Landfill
Summary of Statistical Analyses for Groundwater Well Samples 1986 - August 2008

Pre-9/4/1986 to 4/12/1989 Post- 4/13/1989 to Current Current - Last 8 reportable results (dates vary)

SHALLOW AQUIFER

Well Location	**MW-11**			**MW-6**			**MW-1**			**MW-4**			**MW-10**			**MW-18**		
Gradient Location	Up			Side			Down			Down			Down			Down		
	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current
Potassium, mg/L																		
No. of Analyses	ID	59	8	ID	60	8	ID	57	8	ID	59	8	ID	59	8	ID	59	8
No. of Detections	ID	53	8	ID	59	8	ID	57	8	ID	59	8	ID	57	8	ID	55	8
Minimum	ID	ND	0.3	ID	ND	0.6	ID	1.4	1.6	ID	0.7	0.7	ID	ND	2.4	ID	ND	0.5
Maximum	ID	1.60	0.4	ID	1.2	0.7	ID	5.1	1.9	ID	1.9	0.8	ID	6.3	2.8	ID	1.2	0.6
Mean	ID	0.42	0.4	ID	0.7	0.6	ID	2.5	1.7	ID	1.0	0.7	ID	3.7	2.6	ID	0.6	0.6
Standard Deviation	ID	0.21	0.03	ID	0.2	0.04	ID	1.0	0.1	ID	0.3	0.1	ID	1.3	0.1	ID	0.2	0.04
Median	ID	0.37	0.4	ID	0.7	0.6	ID	2.0	1.7	ID	0.9	0.7	ID	3.5	2.6	ID	0.6	0.6
Sodium, mg/L																		
No. of Analyses	ID	59	8	ID	60	8	ID	57	8	ID	59	8	ID	59	8	ID	59	8
No. of Detections	ID	59	8	ID	60	8	ID	57	8	ID	59	8	ID	59	8	ID	59	8
Minimum	ID	2.0	2.6	ID	3.0	3.4	ID	1.4	1.6	ID	2.0	2.2	ID	1.8	1.7	ID	2.7	2.5
Maximum	ID	4.5	3.3	ID	6.1	4.0	ID	7.8	2.4	ID	3.7	3.0	ID	7.0	2.3	ID	6.0	3.3
Mean	ID	2.9	2.9	ID	4.3	3.6	ID	3.1	2.2	ID	2.7	2.5	ID	3.6	2.0	ID	3.9	2.9
Standard Deviation	ID	0.35	0.22	ID	0.69	0.22	ID	1.46	0.24	ID	0.40	0.25	ID	1.38	0.20	ID	0.89	0.28
Median	ID	2.9	2.9	ID	4.3	3.6	ID	2.5	2.2	ID	2.6	2.4	ID	3.1	2.0	ID	3.7	2.9
Iron, mg/L																		
No. of Analyses	6	72	8	6	73	8	8	69	8	9	72	8	8	70	8	6	71	8
No. of Detections	3	48	8	6	63	8	8	69	8	3	47	7	8	70	8	6	71	8
Minimum	ND	ND	0.006	0.15	ND	0.04	7.4	0.19	0.28	ND	ND	ND	10	0.02	3.4	0.92	0.069	0.094
Maximum	2.1	1.4	0.029	0.82	0.59	0.11	24	21.9	1.30	1.9	0.62	0.10	19	15	4.7	2.40	1.10	0.180
Mean	0.443	0.052	0.022	0.42	0.07	0.06	13.29	4.97	0.79	0.35	0.03	0.03	13.5	5.82	4.0	1.43	0.28	0.118
Standard Deviation	0.819	0.169	0.008	0.27	0.10	0.02	6.23	4.54	0.31	0.63	0.08	0.03	3.38	2.71	0.44	0.57	0.183	0.028
Median	0.123	0.013	0.024	0.32	0.04	0.06	11	4.5	0.75	0.03	0.01	0.03	13.5	5.1	4.0	1.25	0.23	0.110
Manganese, mg/L																		
No. of Analyses	7	72	8	7	73	8	8	69	8	10	72	8	9	70	8	7	71	8
No. of Detections	3	6	0	7	72	7	8	69	8	9	13	0	9	69	8	7	71	8
Minimum	ND	ND	ND	0.360	ND	ND	1.1	0.079	0.750	ND	ND	ND	1.9	ND	0.77	5.5	0.84	0.680
Maximum	0.080	0.730	ND	2.650	0.680	0.013	4.3	6.680	1.800	1.80	0.023	ND	4.2	4.0	1.30	10.5	6.5	1.0
Mean	0.018	0.011	ID	1.086	0.097	0.003	2.39	1.758	1.519	0.67	0.002	ID	3.16	1.49	1.01	7.4	1.53	0.819
Standard Deviation	0.029	0.086	ID	0.725	0.165	0.004	1.19	1.094	0.327	0.67	0.004	ID	0.71	0.76	0.16	1.9	0.89	0.117
Median	0.008	0.001	ID	0.950	0.011	0.002	2.0	1.500	1.600	0.52	0.001	ID	3.1	1.3	0.97	6.7	1.31	0.810

Hobart Landfill

Summary of Statistical Analyses for Groundwater Well Samples 1986 - August 2008

Pre-9/4/1986 to 4/12/1989 Post- 4/13/1989 to Current Current - Last 8 reportable results (dates vary)

SHALLOW AQUIFER

Well Location	**MW-11**			**MW-6**			**MW-1**			**MW-4**			**MW-10**			**MW-18**		
Gradient Location	Up			Side			Down			Down			Down			Down		
	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current	Pre	Post	Current
1,1-Dichloroethane, ug/L																		
No. of Analyses	7	72	8	7	72	8	8	69	8	9	72	8	9	70	8	7	71	8
No. of Detections	0	0	0	1	39	0	1	1	0	0	0	0	2	3	0	2	1	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	2.5	1.1	ND	2.5	0.5	ND	ND	ND	ND	3.0	1.0	ND	2.5	0.5	ND
Mean	ID	ID	ID	ID	0.40	ID	ID	ID	ID	ID	ID	ID	ID	0.19	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	0.28	ID	ID	ID	ID	ID	ID	ID	ID	0.20	ID	ID	ID	ID
Median	ID	ID	ID	ID	0.42	ID	ID	ID	ID	ID	ID	ID	ID	0.10	ID	ID	ID	ID
cis-1,1-Dichloroethene, ug/L																		
No. of Analyses	5	64	8	5	64	8	5	61	8	6	63	8	5	62	8	5	63	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	4	21	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0	ND	2.0	2.0	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.14	ID	1.7	0.2	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.14	ID	0.7	0.3	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	0.10	ID	2.0	0.1	ID
1,1,1-Trichloroethane, ug/L																		
No. of Analyses	7	72	8	7	72	8	8	69	8	9	72	8	9	70	8	7	71	8
No. of Detections	0	0	0	4	43	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	3.0	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	1.64	0.42	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	1.14	0.35	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	2.0	0.33	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Vinyl Chloride, ug/L																		
No. of Analyses	5	72	8	5	72	8	5	69	8	6	72	8	5	70	8	5	71	8
No. of Detections	0	0	0	0	4	0	0	0	0	0	0	0	0	3	0	4	1	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND	ND	ND	1.0	ND	2.0	1.0	ND
Mean	ID	ID	ID	ID	0.16	ID	ID	ID	ID	ID	ID	ID	ID	0.16	ID	1.7	ID	ID
Standard Deviation	ID	ID	ID	ID	0.32	ID	ID	ID	ID	ID	ID	ID	ID	0.32	ID	0.67	ID	ID
Median	ID	ID	ID	ID	0.01	ID	ID	ID	ID	ID	ID	ID	ID	0.01	ID	2.0	ID	ID

NOTES:

ID	Insufficient Data. The number of detections is less than 3.
ND	Not Detected (at laboratory MDL).
mg/L	Milligram per liter.
ug/L	Microgram per liter.
na	Not applicable. Limited data prior to last 8 samples

Hobart Landfill
Summary of Statistical Analyses for Groundwater Well Samples 1986 - August 2008

Pre-9/4/1986 to 4/12/1989 Post- 4/13/1989 to Current Current - Last 8 reportable results (dates vary)

DEEP AQUIFER

Well Location	**MW-9**		**MW-25**		**MW-7**			**MW-3**		
Gradient Location	Up		Up (Replaced MW-9)		Side			Down		
	Pre	Post	Post	Current	Pre	Post	Current	Pre	Post	Current
pH, Standard Units - Lab Measurement										
No. of Analyses	6	49	20	8	8	71	8	8	73	8
No. of Detections	6	49	20	8	8	71	8	8	73	8
Minimum	6.7	6.4	6.6	6.4	6.3	6.8	7.1	6.6	6.6	7.1
Maximum	9.7	7.9	8.1	7.9	7.6	9.0	7.7	7.9	8.0	7.7
Mean	7.6	7.3	7.5	7.3	7.2	7.3	7.4	7.2	7.3	7.4
Standard Deviation	1.1	0.4	0.3	0.5	0.4	0.3	0.2	0.5	0.3	0.3
Median	7.4	7.4	7.5	7.4	7.3	7.3	7.5	7.2	7.3	7.6
pH, Standard Units - Field Measurement										
No. of Analyses	6	49	21	8	6	70	8	6	71	8
No. of Detections	6	49	21	8	6	70	8	6	71	8
Minimum	6.4	5.7	7.7	7.7	7.1	5.8	7.3	7.0	5.8	7.2
Maximum	8.1	9.3	8.4	8.4	8.4	8.0	7.8	8.0	8.2	7.6
Mean	7.4	7.5	8.0	8.0	7.6	7.2	7.5	7.5	7.5	7.4
Standard Deviation	0.6	0.6	0.2	0.2	0.6	0.4	0.2	0.4	0.4	0.1
Median	7.5	7.6	8.0	8.0	7.4	7.3	7.5	7.6	7.6	7.4
Specific Conductance, micromhos/cm										
No. of Analyses	6	50	21	8	6	70	8	7	71	8
No. of Detections	6	50	21	8	6	70	8	7	71	8
Minimum	87	67	81	90	272	255	285	105	87	115
Maximum	100	112	92	93	450	561	320	130	131	135
Mean	93	93	88	91	400	400	303	115	114	128
Standard Deviation	5	8	3	1	68	85	13	9	10	6
Median	93	91	87	91	423	393	305	115	113	130
Total Dissolved Solids, mg/L										
No. of Analyses	ID	45	20	8	ID	67	8	ID	69	8
No. of Detections	ID	44	20	8	ID	67	8	ID	69	8
Minimum	ID	ND	25	25	ID	64	160	ID	16	62
Maximum	ID	100	100	78	ID	350	200	ID	110	82
Mean	ID	63	60	55	ID	249	181	ID	75	75
Standard Deviation	ID	19.6	17.2	17.0	ID	59.4	12.5	ID	15.8	7.3
Median	ID	64	60	55	ID	260	180	ID	77	78
Ammonia as N, mg/L										
No. of Analyses	7	49	20	8	9	71	8	9	73	8
No. of Detections	2	7	2	0	1	13	0	0	9	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	0.08	0.03	0.08	ND	0.09	0.18	ND	ND	0.09	ND
Mean	ID	0.01	ID	ID	ID	0.02	ID	ID	0.01	ID
Standard Deviation	ID	0.01	ID	ID	ID	0.03	ID	ID	0.02	ID
Median	ID	0.01	ID	ID	ID	0.01	ID	ID	0.01	ID
Chloride, mg/L										
No. of Analyses	7	49	20	8	9	71	8	9	73	8
No. of Detections	7	7	20	8	9	71	8	9	73	8
Minimum	1.0	ND	2.0	2.6	13.0	4.6	3.8	1.5	1.0	2.7
Maximum	3.0	3.2	3.0	3.1	15.0	18.0	5.0	2.0	5.0	3.2
Mean	1.9	1.8	2.3	2.8	14.1	9.6	4.2	1.9	2.5	3.0
Standard Deviation	0.6	0.6	0.4	0.2	0.6	3.4	0.4	0.2	0.7	0.2
Median	2.0	2.0	2.0	2.7	14.0	9.0	4.1	2.0	2.5	3.1
Nitrate as N, mg/L										
No. of Analyses	7	49	20	8	9	71	8	9	73	8
No. of Detections	6	49	20	8	1	35	1	4	38	0
Minimum	ND	0.0	0.0	0.0	ND	ND	ND	ND	ND	ND
Maximum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ND
Mean	0.3	0.3	0.3	0.3	ID	0.0	ID	0.1	0.1	ID
Standard Deviation	0.1	0.1	0.0	0.0	ID	0.0	ID	0.1	0.1	ID
Median	0.3	0.3	0.3	0.3	ID	0.0	ID	0.1	0.0	ID

Hobart Landfill
Summary of Statistical Analyses for Groundwater Well Samples 1986 - August 2008

Pre-9/4/1986 to 4/12/1989 Post- 4/13/1989 to Current Current - Last 8 reportable results (dates vary)

DEEP AQUIFER

Well Location	**MW-9**		**MW-25**		**MW-7**			**MW-3**		
Gradient Location	Up		Up (Replaced MW-9)		Side			Down		
	Pre	Post	Post	Current	Pre	Post	Current	Pre	Post	Current
Sulfate, mg/L										
No. of Analyses	7	49	20	8	9	71	8	9	73	8
No. of Detections	7	47	20	8	9	71	8	9	64	7
Minimum	3.0	ND	1.9	1.8	2.0	1.2	11.0	2.0	ND	ND
Maximum	6.0	4.2	2.1	2.3	3.0	18.0	12.0	3.0	4.5	2.9
Mean	3.6	2.8	2.0	2.0	2.5	9.3	11.4	2.5	2.2	2.3
Standard Deviation	1.1	0.7	0.0	0.2	0.5	3.5	0.5	0.5	0.8	0.8
Median	3.0	3.0	2.0	2.0	2.4	10.0	11.0	2.9	2.0	2.6
Alkalinity, mg/L										
No. of Analyses	ID	25	20	8	ID	47	8	ID	49	8
No. of Detections	ID	25	20	8	ID	47	8	ID	49	8
Minimum	ID	40	38	38	ID	100	150	ID	41	58
Maximum	ID	50	42	42	ID	284	170	ID	62	68
Mean	ID	43.7	39.5	39.5	ID	194.1	153.8	ID	56.5	62.8
Standard Deviation	ID	2.2	1.1	1.4	ID	43.1	7.4	ID	3.2	3.0
Median	ID	44	40	40	ID	190	150	ID	57	63
Arsenic, mg/L										
No. of Analyses	7	49	20	8	9	71	8	9	73	8
No. of Detections	0	41	17	8	0	7	0	0	3	0
Minimum	ND	ND	ND	0.001	ND	ND	ND	ND	ND	ND
Maximum	ND	0.003	0.002	0.001	ND	0.007	ND	ND	0.003	ND
Mean	ID	0.001	0.001	0.001	ID	0.001	ID	ID	0.001	ID
Standard Deviation	ID	0.001	0.000	0.000	ID	0.001	ID	ID	0.000	ID
Median	ID	0.001	0.001	0.001	ID	0.001	ID	ID	0.001	ID
Calcium, mg/L										
No. of Analyses	ID	37	20	8	ID	59	8	ID	61	8
No. of Detections	ID	37	20	8	ID	49	8	ID	8	8
Minimum	ID	7.4	6.8	7.5	ID	ND	34.0	ID	ND	10.0
Maximum	ID	13	11.0	8.9	ID	77.8	38.0	ID	13.0	20.0
Mean	ID	9.7	8.3	8.3	ID	55.2	36.0	ID	10.0	12.3
Standard Deviation	ID	0.97	1.0	0.5	ID	14.2	1.7	ID	1.7	3.2
Median	ID	10	8.2	8.4	ID	57.0	37.0	ID	10.0	11.0
Magnesium, mg/L										
No. of Analyses	ID	37	20	8	ID	59	8	ID	61	8
No. of Detections	ID	37	20	8	ID	59	8	ID	61	8
Minimum	ID	2.8	2.6	2.9	ID	11.0	11.0	ID	0.03	3.9
Maximum	ID	3.51	4.0	3.3	ID	23.7	13.0	ID	4.8	6.4
Mean	ID	3.28	3.0	3.0	ID	17.3	11.9	ID	3.6	4.4
Standard Deviation	ID	0.18	0.3	0.1	ID	4.0	0.6	ID	0.6	0.8
Median	ID	3.3	3.0	3.0	ID	18.0	12.0	ID	3.6	4.2
Potassium, mg/L										
No. of Analyses	ID	37	20	8	ID	59	8	ID	61	8
No. of Detections	ID	37	20	8	ID	59	8	ID	59	8
Minimum	ID	ND	0.4	0.4	ID	0.7	0.9	ID	ND	0.6
Maximum	ID	0.9	0.6	0.5	ID	1.8	1.0	ID	1.2	1.2
Mean	ID	0.42	0.5	0.5	ID	1.2	1.0	ID	0.7	0.7
Standard Deviation	ID	0.285	0.1	0.0	ID	0.2	0.0	ID	0.2	0.2
Median	ID	0.47	0.5	0.5	ID	1.2	1.0	ID	0.6	0.7
Sodium, mg/L										
No. of Analyses	ID	37	20	8	ID	59	8	ID	61	8
No. of Detections	ID	37	20	8	ID	59	8	ID	61	8
Minimum	ID	2.9	4.1	4.2	ID	6.7	7.1	ID	3.1	8.0
Maximum	ID	4.7	6.4	5.3	ID	12.0	8.6	ID	9.8	12.0
Mean	ID	3.96	4.7	4.6	ID	9.5	7.8	ID	8.4	8.9
Standard Deviation	ID	0.3	0.6	0.4	ID	1.3	0.5	ID	0.9	1.3
Median	ID	4	4.6	4.6	ID	9.7	7.8	ID	8.4	8.4

Hobart Landfill
Summary of Statistical Analyses for Groundwater Well Samples 1986 - August 2008

Pre-9/4/1986 to 4/12/1989 Post- 4/13/1989 to Current Current - Last 8 reportable results (dates vary)

DEEP AQUIFER

Well Location	**MW-9**		**MW-25**		**MW-7**			**MW-3**		
Gradient Location	Up		Up (Replaced MW-9)		Side			Down		
	Pre	Post	Post	Current	Pre	Post	Current	Pre	Post	Current
Iron, mg/L										
No. of Analyses	7	49	20	8	9	71	8	9	73	8
No. of Detections	3	29	17	8	4	55	8	2	47	8
Minimum	ND	ND	ND	0.013	ND	ND	0.100	ND	ND	0.023
Maximum	0.270	0.450	0.061	0.061	0.090	0.730	0.180	0.310	0.330	0.094
Mean	0.089	0.041	0.031	0.036	0.040	0.091	0.126	ID	0.037	0.064
Standard Deviation	0.120	0.074	0.017	0.015	0.029	0.105	0.032	ID	0.060	0.025
Median	0.025	0.013	0.033	0.034	0.025	0.080	0.110	ID	0.021	0.070
Manganese, mg/L										
No. of Analyses	7	49	20	8	9	71	8	9	73	8
No. of Detections	1	8	4	1	5	15	2	9	71	8
Minimum	ND	ND	ND	ND	ND	ND	ND	0.021	ND	0.043
Maximum	0.029	0.030	0.009	0.001	0.066	0.280	0.230	0.052	0.050	0.050
Mean	ID	0.003	0.001	ID	0.010	0.006	ID	0.026	0.037	0.048
Standard Deviation	ID	0.006	0.002	ID	0.021	0.033	ID	0.010	0.009	0.002
Median	ID	0.001	0.001	ID	0.004	0.001	ID	0.022	0.040	0.047
1,1-Dichloroethane, ug/L										
No. of Analyses	7	49	20	8	9	72	8	9	73	8
No. of Detections	0	0	0	0	0	32	1	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	0.63	0.22	ND	ND	ND
Mean	ID	ID	ID	ID	ID	0.29	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	0.18	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	0.32	ID	ID	ID	ID
cis-1,1-Dichloroethene, ug/L										
No. of Analyses	5	41	20	8	6	64	8	5	65	8
No. of Detections	0	0	0	0	0	1	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	0.50	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
1,1,1-Trichloroethane, ug/L										
No. of Analyses	7	49	20	8	9	72	8	9	73	8
No. of Detections	0	0	0	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Vinyl Chloride, ug/L										
No. of Analyses	5	41	20	8	6	72	8	5	73	8
No. of Detections	0	0	0	0	0	1	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	1.00	ND	ND	ND	ND
Mean	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID

NOTES:

	Insufficient Data. The number of detections is less than 3.
ND	Not Detected (at laboratory MDL).
mg/L	Milligram per liter.
ug/L	Microgram per liter.
na	Not applicable. Limited data prior to last 8 samples

Hobart Landfill
Trends in Individual Wells

	SHALLOW AQUIFER												DEEP AQUIFER					
Well Location	**MW-11**		**MW-6**		**MW-1**		**MW-4**		**MW-10**		**MW-18**		**MW-25**		**MW-7**		**MW-3**	
*Gradient Location	Up		Side		Down		Down		Down		Down		Up		Down		Down	
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH - Lab Measurement																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
Trend	--	--	I	--	I	--	--	--	--	--	--	--	--	--	--	--	--	--
Probability	0.300	0.227	0.032	1.000	0.032	1.000	0.447	0.085	0.096	0.904	0.096	0.085	0.428	0.634	0.066	0.227	0.763	0.634
Probability	0.300	0.227	0.032	1.000	0.032	1.000	0.447	0.085	0.096	0.904	0.096	0.085	0.428	0.634	0.066	0.227	0.763	0.634
Significant	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
pH - Field Measurement																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
Trend	D	--	D	--	D	--	D	--	--	--	D	--	--	D	I	--	--	--
Probability	0.000	1.000	0.002	0.904	0.001	0.812	0.000	0.062	0.118	0.812	0.000	0.108	0.685	0.010	0.039	0.720	0.065	0.178
Probability	9.93E-08	1.000	0.002	0.904	0.001	0.812	0.000	0.062	0.118	0.812	9.65E-06	0.108	0.685	0.010	0.039	0.720	0.065	0.178
Significant	YES	NO	YES	NO	YES	NO	YES	NO	NO	NO	YES	NO	NO	YES	YES	NO	NO	NO
Specific Conductance - Field Measurement																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
Trend	I	--	D	--	D	--	D	--	D	--	D	--	--	--	D	D	I	--
Probability	0.048	0.227	0.000	0.904	0.000	0.398	0.000	0.062	0.000	0.720	0.000	0.143	0.096	0.085	0.000	0.014	0.000	1.000
Probability	0.048	0.227	0.000	0.904	0.000	0.398	0.000	0.062	0.000	0.720	0.000	0.143	0.096	0.085	0.000	0.014	0.000	1.000
Significant	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	NO	NO	YES	YES	YES	NO
Total Dissolved Solids																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	50	8	50	8	50	8	50	7	50	8	50	8	20	8	50	8	50	8
Trend	--	--	--	--	D	--	--	--	D	--	D	D	--	--	D	--	--	--
Probability	0.795	0.812	0.795	0.178	0.000	0.548	0.232	1.000	0.000	1.000	0.004	0.014	0.299	0.276	0.00	0.108	0.477	0.178
Probability	0.795	0.812	0.795	0.178	0.000	0.548	0.232	1.000	0.000	1.000	0.004	0.014	0.299	0.276	0.00	0.108	0.477	0.178
Significant	NO	NO	NO	NO	YES	NO	NO	NO	YES	NO	YES	YES	NO	NO	YES	NO	NO	NO
Ammonia as N																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	11	0	16	0	50	8	13	0	50	8	27	1	2	0	14	0	9	0
Trend	I	--	I	--	D	--	I	--	D	--	--	--	--	--	I	--	I	--
Probability	0.005	1.000	0.041	1.000	0.000	1.000	0.025	1.000	0.000	0.720	0.340	0.4730	0.018	1.000	0.032	1.000	0.004	1.000
Probability	0.005	--	0.041	--	0.000	1.000	0.025	--	0.000	0.720	0.340	--	0.018	--	0.032	--	0.004	--
Significant	YES	--	YES	--	YES	NO	YES	--	YES	NO	NO	--	--	--	YES	--	YES	--
Chloride																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	50	8	50	8	50	7	50	8	50	3	50	8	20	8	50	8	50	8
Trend	D	--	--	--	D	--	--	--	D	--	--	--	--	--	D	D	I	--
Probability	0.029	0.904	0.139	1.000	0.029	0.904	0.371	0.720	0.00	0.548	0.120	0.143	0.805	0.473	0.000	0.014	0.000	0.178
Probability	0.029	0.904	0.13872	1.000	0.029	0.904	0.371	0.720	0.00	--	0.120	0.143	0.805	0.473	0.000	0.014	0.000	0.178
Significant	YES	NO	NO	NO	YES	NO	NO	NO	YES	NO	NO	NO	NO	NO	YES	YES	YES	NO
Nitrate as N																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	50	8	49	8	16	1	50	8	18	0	46	6	20	8	36	1	42	0
Trend	--	--	--	--	--	--	--	--	--	--	I	--	--	--	--	--	--	--
Probability	0.069	0.108	0.010	1.000	0.707	1.000	0.114	0.108	0.472	1.000	0.020	1.000	0.113	0.473	0.296	0.634	0.467	1.000
Probability	0.069	0.108	0.010	1.000	0.707	--	0.114	0.108	0.472	--	0.020	1.000	0.113	0.473	0.296	--	0.467	--
Significant	NO	NO	YES	NO	NO	--	NO	NO	NO	--	YES	NO	NO	NO	NO	--	NO	--

D = Decreasing concentrations
I = Increasing concentrations
Probability = probality that the null hypotesis is true.
Ho = There is no trend.

Significant = The trend is significant at a p = 0.05 level.

	SHALLOW AQUIFER												DEEP AQUIFER					
Well Location	**MW-11**		**MW-6**		**MW-1**		**MW-4**		**MW-10**		**MW-18**		**MW-25**		**MW-7**		**MW-3**	
*Gradient Location	Up		Side		Down		Down		Down		Down		Up		Down		Down	
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Sulfate																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	50	8	50	8	50	7	50	8	50	8	50	8	20	8	50	8	50	7
Trend	--	--	D	--	D	--	D	--	D	--	D	--	--	--	I	--	--	--
Probability	0.126	0.178	0.000	0.904	0.000	0.473	0.000	0.904	0.000	0.227	0.000	0.178	0.961	0.227	0.00	1.000	0.953	0.28
Probability	0.126	0.178	5.69E-08	0.904	0.00002	0.473	0.00009	0.904	8.69E-09	0.227	0.00005	0.178	0.961	0.227	0.0002	1.000	0.9533	0.28
Significant	NO	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	NO	NO	YES	NO	NO	NO
Alkalinity																		
No. of Analyses	47	8	48	8	45	8	47	8	47	8	47	8	20	8	47	8	49	8
No. of Detections	47	8	48	8	45	8	47	8	47	8	47	8	20	8	47	8	49	8
Trend	--	--	D	--	D	--	D	--	D	--	D	--	--	--	D	--	I	I
Probability	0.700	0.143	0.000	0.634	0.000	0.276	0.000	1.000	0.000	1.00	0.00	0.473	0.166	0.227	0.00	0.473	0.00	0.047
Probability	0.700	0.143	0.000	0.634	0.000	0.276	0.0005	1.000	0.000	1.00	0.0000	0.473	0.166	0.227	0.0000	0.473	0.00	0.047
Significant	NO	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	NO	NO	YES	NO	YES	YES
Arsenic																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	2	0	4	0	50	0	0	0	50	8	50	0	17	8	0	0	3	0
Trend	--	--	--	--	D	--	--	--	--	--	D	--	--	--	--	--	--	--
Probability	0.987	1.00	0.738	1.00	0.00	1.00	0.993	1.00	0.084	0.18	0.00	1.000	0.075	0.227	0.993	1.000	0.993	0.634
Probability	--	--	0.738	--	0.00	--	--	--	0.084	0.18	0.00	--	0.075	0.227	--	--	0.9933	--
Significant	--	--	NO	--	YES	--	--	--	NO	NO	YES	--	NO	NO	--	--	NO	--
Calcium																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
Trend	--	--	D	--	D	--	D	--	D	--	D	D	I	--	D	D	I	--
Probability	0.60402	0.47	0.00	0.904	9.4E-05	0.398	0.000	0.227	0.001	1.000	0.00	0.05	0.001	1.000	0.00	0.047	0.019	1.000
Probability	0.604	0.47	0.00	0.904	0.000	0.398	0.000	0.227	0.001	1.000	0.00	0.05	0.001	1.000	0.00	0.047	0.019	1.000
Significant	NO	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	YES	YES	NO	YES	YES	YES	NO
Magnesium																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
Trend	--	--	D	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Probability	0.564	0.062	0.00	0.634	0.371	0.720	0.277	0.337	0.993	0.548	0.99	0.812	0.166	0.398	0.99	0.81	0.993	0.398
Probability	0.564	0.062	0.00	0.634	0.371	0.720	0.277	0.337	0.993	0.548	0.99	0.812	0.166	0.398	0.99	0.81	0.993	0.398
Significant	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Potassium																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
Trend	--	--	D	--	D	--	D	--	D	--	D	--	--	--	D	--	--	--
Probability	0.685	1.000	0.004	1.000	0.000	1.000	0.000	1.00	0.000	1.00	0.000	1.000	0.322	1.000	0.000	1.000	0.067	1.000
Probability	0.685	1.000	0.004	1.000	1.09E-07	1.000	3.18E-10	1.000	7.08E-10	1.000	1.56E-04	1.000	0.322	1.000	7.18E-08	1.000	0.067	1.000
Significant	NO	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	NO	NO	YES	NO	NO	NO
Sodium																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
Trend	--	--	D	--	D	--	D	--	D	--	D	--	--	--	D	--	--	--
Probability	0.993	0.23	0.000	0.40	0.000	1.000	0.001	0.904	0.000	0.81	0.000	0.55	0.083	0.904	0.000	0.548	0.645	0.276
Probability	0.993	0.227	4.29E-08	0.398	0.000	1.000	0.001	0.904	0.000	0.812	0.000	0.548	0.083	0.904	2.23E-09	0.548	0.645	0.276
Significant	NO	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	NO	NO	YES	NO	NO	NO

D = Decreasing concentrations
I = Increasing concentrations
Probability = probality that the null hypotesis is true.
Ho = There is no trend.

Significant = The trend is significant at a p = 0.05 level.

	SHALLOW AQUIFER												DEEP AQUIFER					
Well Location	**MW-11**		**MW-6**		**MW-1**		**MW-4**		**MW-10**		**MW-18**		**MW-25**		**MW-7**		**MW-3**	
*Gradient Location	Up		Side		Down		Down		Down		Down		Up		Down		Down	
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Iron																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	50	8	50	8	50	8	50	7	50	8	50	8	17	8	44	8	49	8
Trend	--	--	I	--	D	--	I	--	D	--	D	--	I	--	I	--	--	--
Probability	0.372	0.812	0.020	0.904	0.00	0.720	0.004	0.398	0.004	0.34	0.000	0.904	0.048	1.000	0.016	0.398	0.078	0.904
Probability	0.372	0.812	0.020	0.904	0.00	0.720	0.004	0.398	0.004	0.34	1.81E-08	0.904	0.048	1.000	0.016	0.398	0.0776	0.904
Significant	NO	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	NO	NO
Manganese																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	10	0	50	7	50	8	22	0	50	8	50	8	4	1	9	2	50	8
Trend	--	--	D	--	D	--	--	--	D	--	D	--	D	--	--	--	--	--
Probability	0.559	1.000	0.00	0.085	0.00	0.473	0.757	1.000	0.004	0.720	0.000	0.276	0.015	0.473	0.053	0.473	0.408	0.473
Probability	0.559	--	0.00	0.085	0.00	0.473	0.757	--	0.004	0.720	5.51E-12	0.276	0.015	--	0.053	--	0.408	0.473
Significant	NO	--	YES	NO	YES	NO	NO	--	YES	NO	YES	NO	YES	--	NO	--	NO	NO
1,1-Dichloroethane																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	0	0	39	0	2	0	0	0	5	0	3	0	0	0	29	1	0	0
Trend	--	--	D	--	--	--	--	--	--	--	--	--	--	--	D	--	--	--
Probability	0.993	1.000	0.000	1.000	0.993	1.00	0.993	1.000	0.920	1.000	0.993	1.000	0.961	1.000	0.000	0.473	0.993	1.000
Probability	--	--	4.77E-09	--	--	--	--	--	0.920	--	--	--	--	--	2.11E-06	--	--	--
Significant	--	--	YES	--	--	--	--	--	NO	--	NO	--	--	--	YES	--	--	--
cis 1,2-Dichloroethene																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	0	0	0	0	0	0	0	0	3	0	25	0	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	D	--	--	--	--	--	--	--
Probability	0.993	0.000	0.993	0.000	0.993	0.00	0.993	0.000	0.920	0.000	0.001	0.000	0.000	0.000	0.993	0.000	0.993	0.000
Probability	--	--	--	--	--	--	--	--	--	--	0.001	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	NO	--	YES	--	--	--	--	--	--	--
1,1,1-Trichloroethane																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	0	0	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trend	--	--	D	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Probability	0.993	1.000	0.000	1.000	0.993	1.00	0.993	1.000	0.920	1.000	0.993	1.000	0.961	1.000	0.993	1.000	0.993	1.000
Probability	--	--	5.28E-09	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	YES	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vinyl Chloride																		
No. of Analyses	50	8	50	8	50	8	50	8	50	8	50	8	20	8	50	8	50	8
No. of Detections	0	0	4	0	0	0	0	0	3	0	1	0	0	0	1	0	0	0
Trend	--	--	--	--	--	--	--	--	D	--	--	--	--	--	--	--	--	--
Probability	0.432	1.000	0.1	1.00	0.1	1.00	0.432	1.000	0.017	1.000	0.242	1.000	0.961	0.000	0.789	1.000	0.987	1.000
Probability	--	--	0.085	--	--	--	--	--	0.017	--	--	--	--	--	--	--	--	--
Significant	--	--	NO	--	--	--	--	--	YES	--	--	--	--	--	--	--		

NOTE Previous Period of Record excluding the last 8 sampling quarters.
Last 8 Results from the 8 most recent sampling quarters.
* Gradient indicates location of monitoring well relative to the hydraulic gradient and the placement of Solid Waste.

D = Decreasing concentrations
I = Increasing concentrations
Probability = probality that the null hypotesis is true.
Ho = There is no trend.

Significant = The trend is significant at a p = 0.05 level.

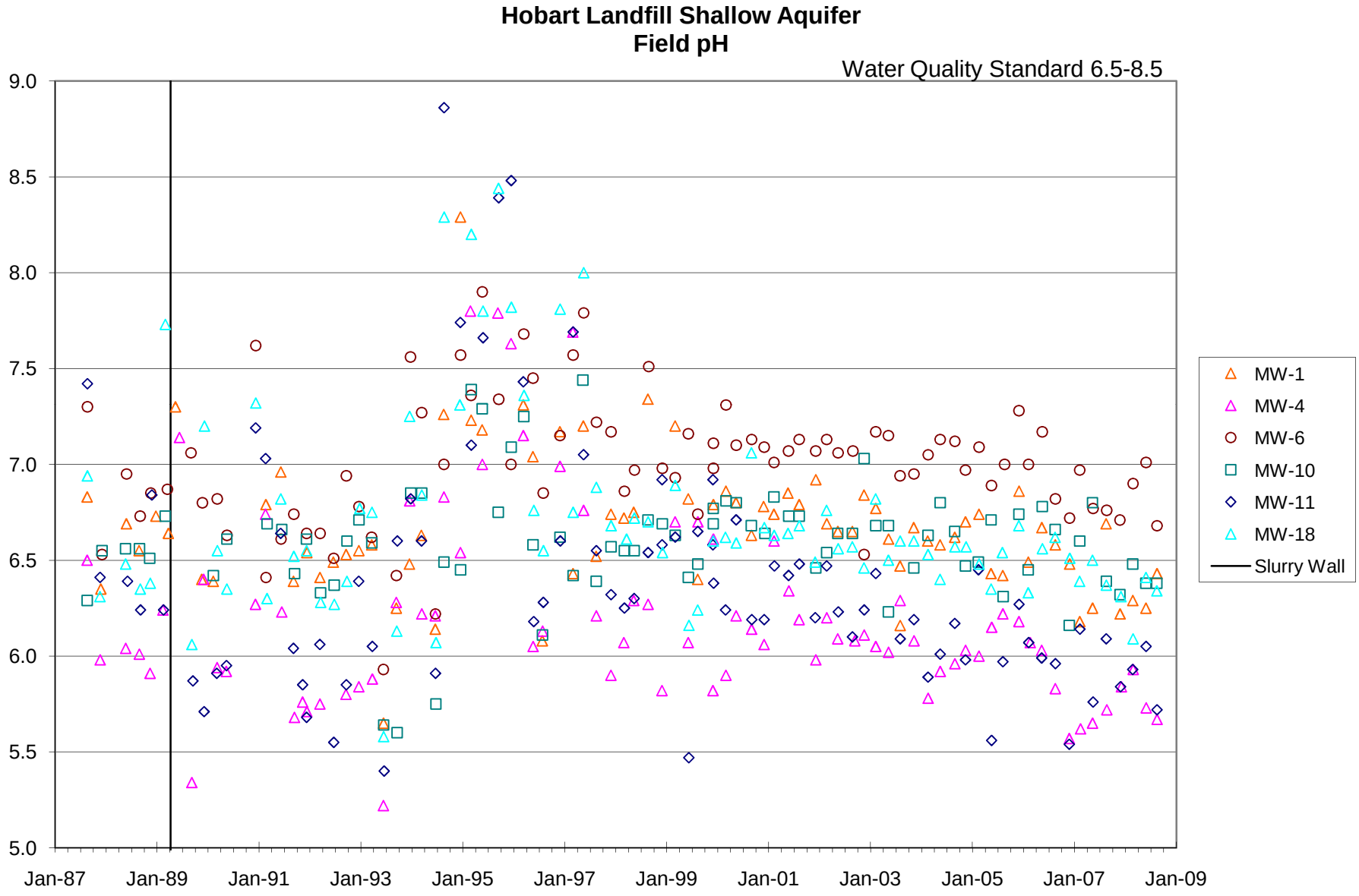
APPENDIX D

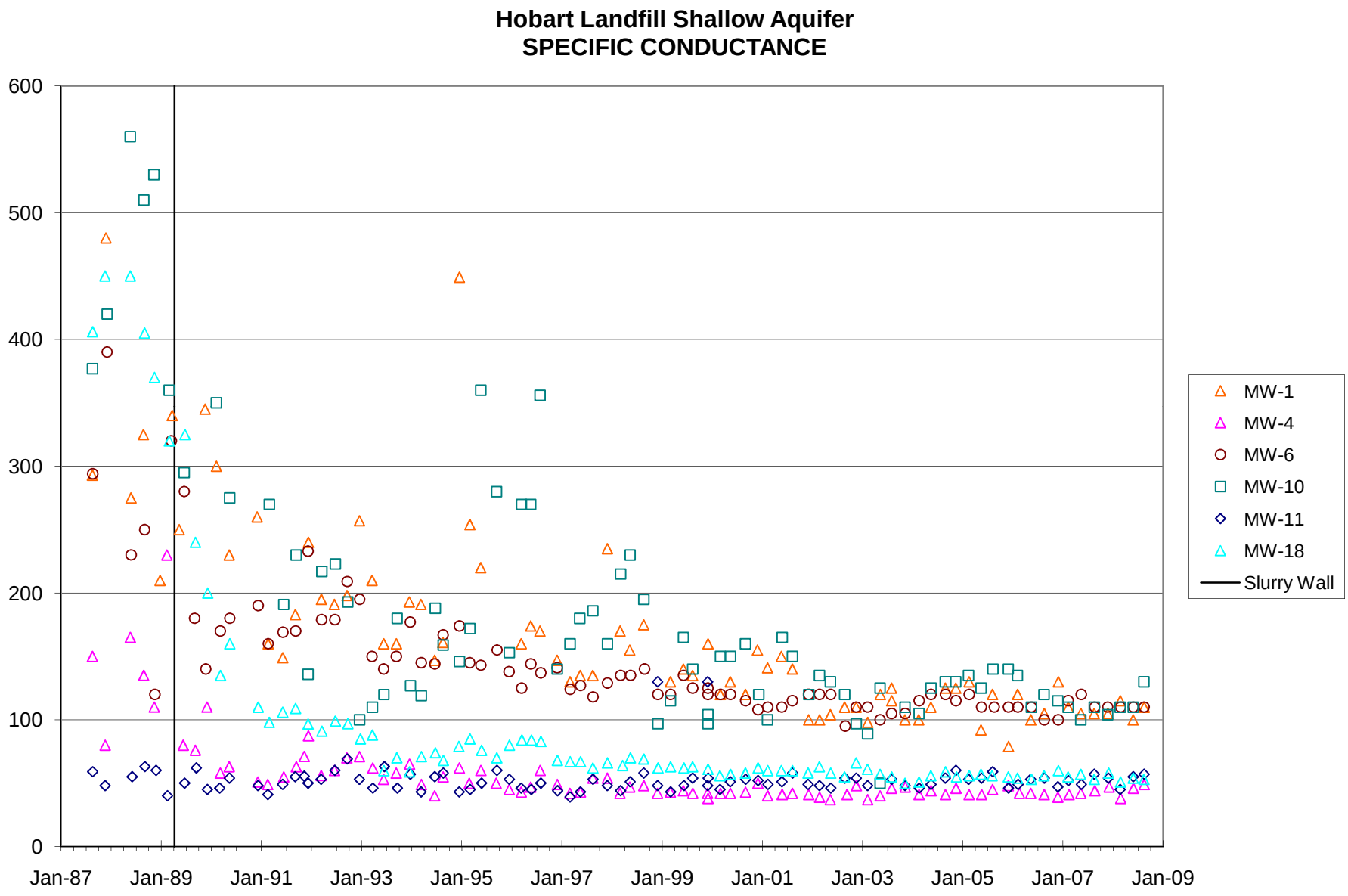
Time Concentration Plots for Shallow Aquifer

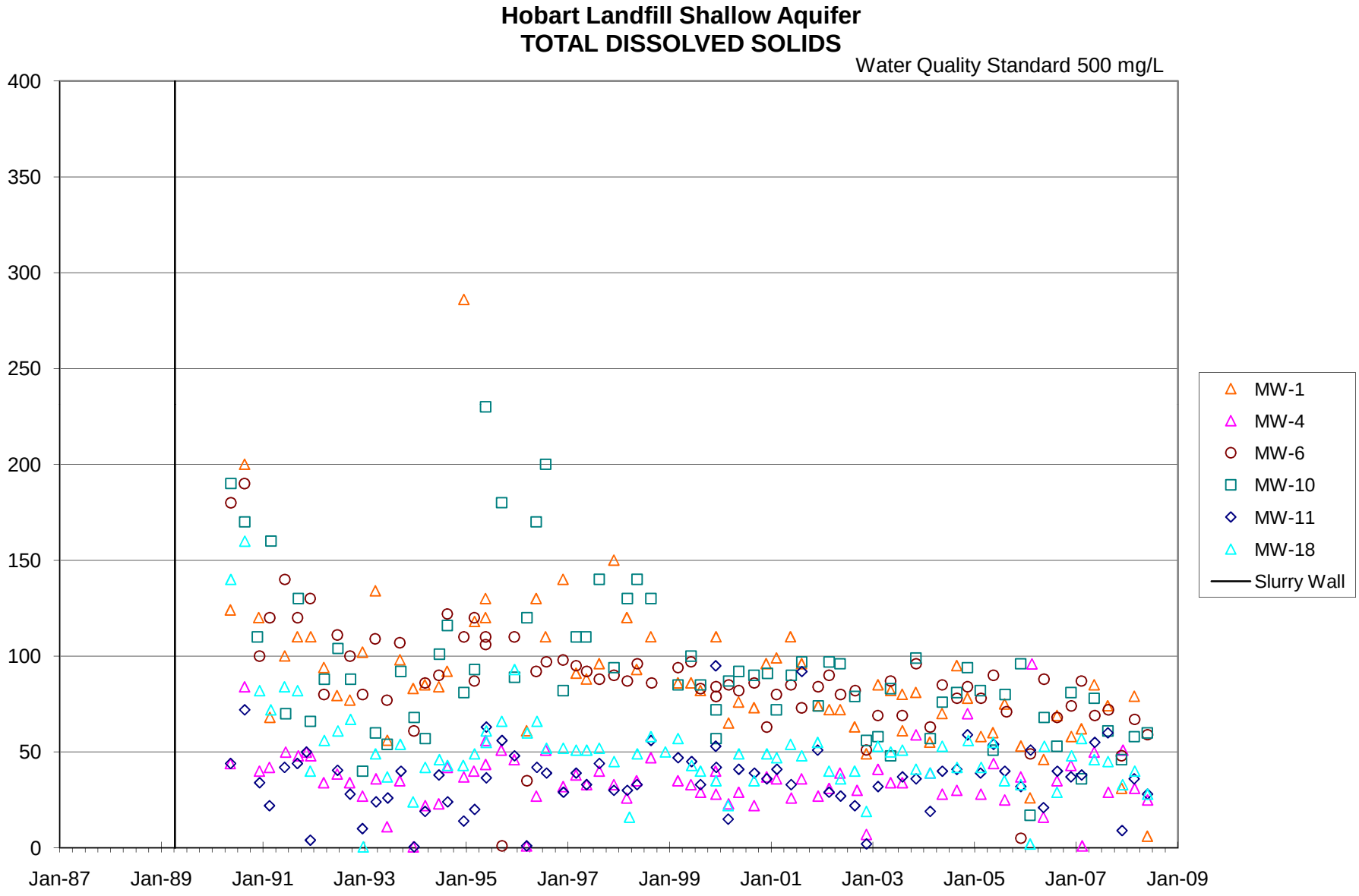
Upgradient Well: MW-11

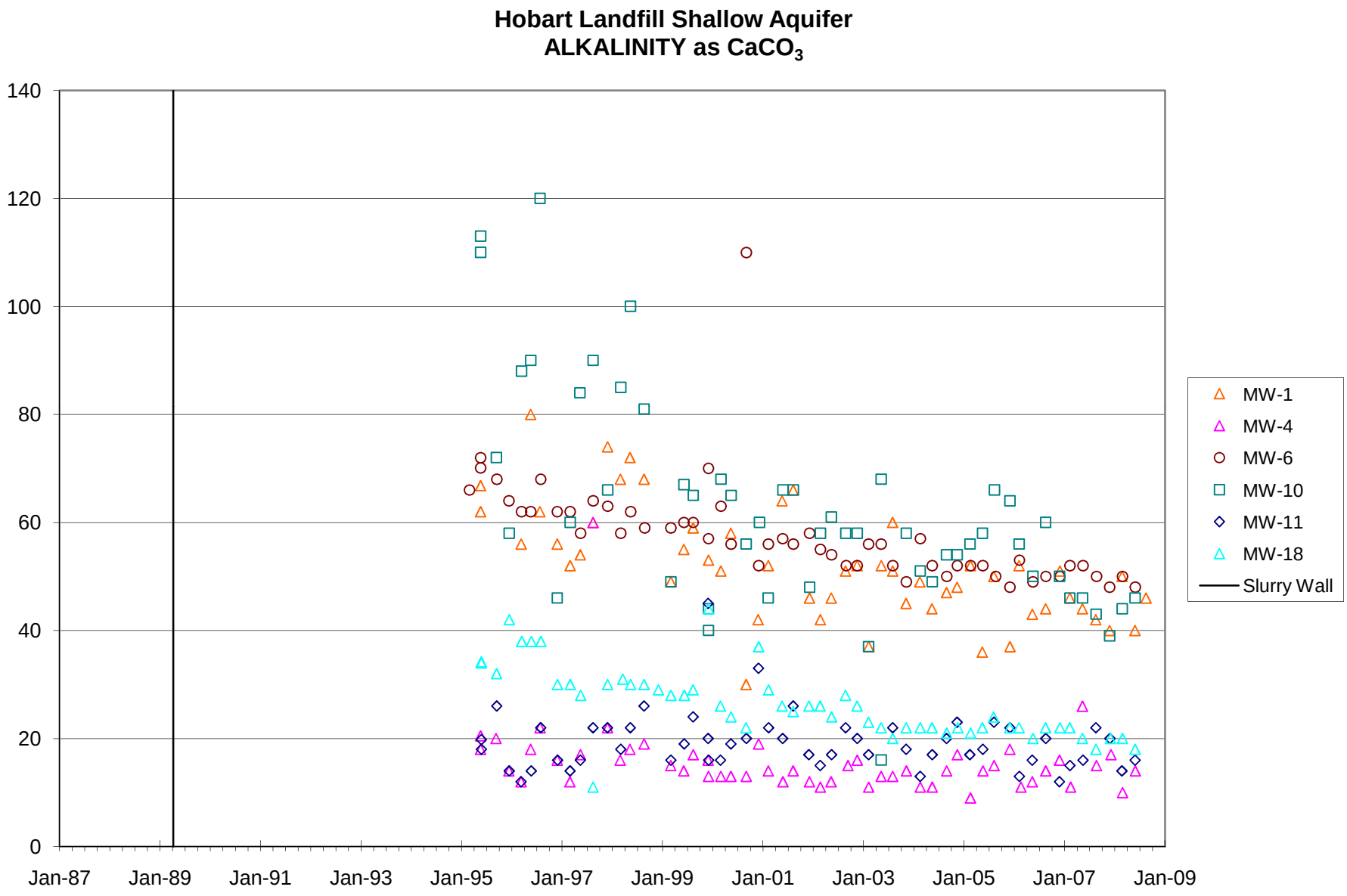
Parameters

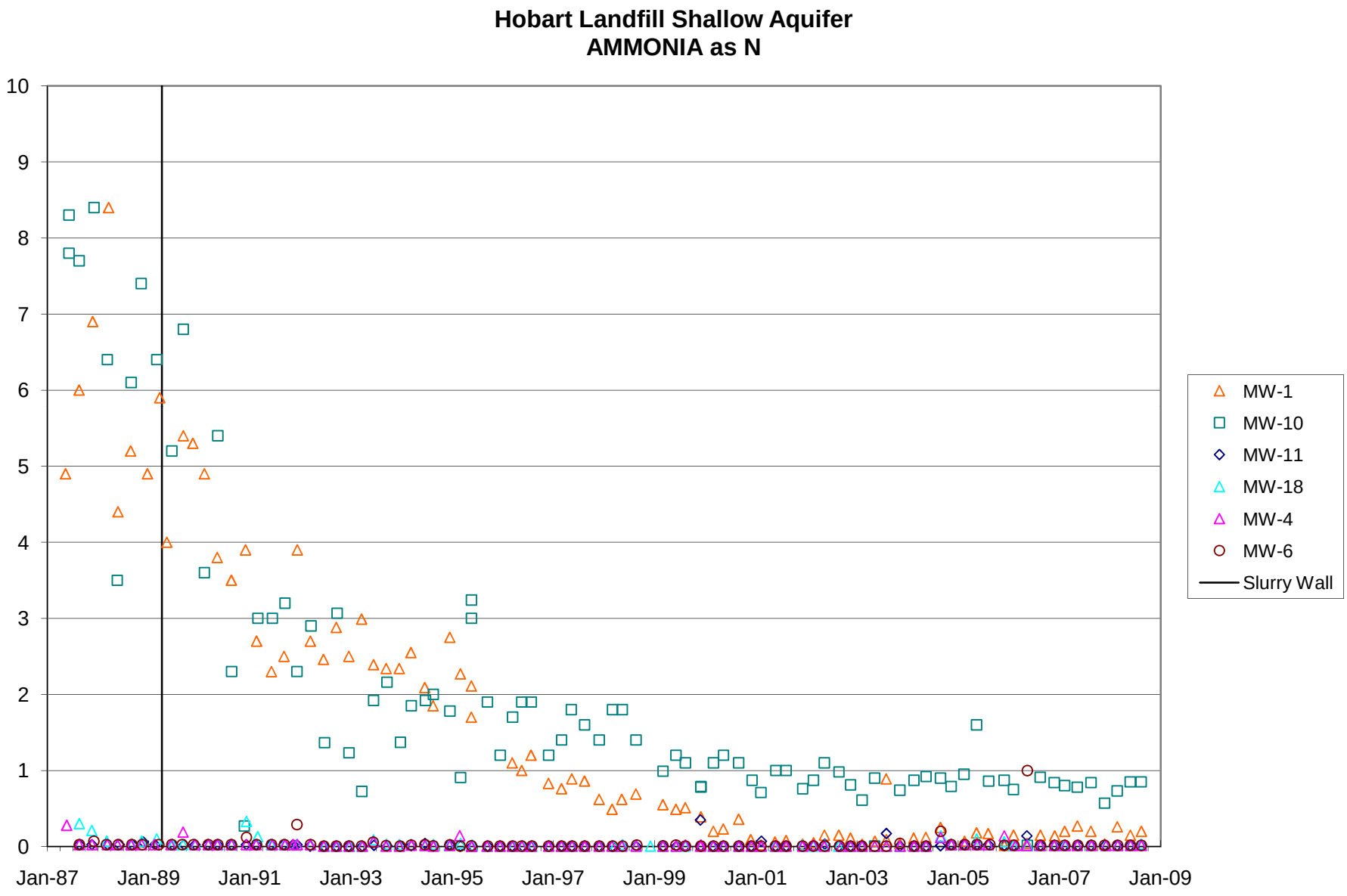
pH
Specific Conductance
Total Dissolved Solids
Alkalinity
Ammonia
Chloride
Nitrate
Sulfate
Arsenic
Calcium
Magnesium
Potassium
Sodium
Iron
Manganese
1,1-Dichloroethane
cis-1,2-Dichloroethene
1,1,1-Trichloroethane
Vinyl Chloride

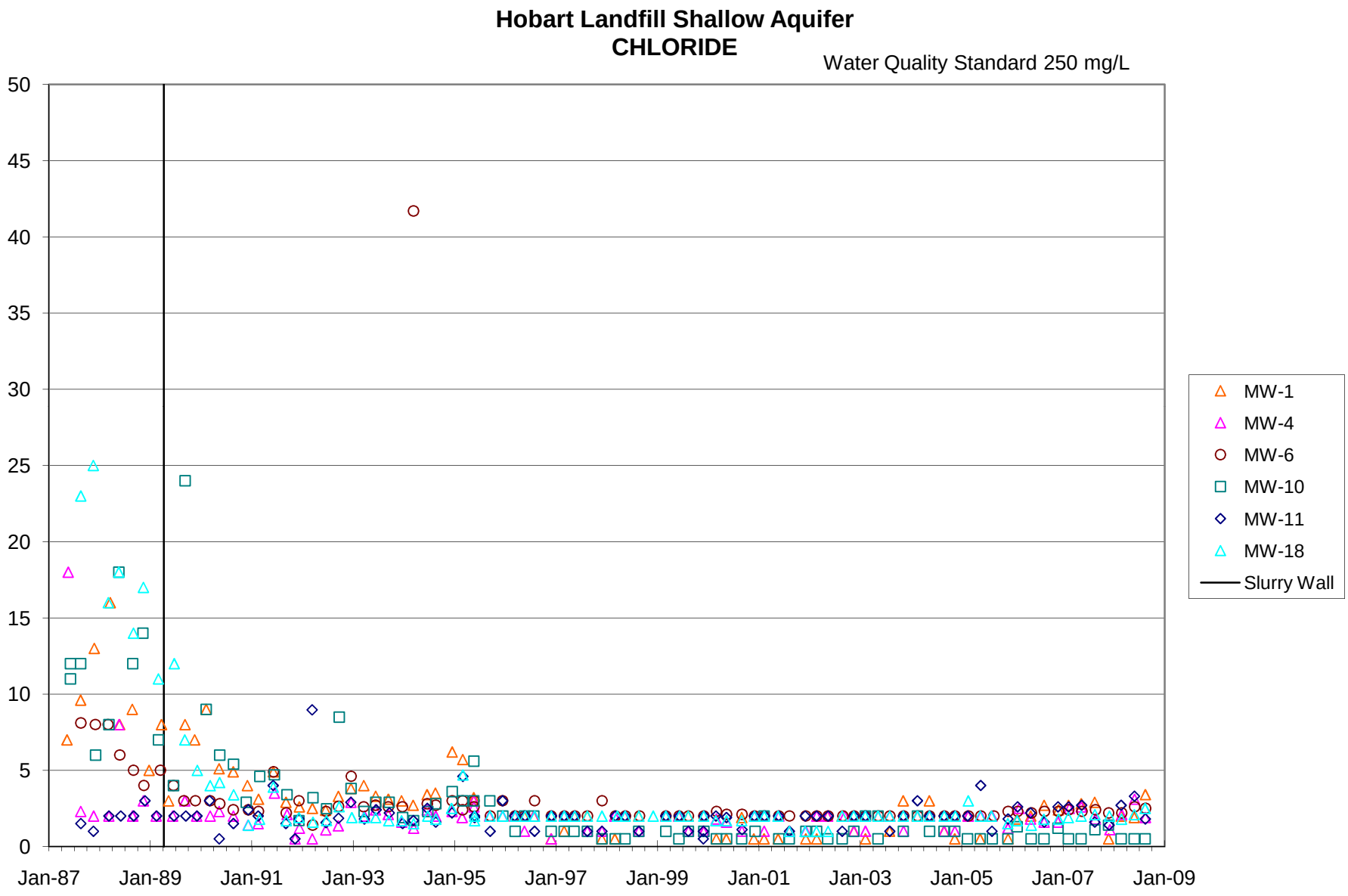

Hobart Landfill Shallow Aquifer
Field pH
Water Quality Standard 6.5-8.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall

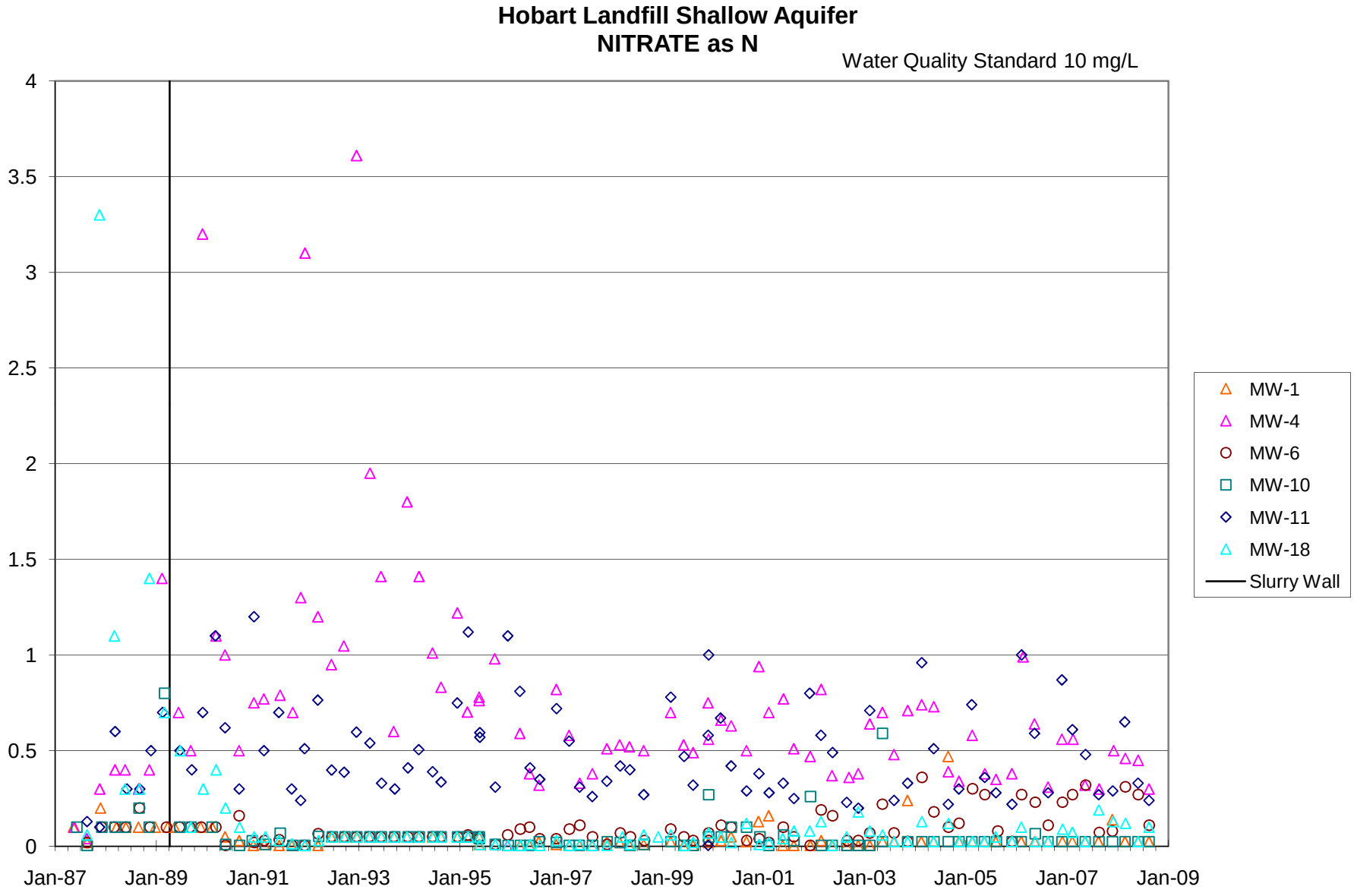

Hobart Landfill Shallow Aquifer
SPECIFIC CONDUCTANCE
600
500
400
300
200
100
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall

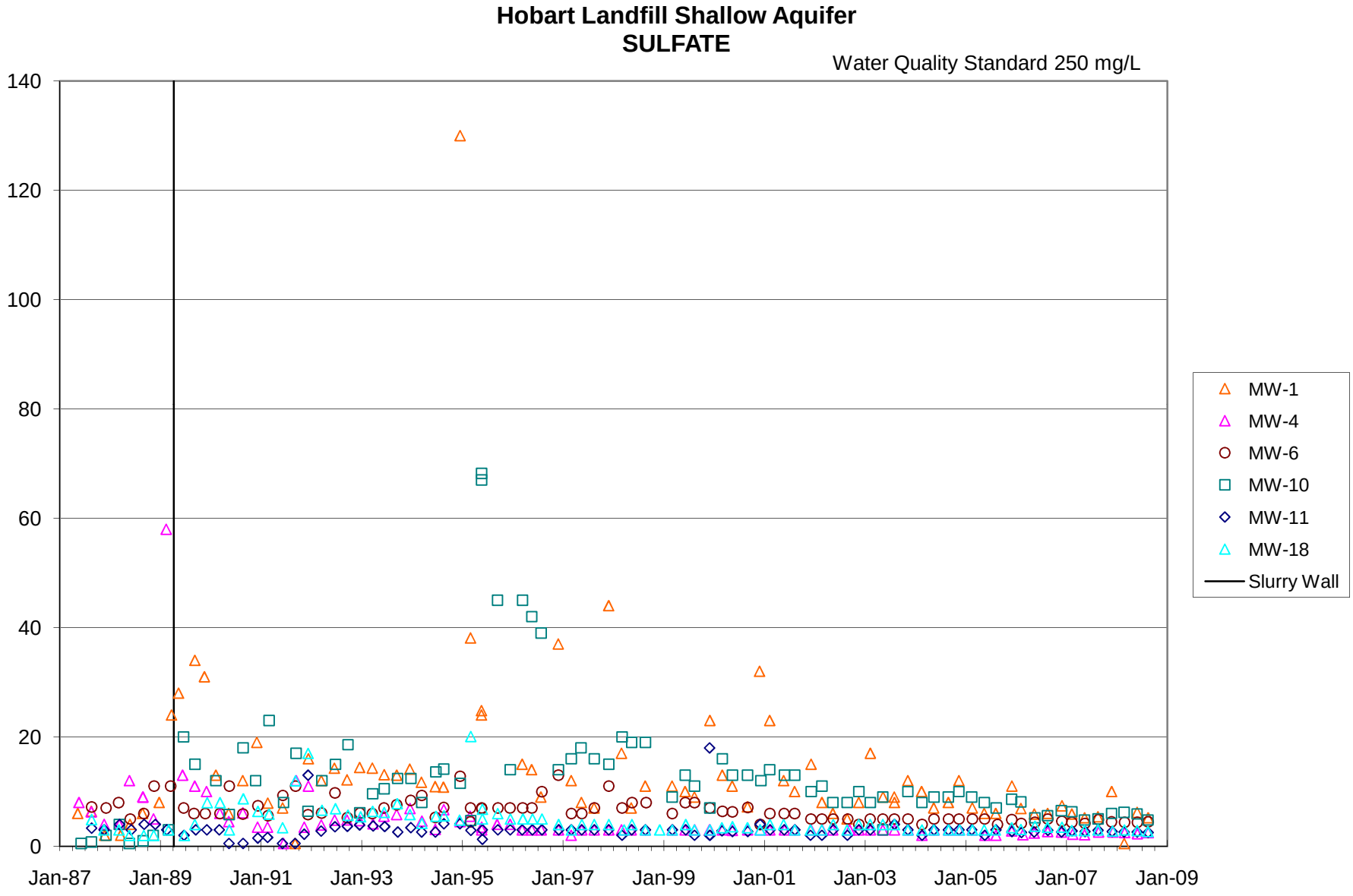

Hobart Landfill Shallow Aquifer
TOTAL DISSOLVED SOLIDS
Water Quality Standard 500 mg/L
400
350
300
250
200
150
100
50
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall

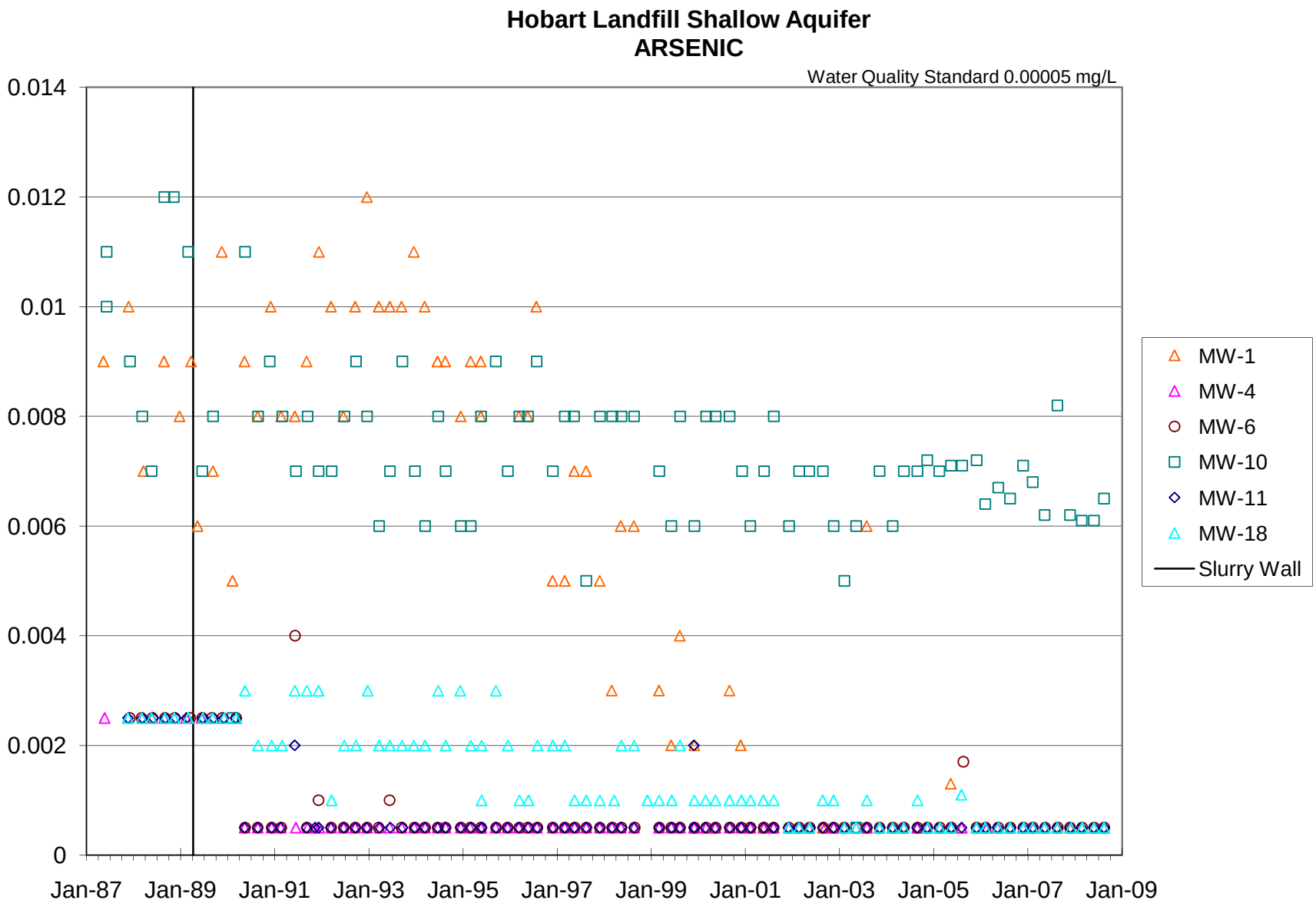

Hobart Landfill Shallow Aquifer
ALKALINITY as $CaCO_3$
140
120
100
80
60
40
20
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall

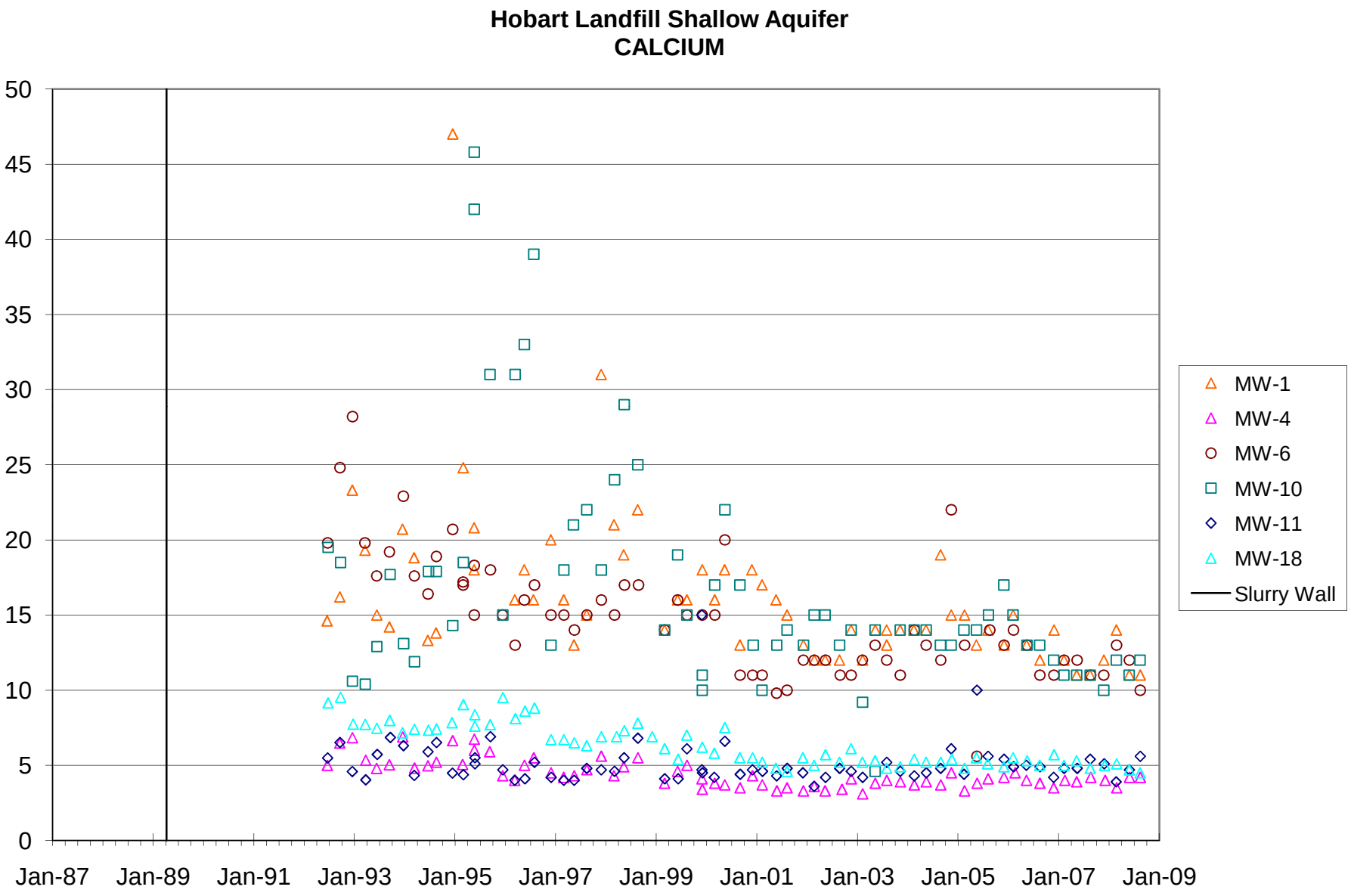

Hobart Landfill Shallow Aquifer
AMMONIA as N
10
9
8
7
6
5
4
3
2
1
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-10
MW-11
MW-18
MW-4
MW-6
Slurry Wall

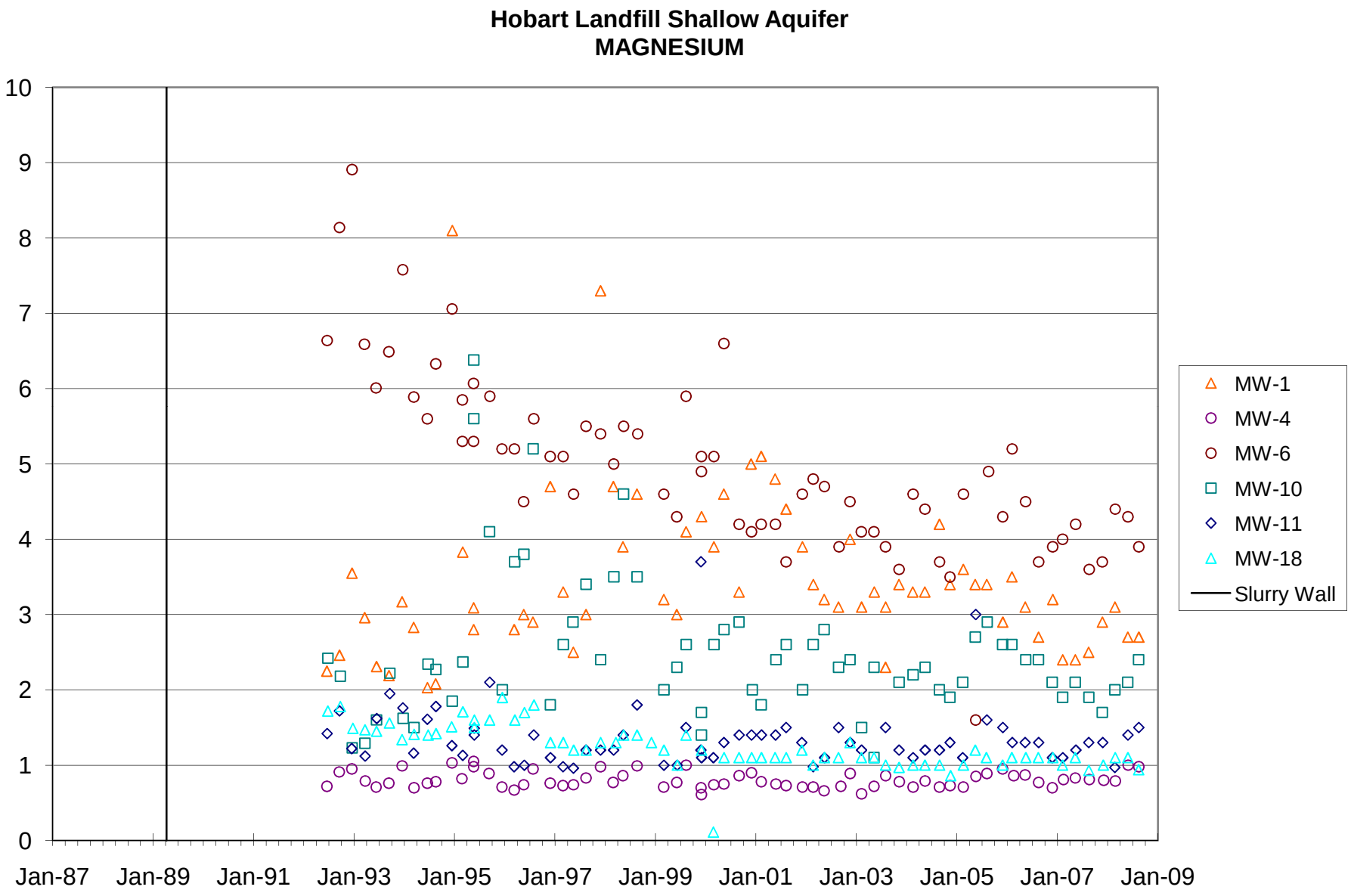

Hobart Landfill Shallow Aquifer
CHLORIDE
Water Quality Standard 250 mg/L
50
45
40
35
30
25
20
15
10
5
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall

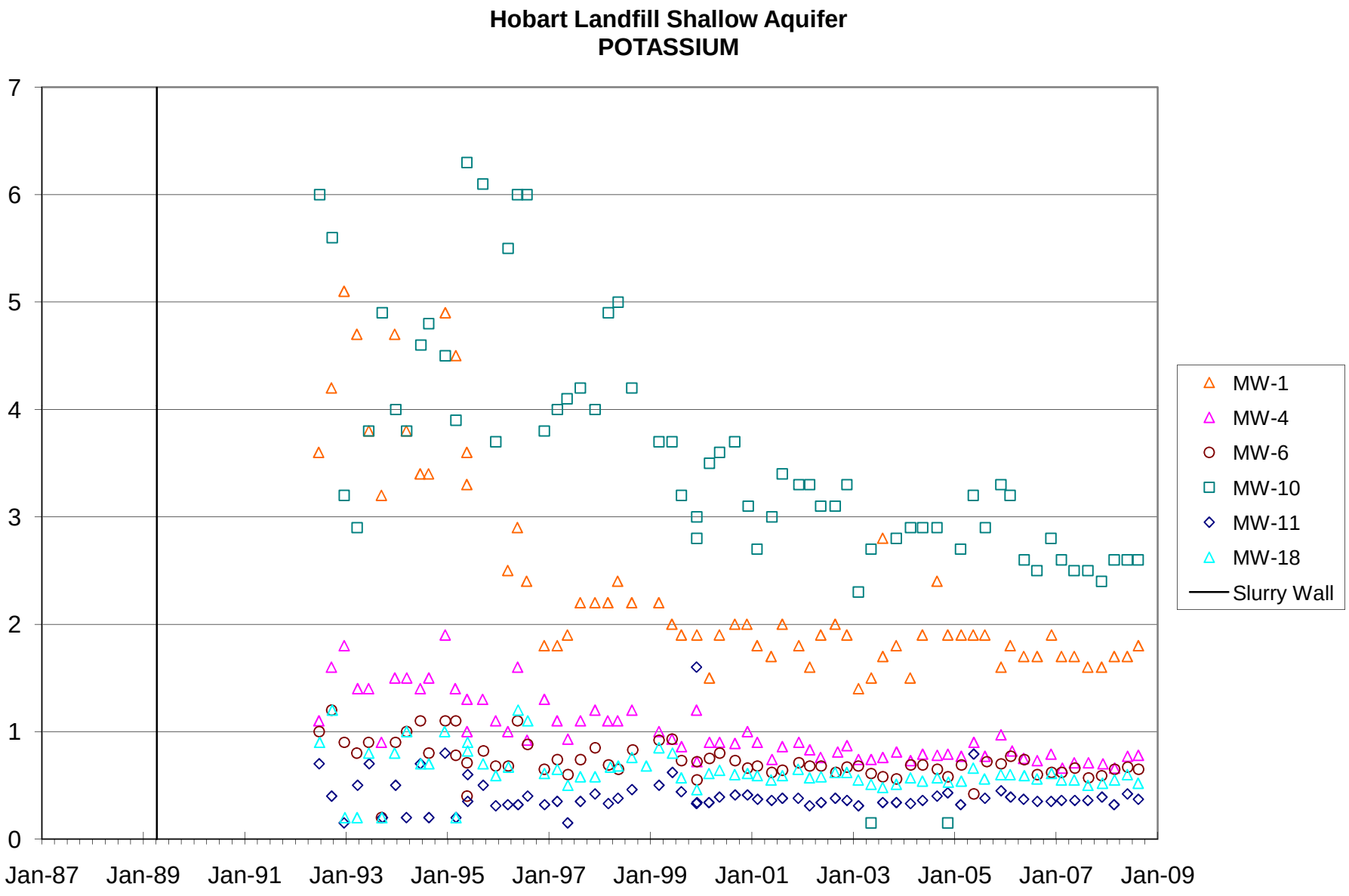

Hobart Landfill Shallow Aquifer
NITRATE as N
Water Quality Standard 10 mg/L
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall

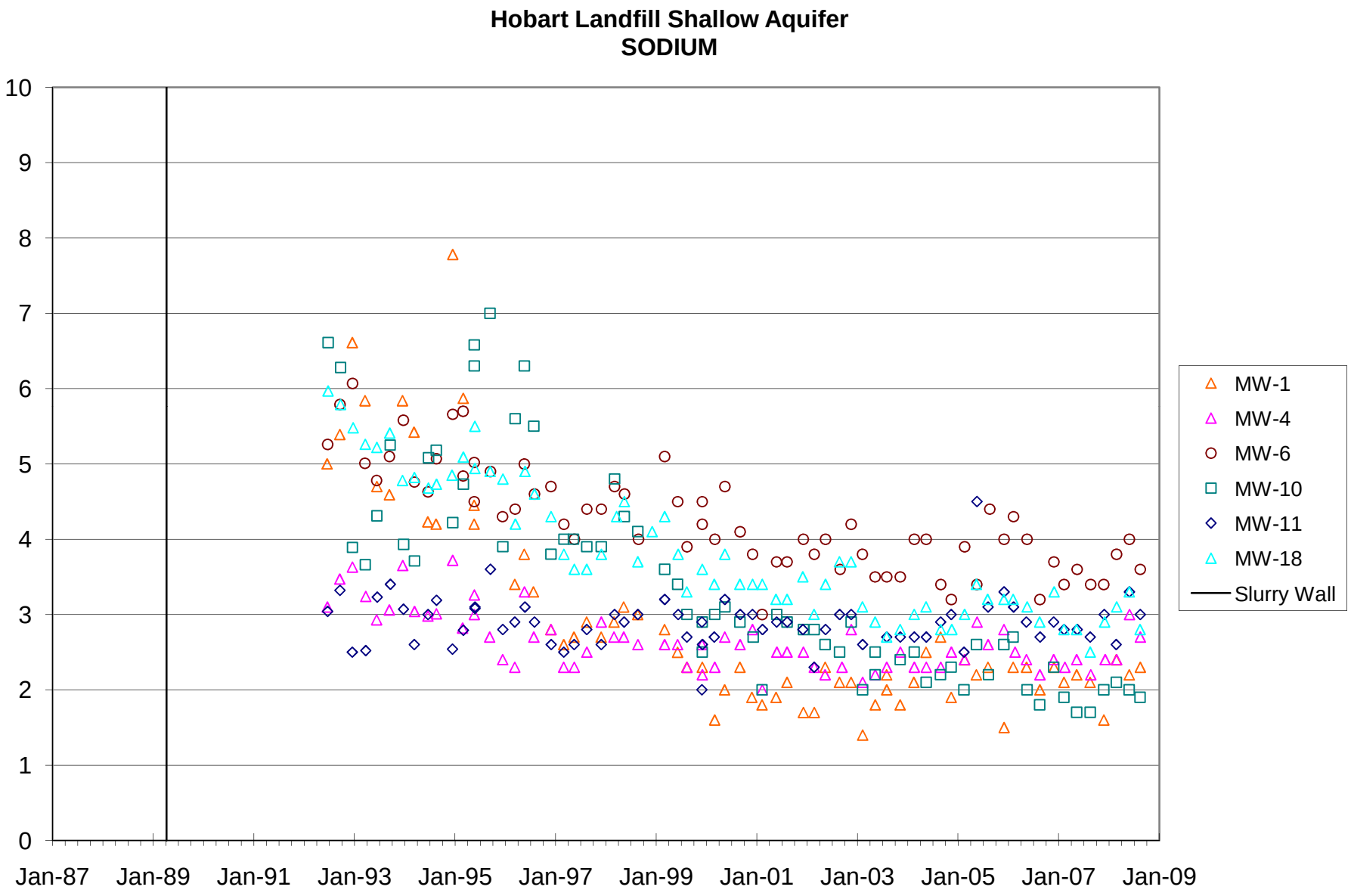

Hobart Landfill Shallow Aquifer
SULFATE
Water Quality Standard 250 mg/L
140
120
100
80
60
40
20
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall

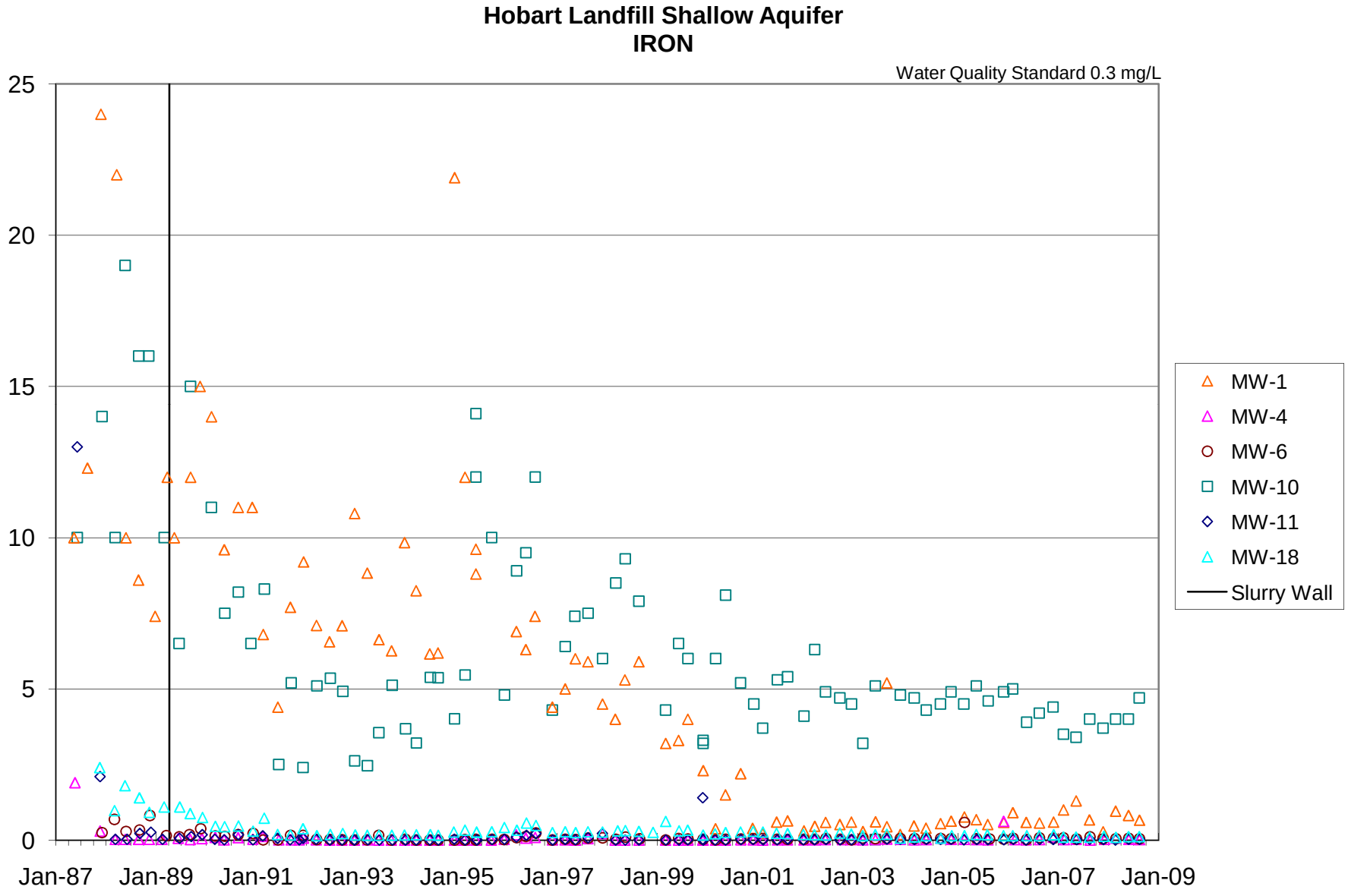

Hobart Landfill Shallow Aquifer
ARSENIC
Water Quality Standard 0.00005 mg/L
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall

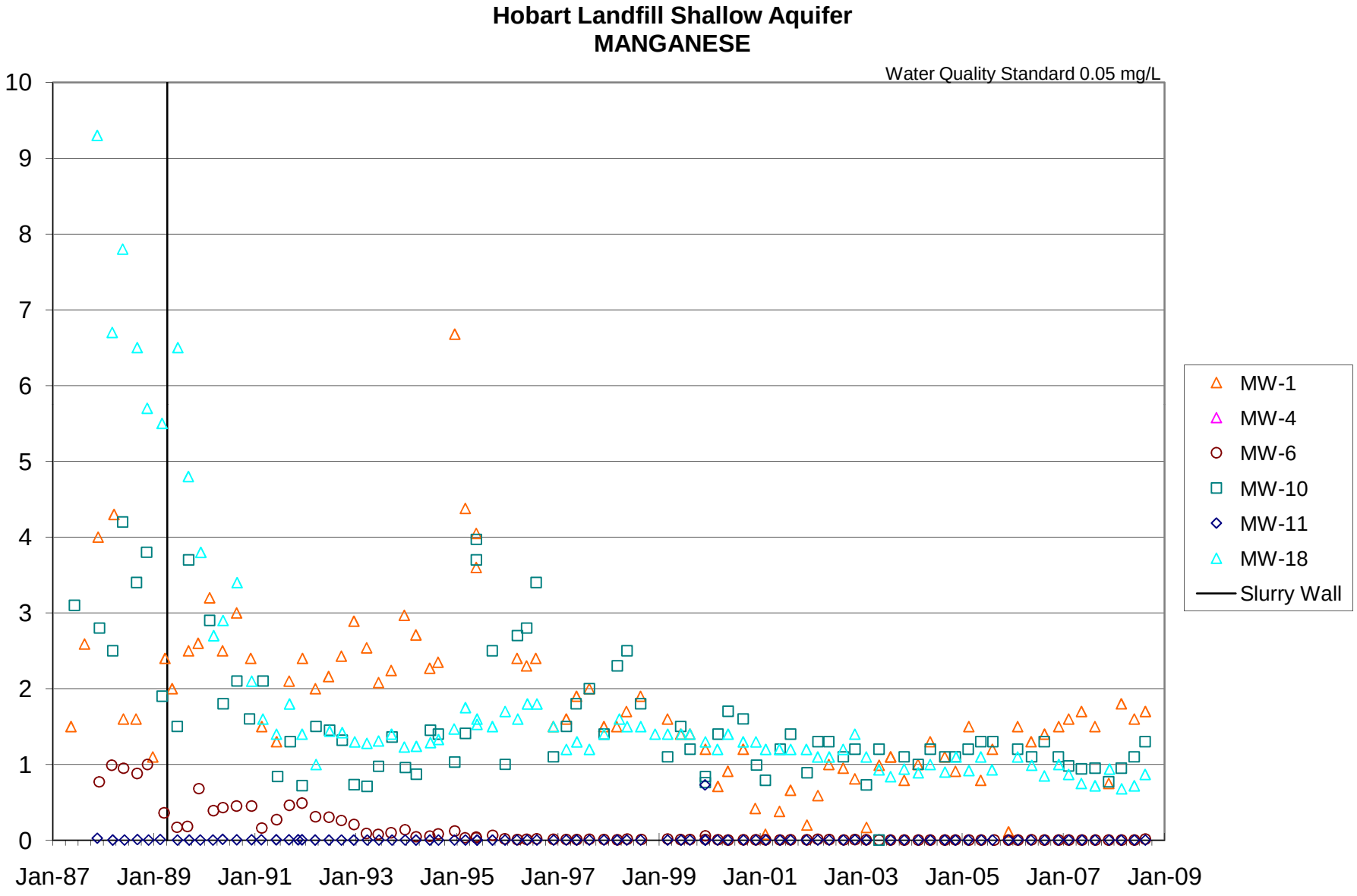

Hobart Landfill Shallow Aquifer
CALCIUM
50
45
40
35
30
25
20
15
10
5
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall

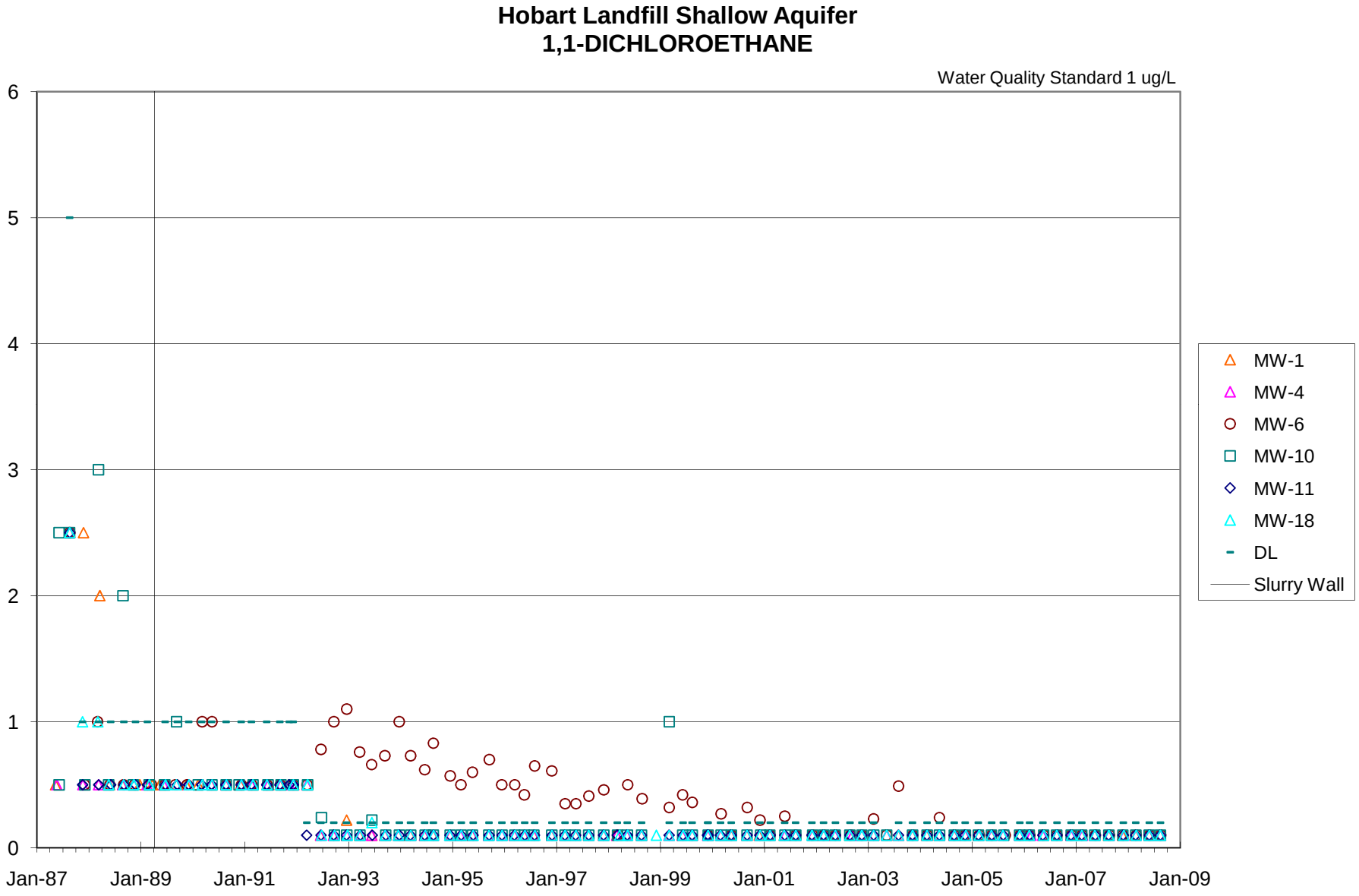

Hobart Landfill Shallow Aquifer
MAGNESIUM
10
9
8
7
6
5
4
3
2
1
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall

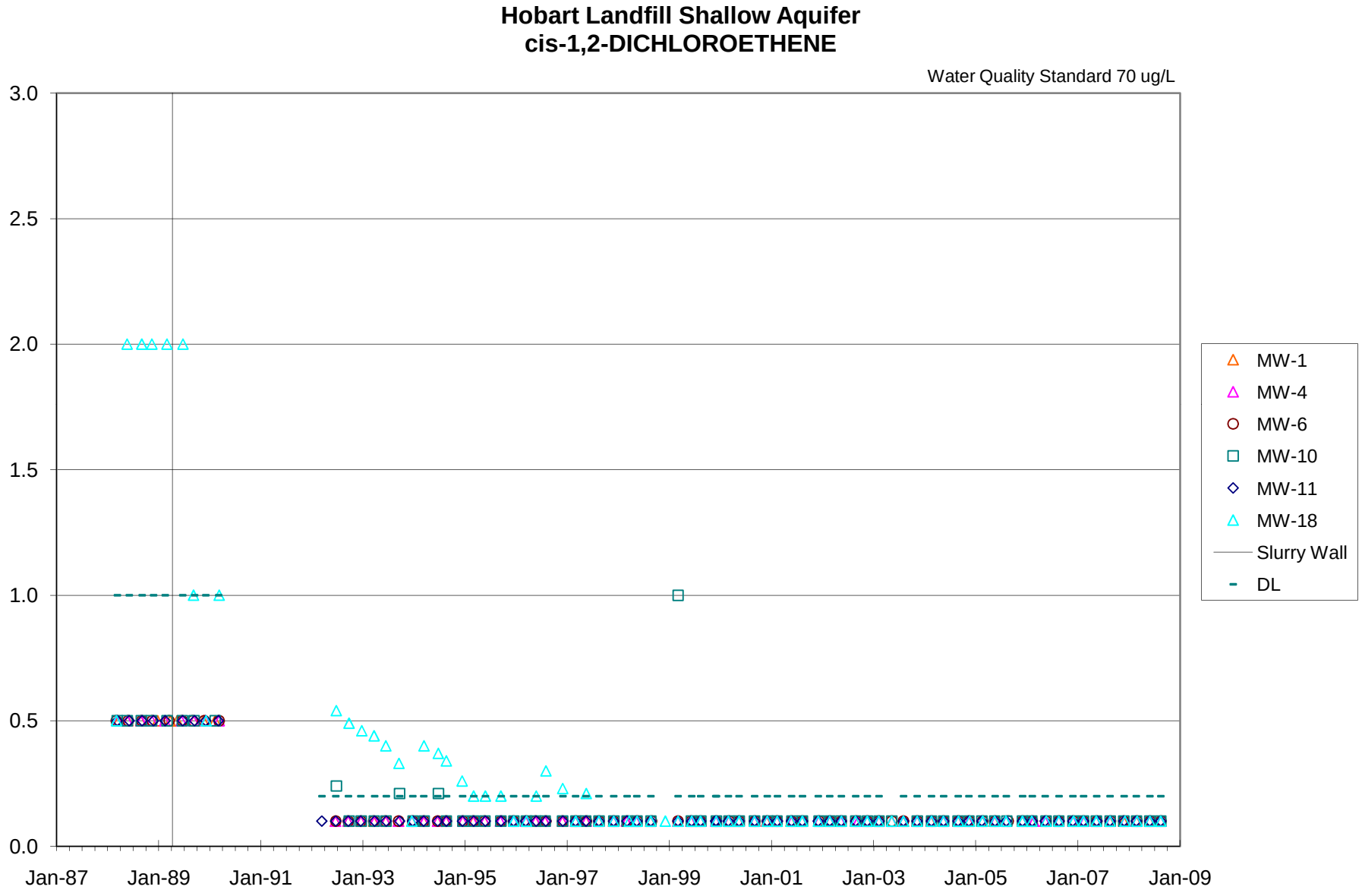

Hobart Landfill Shallow Aquifer
POTASSIUM
7
6
5
4
3
2
1
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall

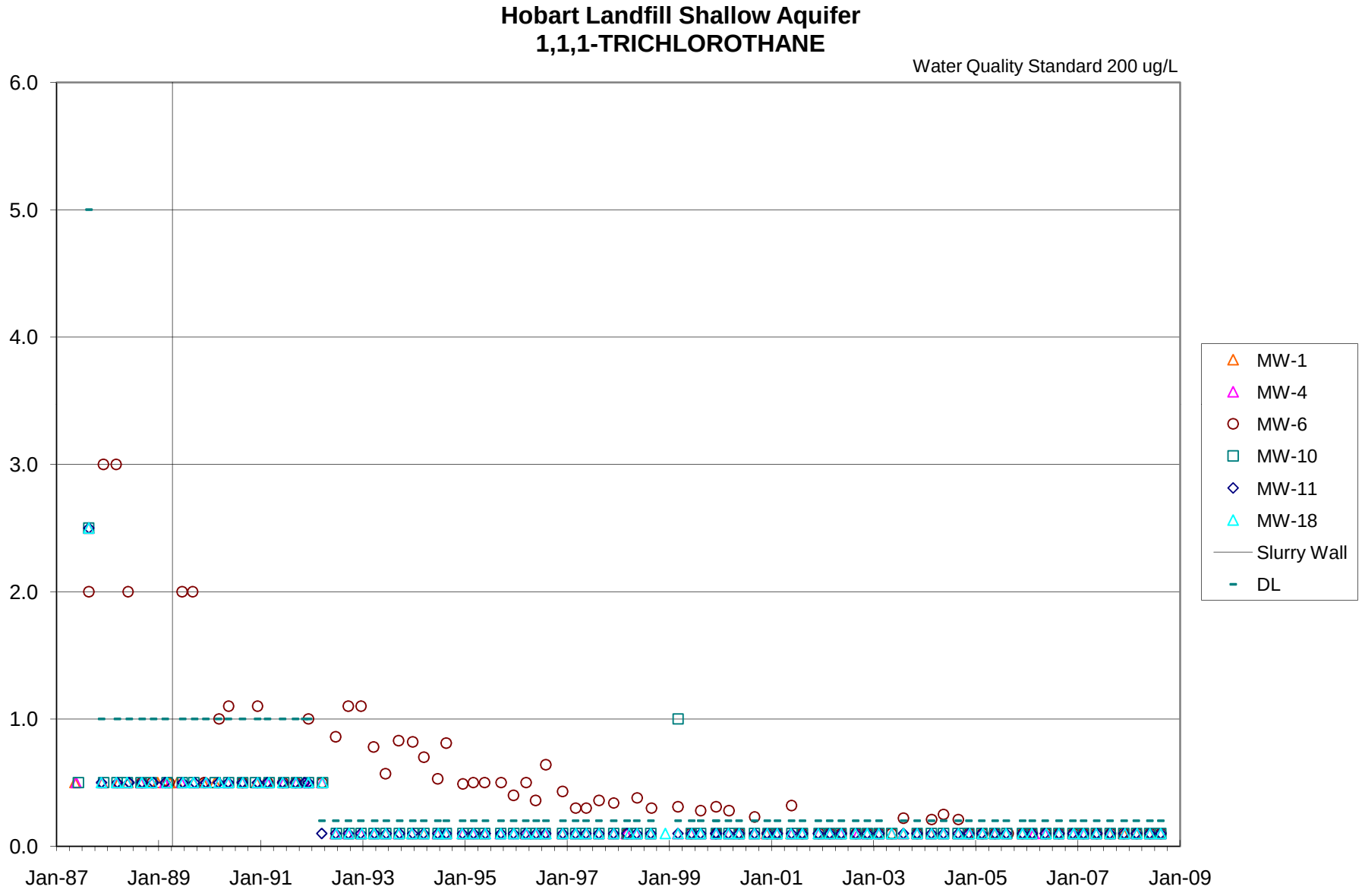

Hobart Landfill Shallow Aquifer
SODIUM
10
9
8
7
6
5
4
3
2
1
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall

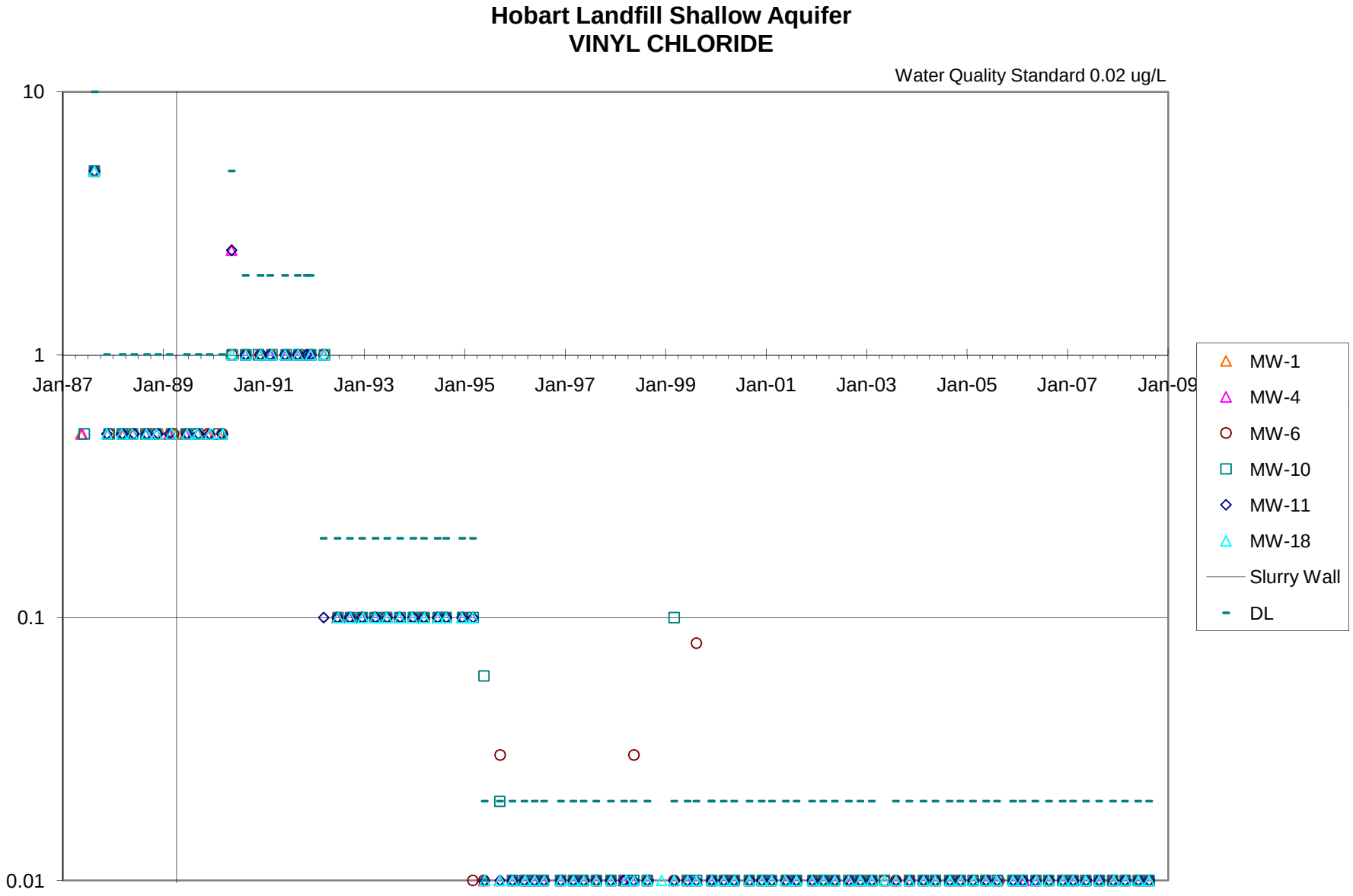

Hobart Landfill Shallow Aquifer
IRON
Water Quality Standard 0.3 mg/L
25
20
15
10
5
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall


Hobart Landfill Shallow Aquifer
MANGANESE
Water Quality Standard 0.05 mg/L
10
9
8
7
6
5
4
3
2
1
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall


Hobart Landfill Shallow Aquifer
1,1-DICHLOROETHANE
Water Quality Standard 1 ug/L
6
5
4
3
2
1
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
DL
Slurry Wall


Hobart Landfill Shallow Aquifer
cis-1,2-DICHLOROETHENE
Water Quality Standard 70 ug/L
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall
DL


Hobart Landfill Shallow Aquifer
1,1,1-TRICHLOROTHANE
Water Quality Standard 200 ug/L
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall
DL


Hobart Landfill Shallow Aquifer
VINYL CHLORIDE
Water Quality Standard 0.02 ug/L
10
1
0.1
0.01
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-1
MW-4
MW-6
MW-10
MW-11
MW-18
Slurry Wall
DL

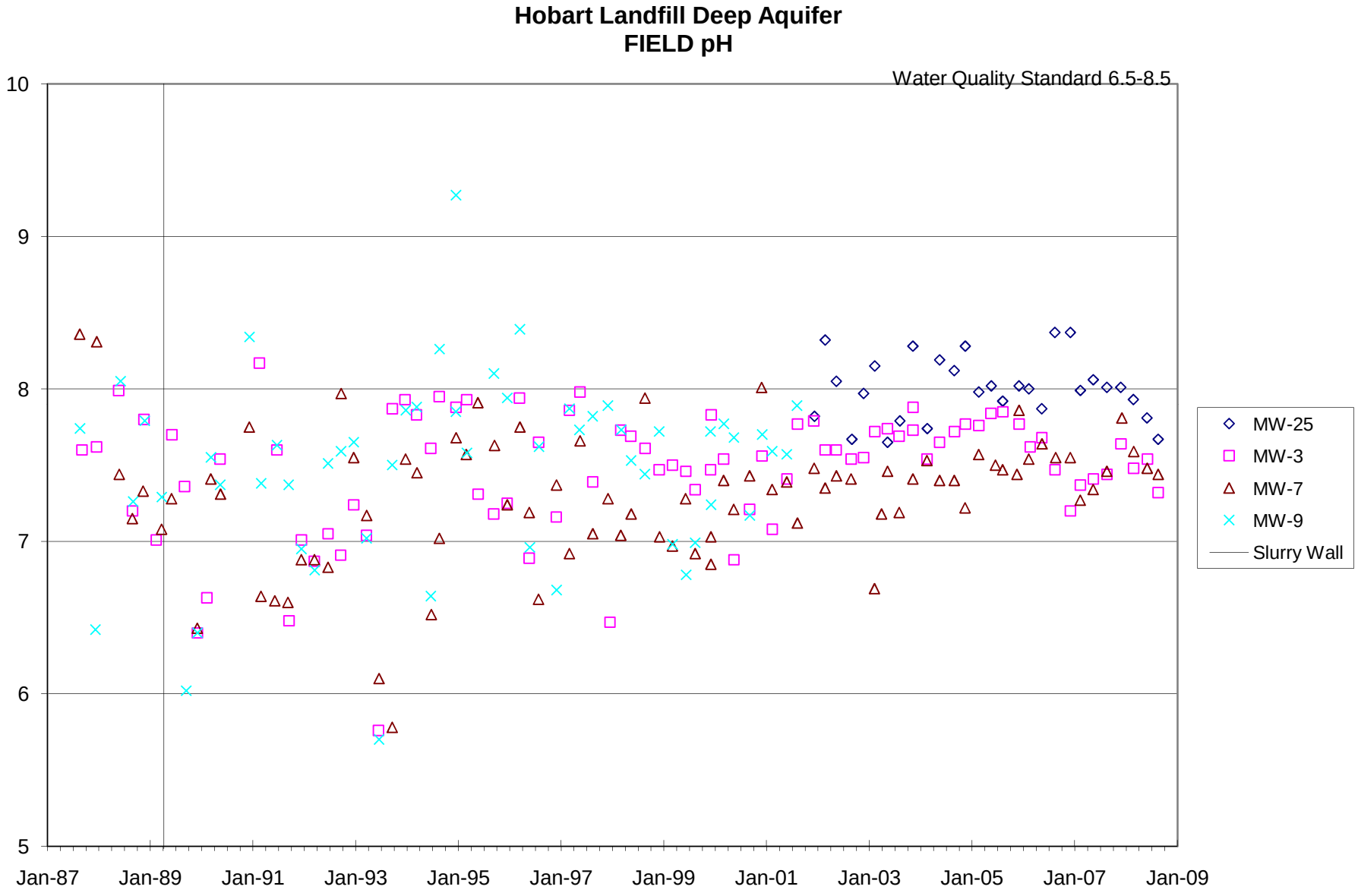
APPENDIX E

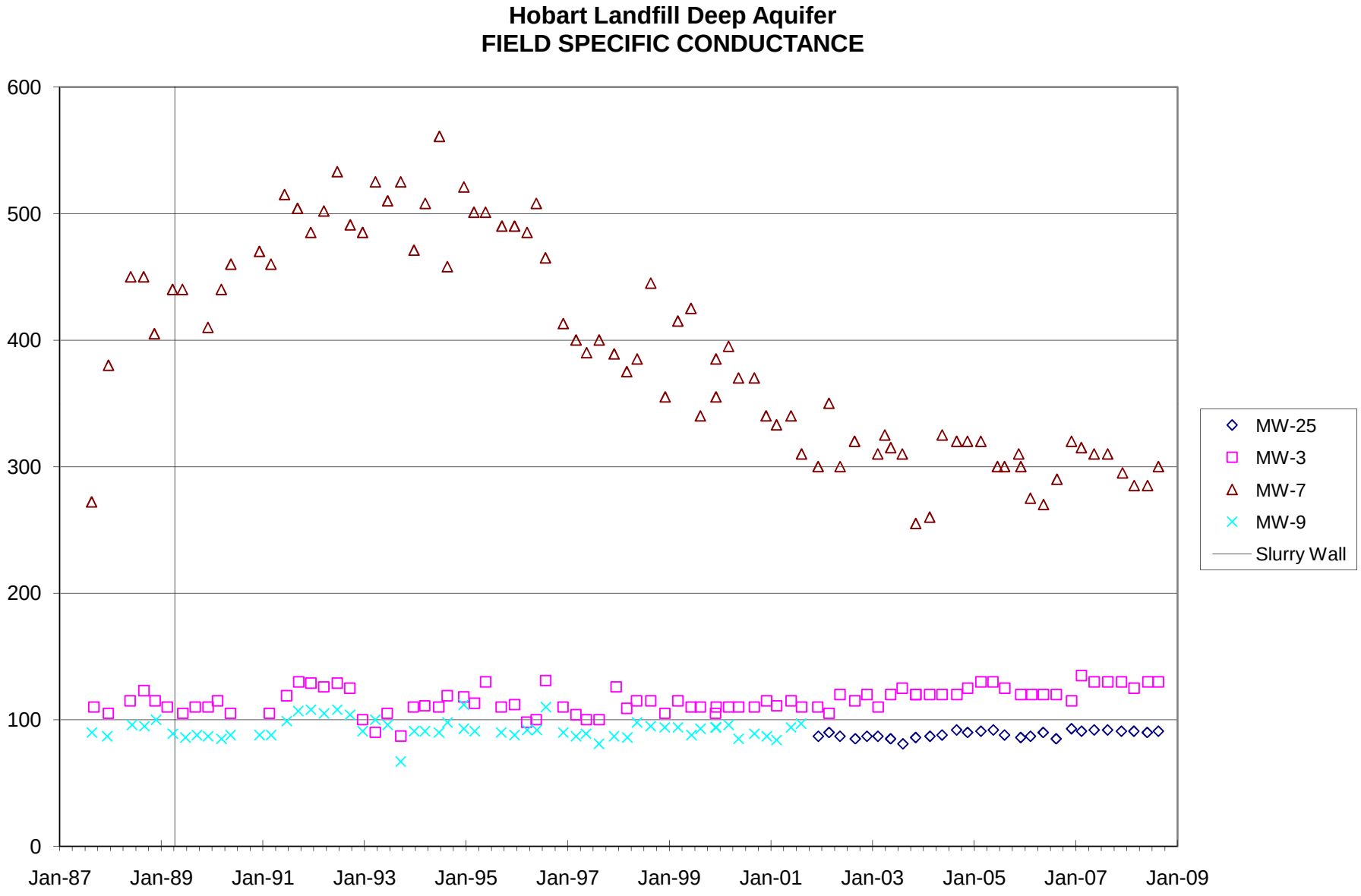
Time Concentration Plots for Deep Aquifer

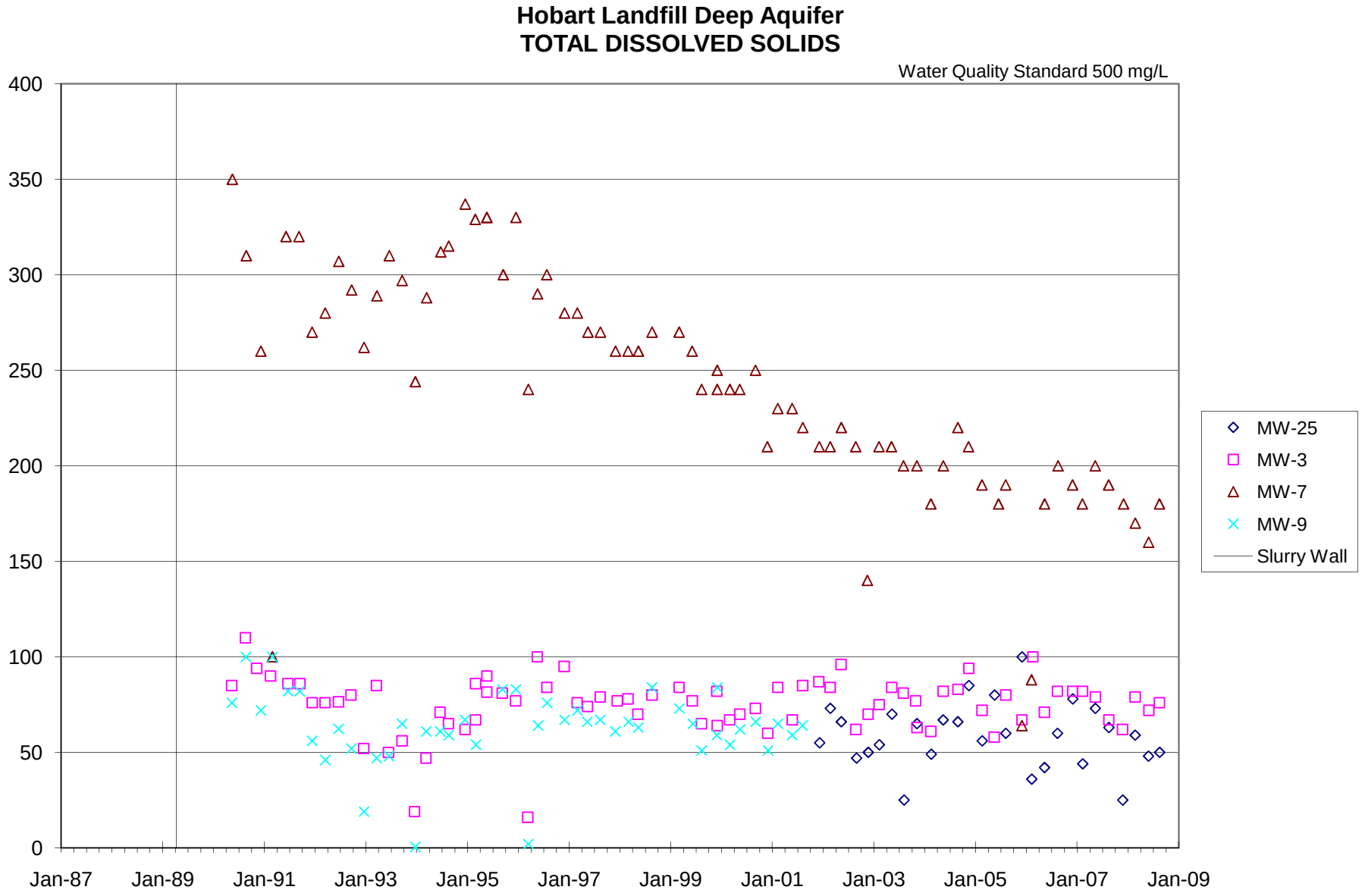
Upgradient Well: MW-25

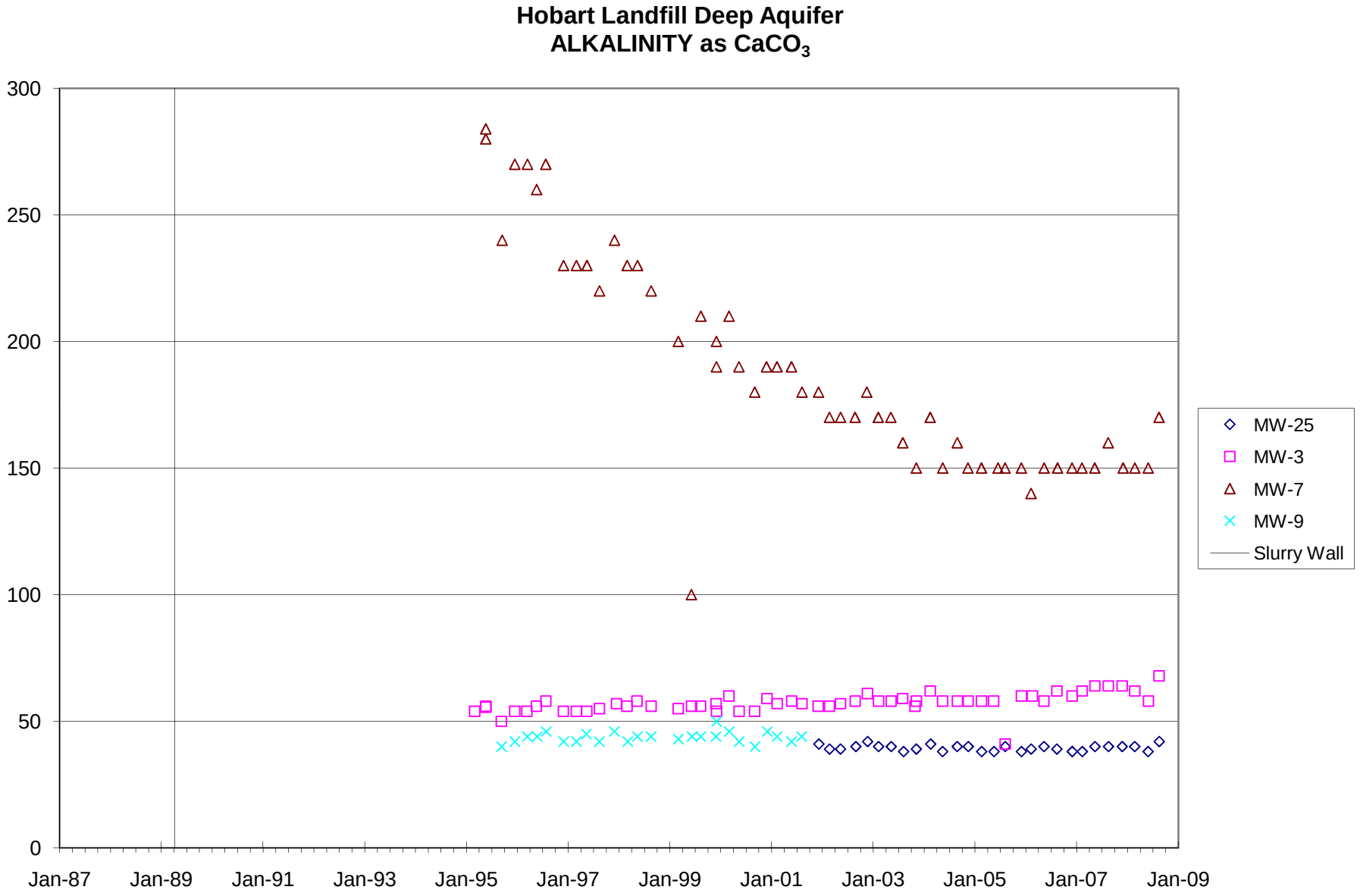
Parameters

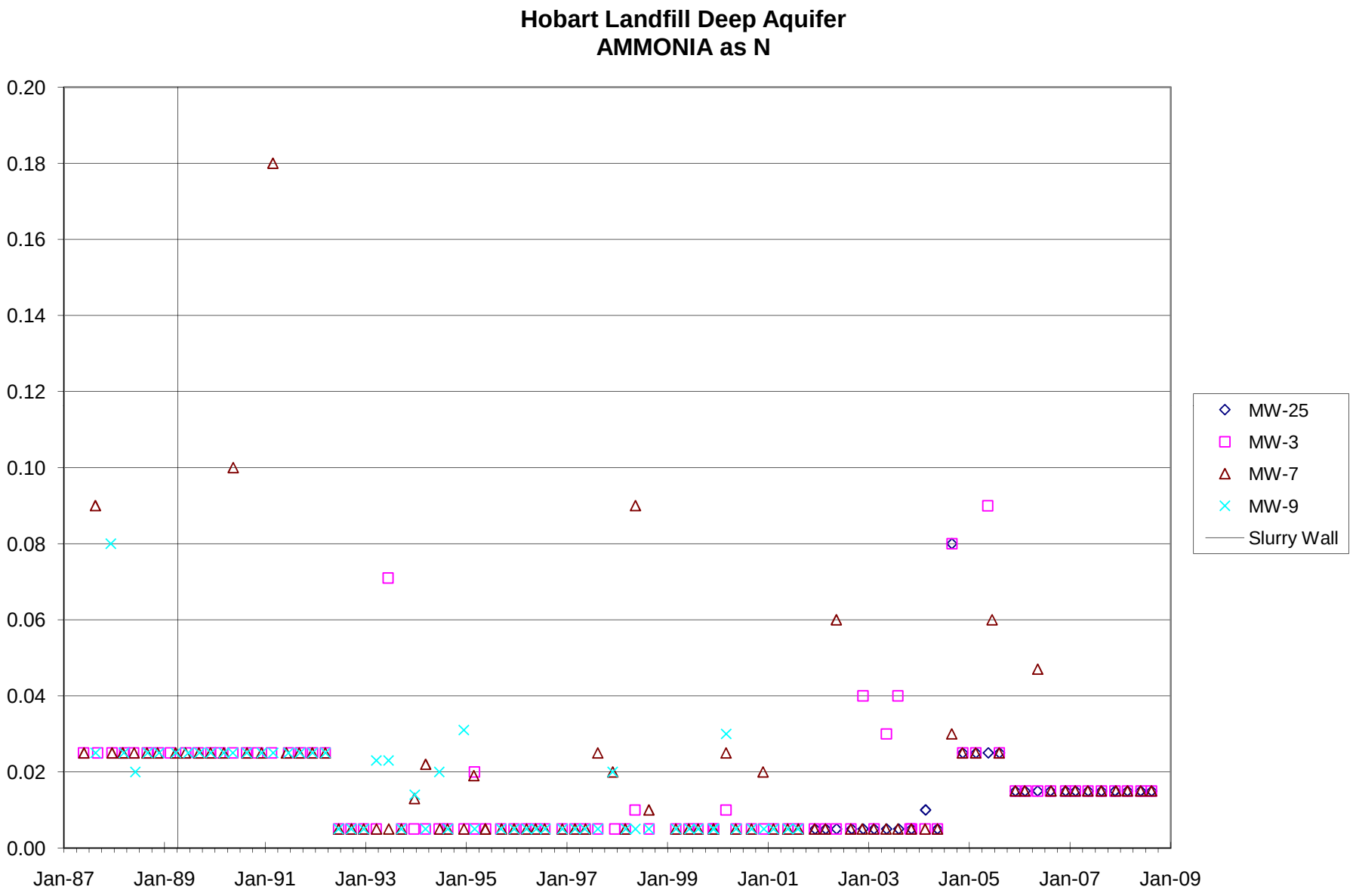
pH
Specific Conductance
Alkalinity
Total Dissolved Solids
Ammonia
Nitrate
Sulfate
Chloride
Total Organic Carbon
Iron
Manganese
Magnesium
Potassium
Arsenic
Calcium
1,1-Dichloroethane

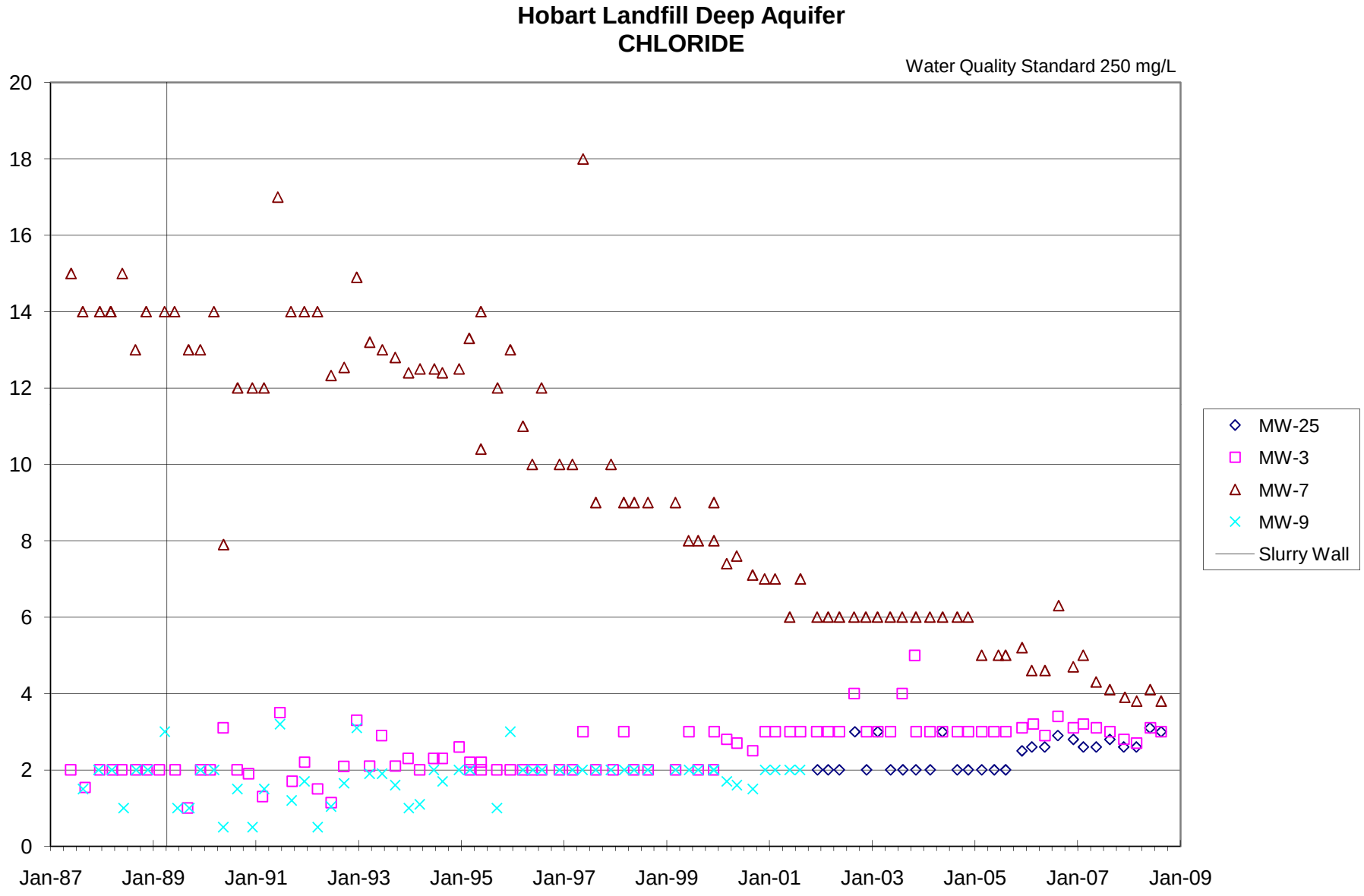

Hobart Landfill Deep Aquifer
FIELD pH
Water Quality Standard 6.5-8.5
10
9
8
7
6
5
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-25
MW-3
MW-7
MW-9
Slurry Wall

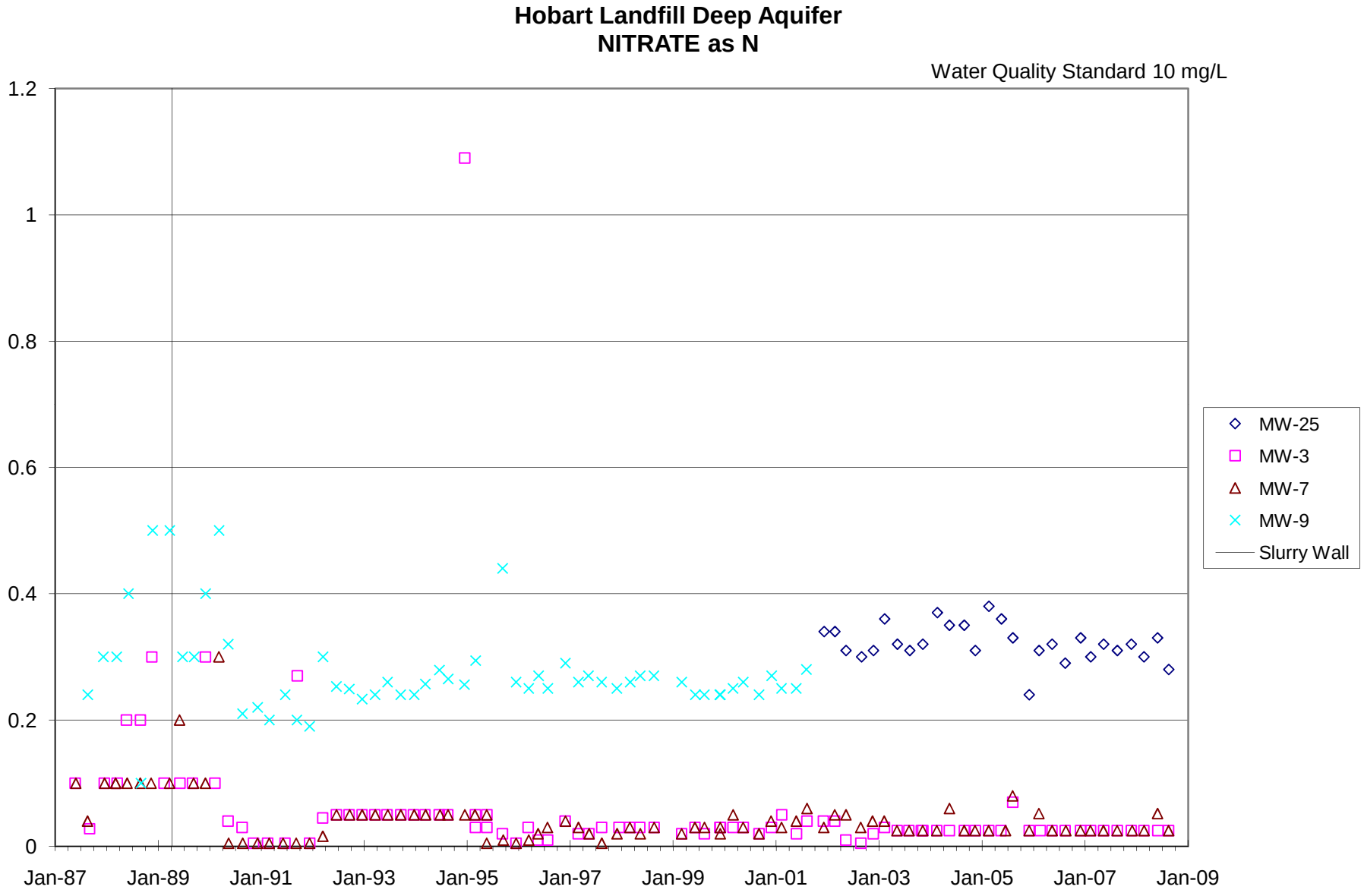

Hobart Landfill Deep Aquifer
FIELD SPECIFIC CONDUCTANCE
600
500
400
300
200
100
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-25
MW-3
MW-7
MW-9
Slurry Wall

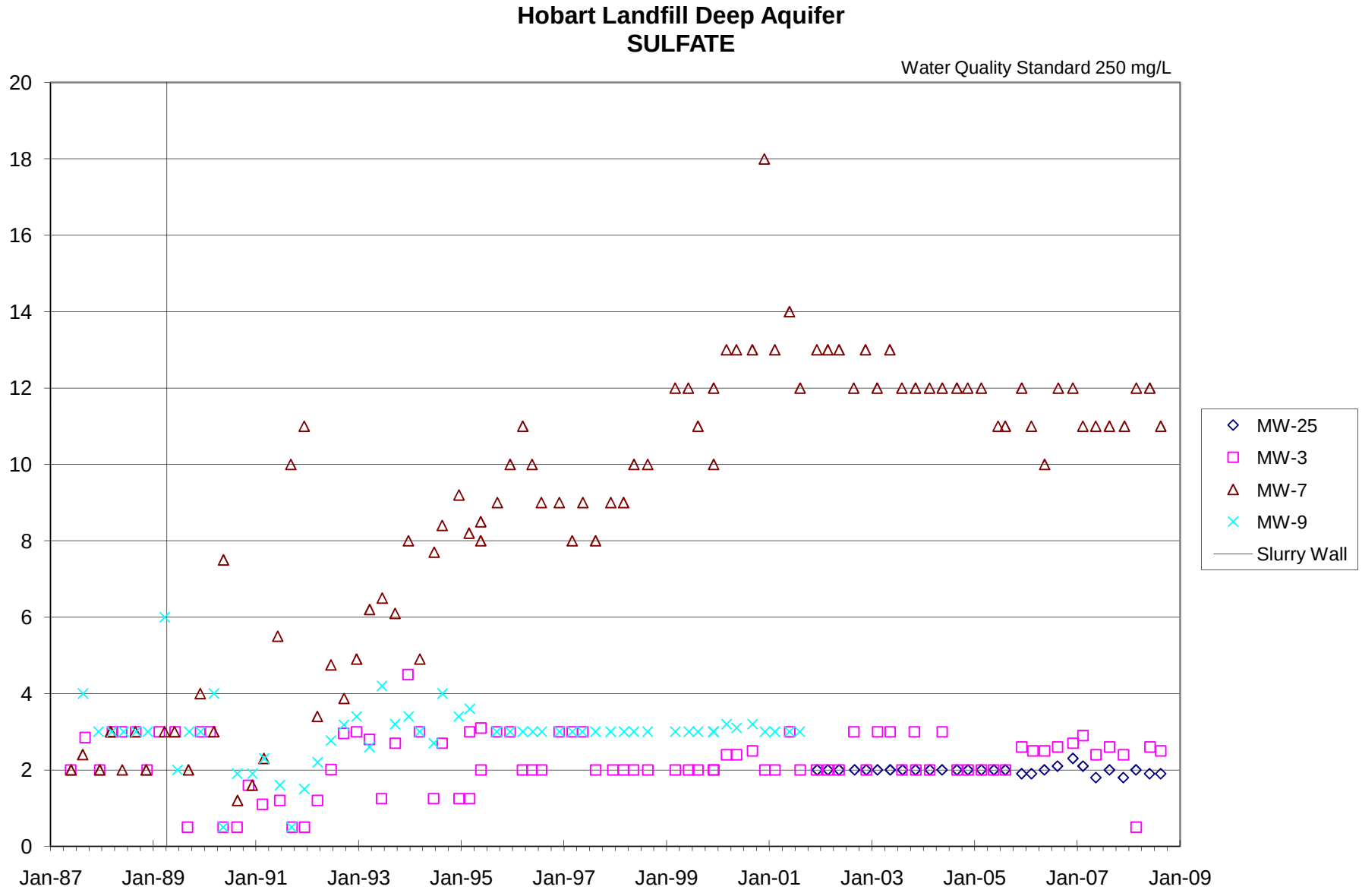

Hobart Landfill Deep Aquifer
TOTAL DISSOLVED SOLIDS
Water Quality Standard 500 mg/L
400
350
300
250
200
150
100
50
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-25
MW-3
MW-7
MW-9
Slurry Wall

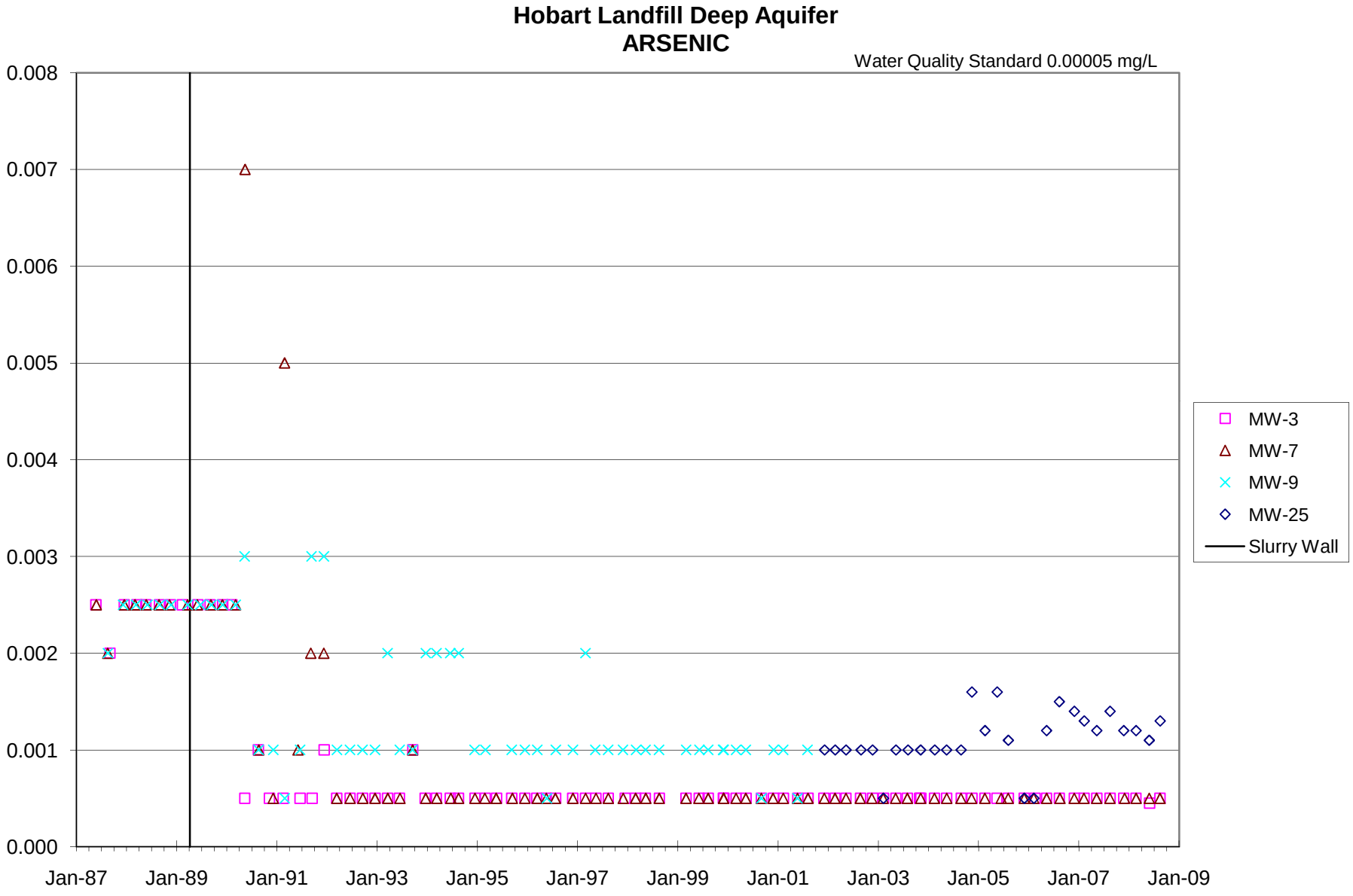

Hobart Landfill Deep Aquifer
ALKALINITY as $CaCO_3$
300
250
200
150
100
50
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-25
MW-3
MW-7
MW-9
Slurry Wall

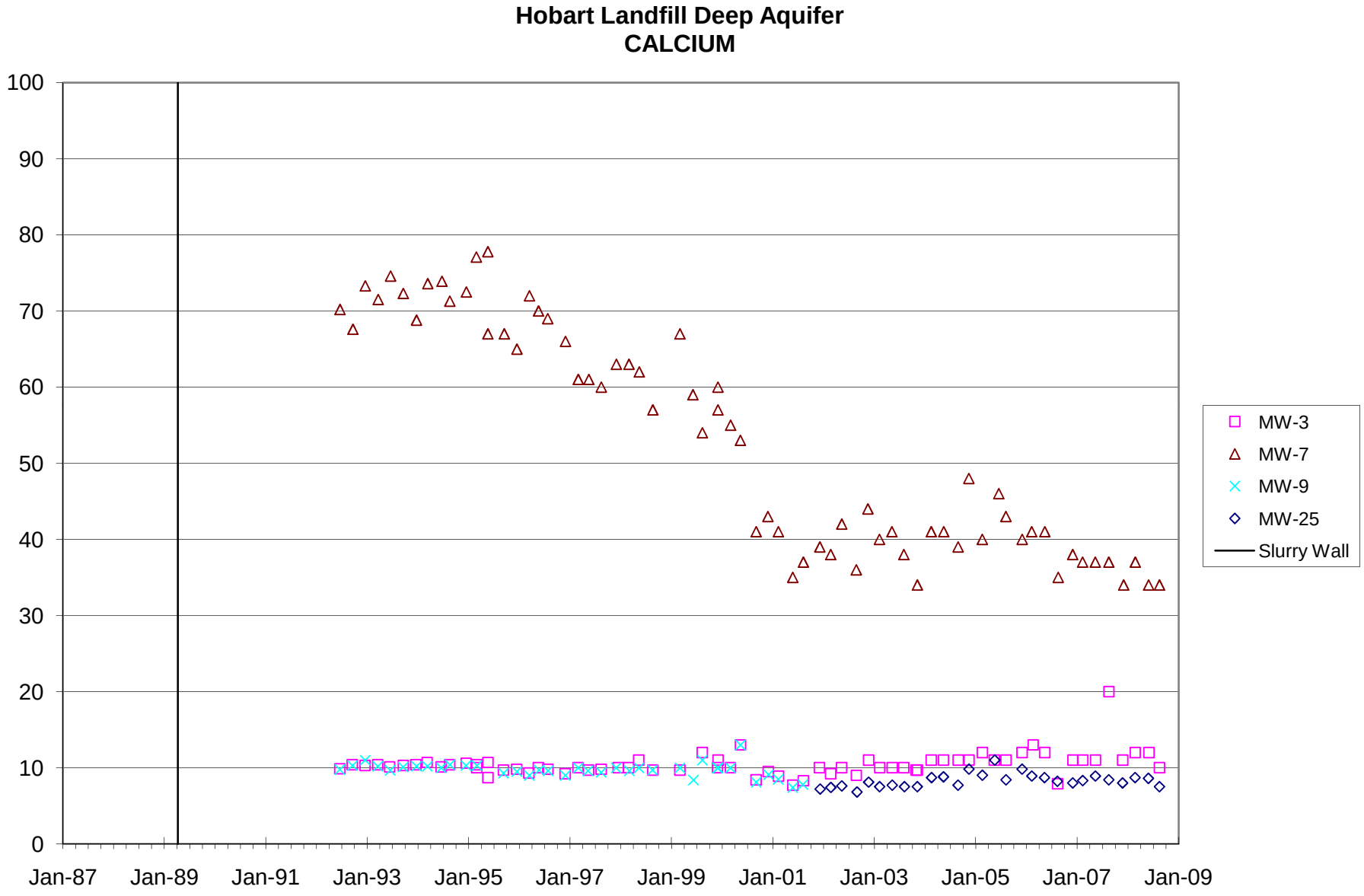

Hobart Landfill Deep Aquifer
AMMONIA as N
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-25
MW-3
MW-7
MW-9
Slurry Wall

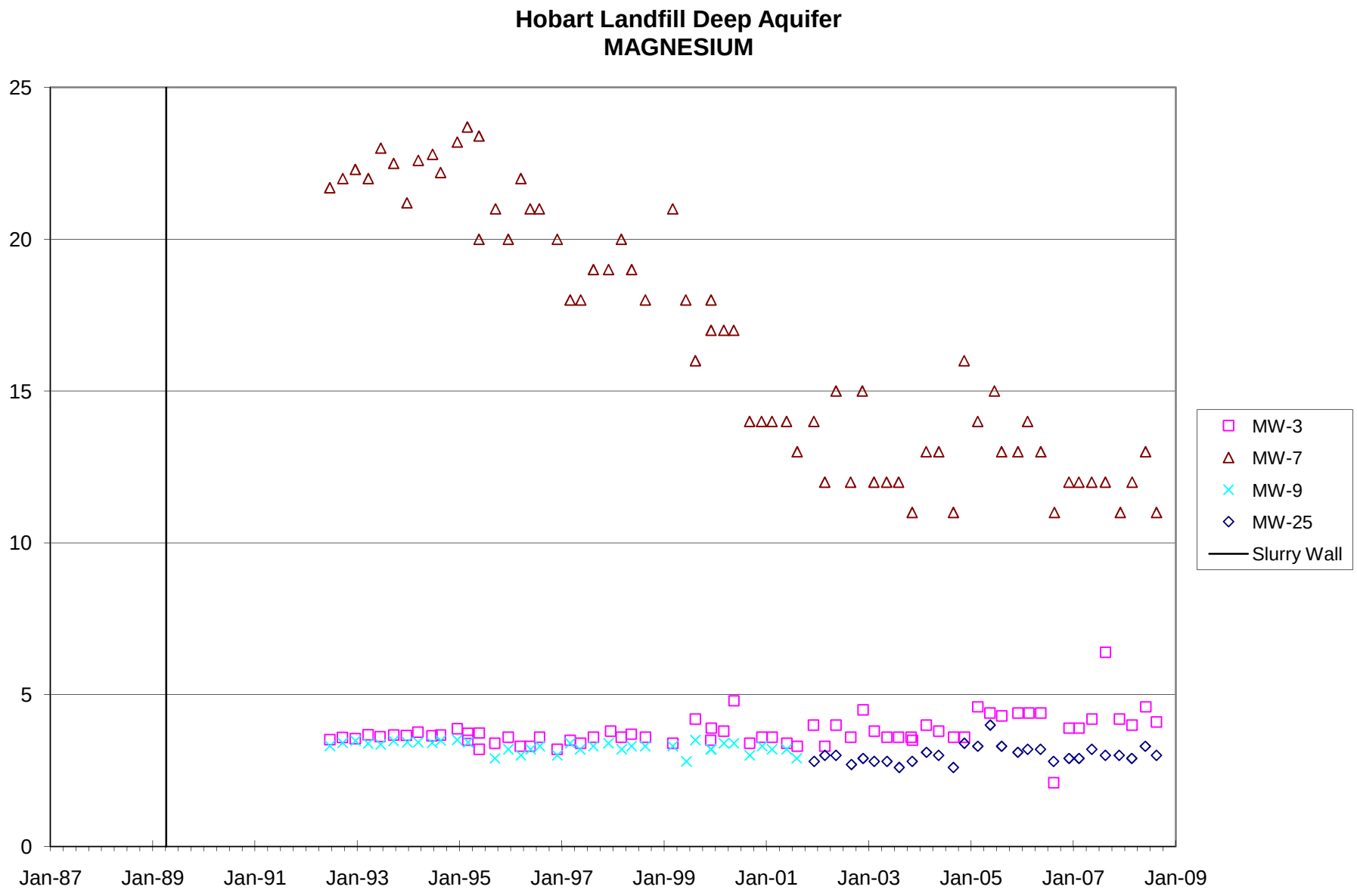

Hobart Landfill Deep Aquifer
CHLORIDE
Water Quality Standard 250 mg/L
20
18
16
14
12
10
8
6
4
2
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-25
MW-3
MW-7
MW-9
Slurry Wall

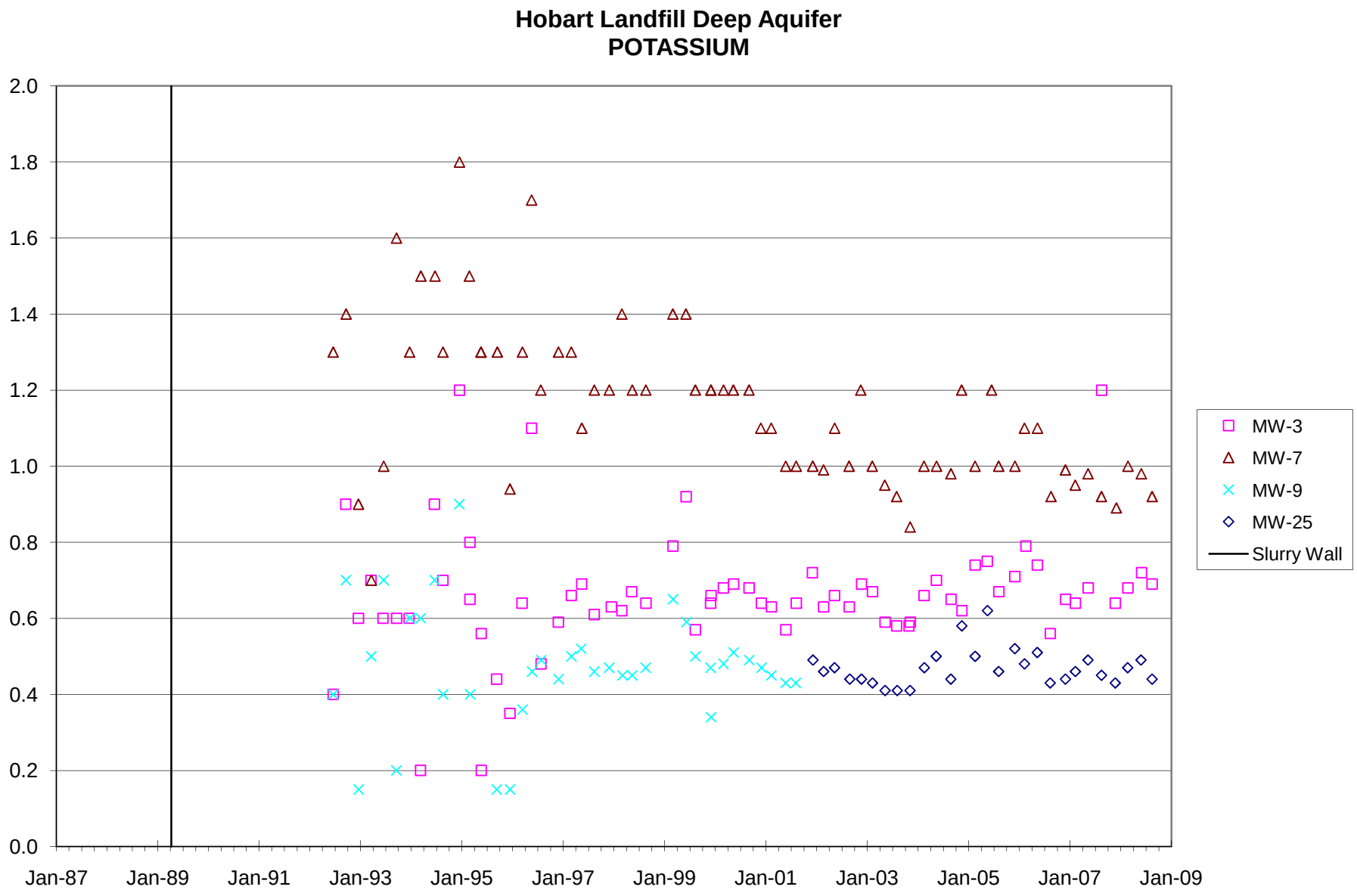

Hobart Landfill Deep Aquifer
NITRATE as N
Water Quality Standard 10 mg/L
1.2
1
0.8
0.6
0.4
0.2
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-25
MW-3
MW-7
MW-9
Slurry Wall

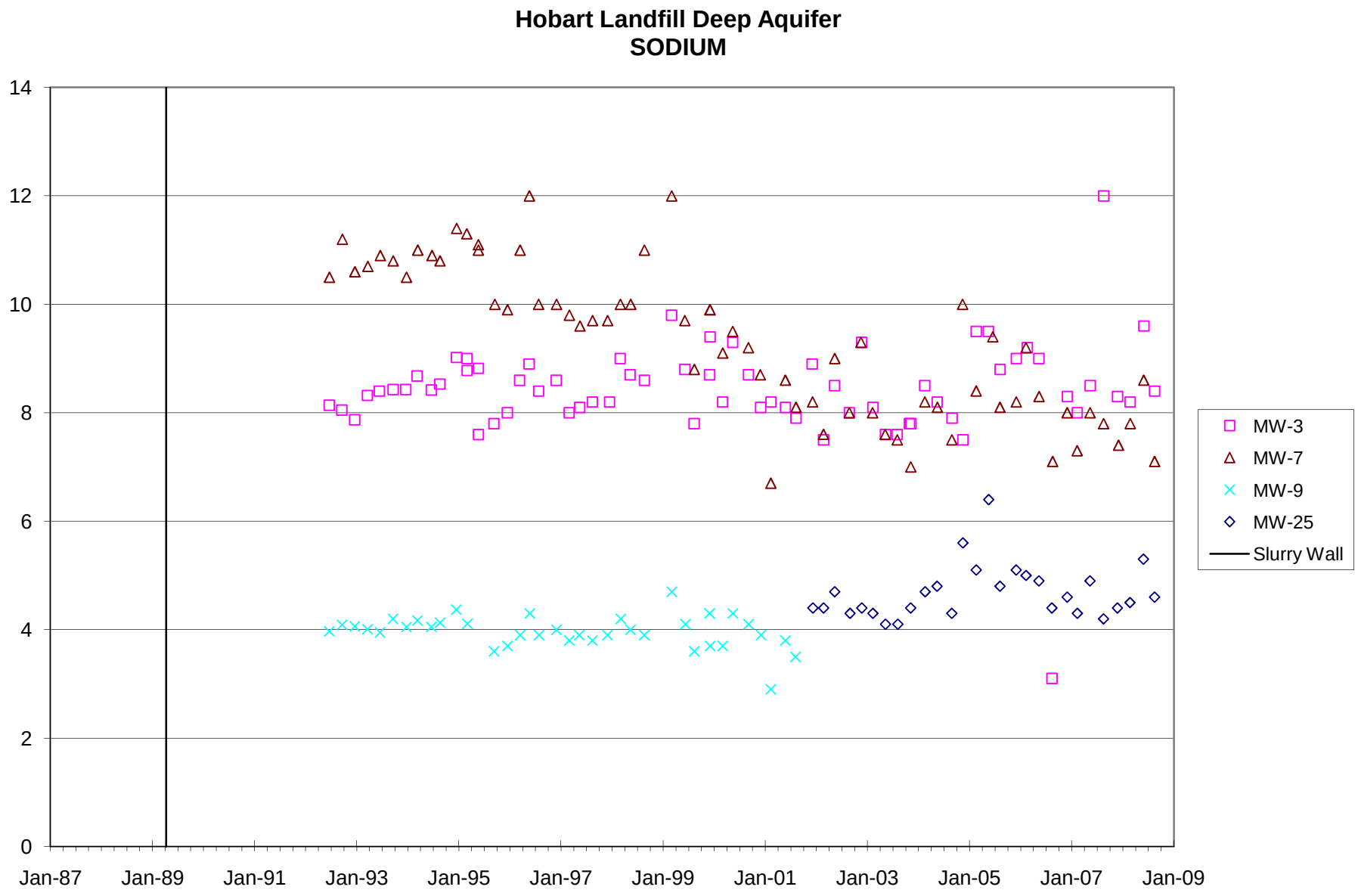

Hobart Landfill Deep Aquifer
SULFATE
Water Quality Standard 250 mg/L
20
18
16
14
12
10
8
6
4
2
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-25
MW-3
MW-7
MW-9
Slurry Wall

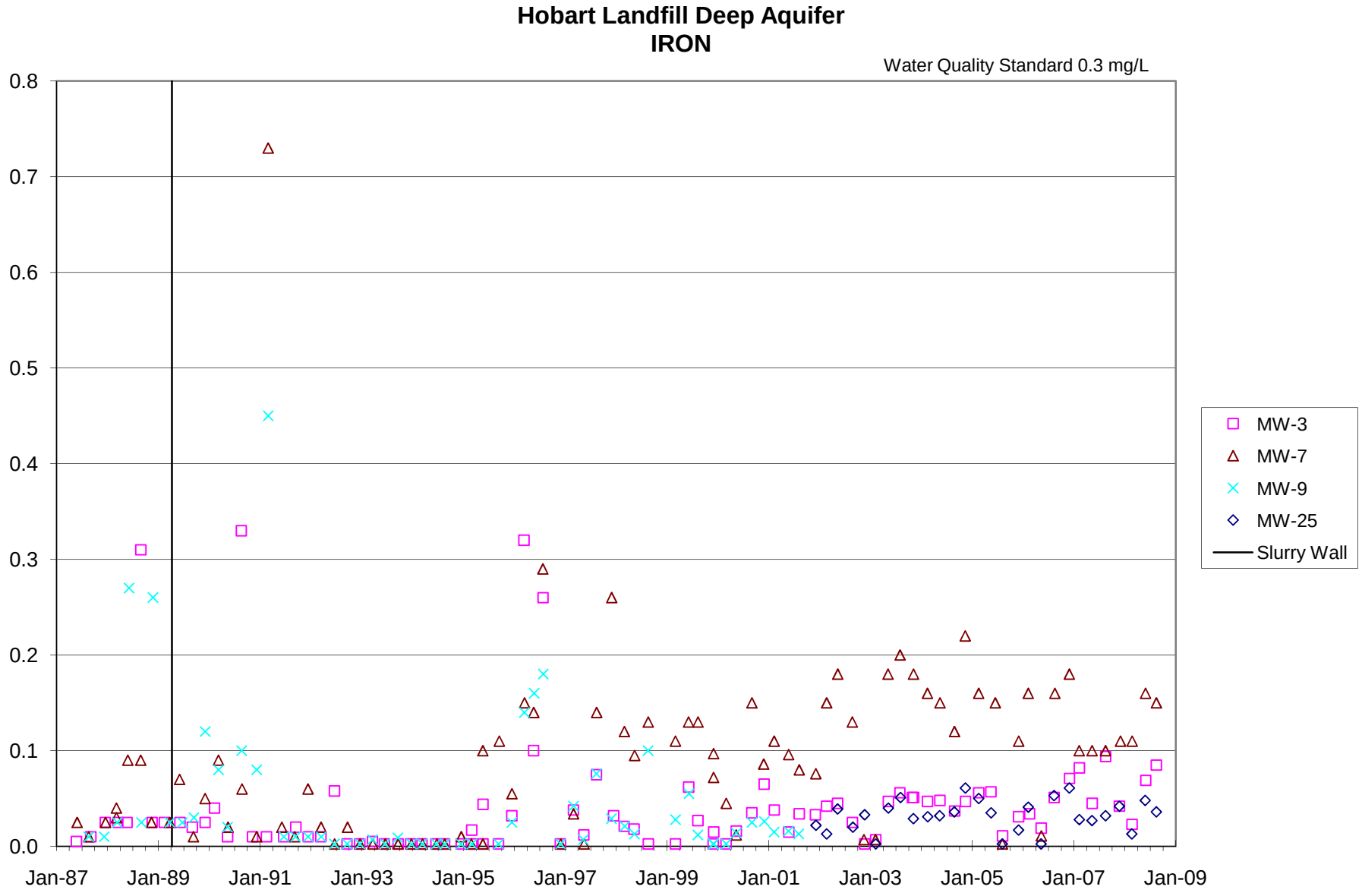

Hobart Landfill Deep Aquifer
ARSENIC
Water Quality Standard 0.00005 mg/L
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-3
MW-7
MW-9
MW-25
Slurry Wall

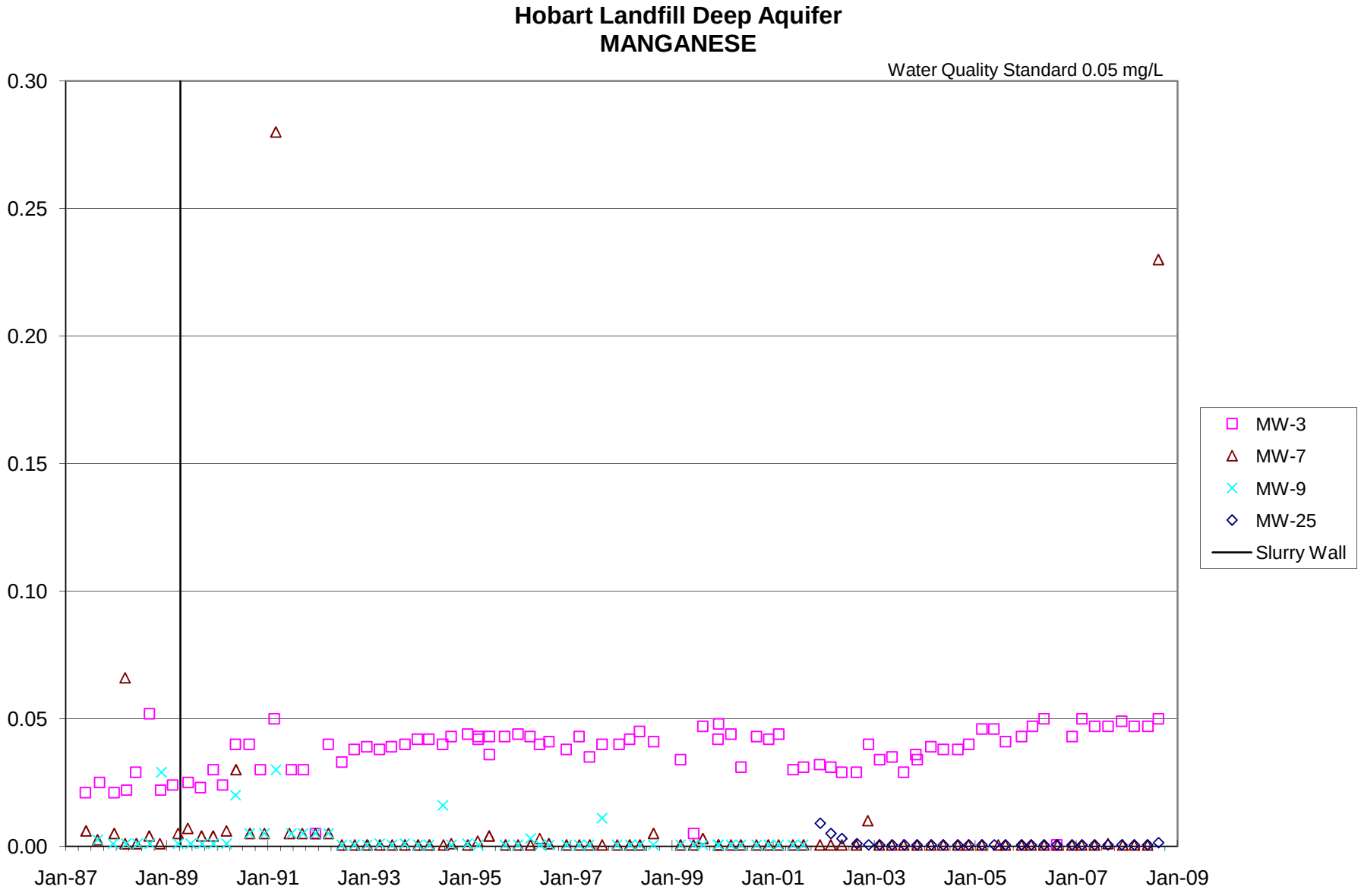

Hobart Landfill Deep Aquifer
CALCIUM
100
90
80
70
60
50
40
30
20
10
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-3
MW-7
MW-9
MW-25
Slurry Wall

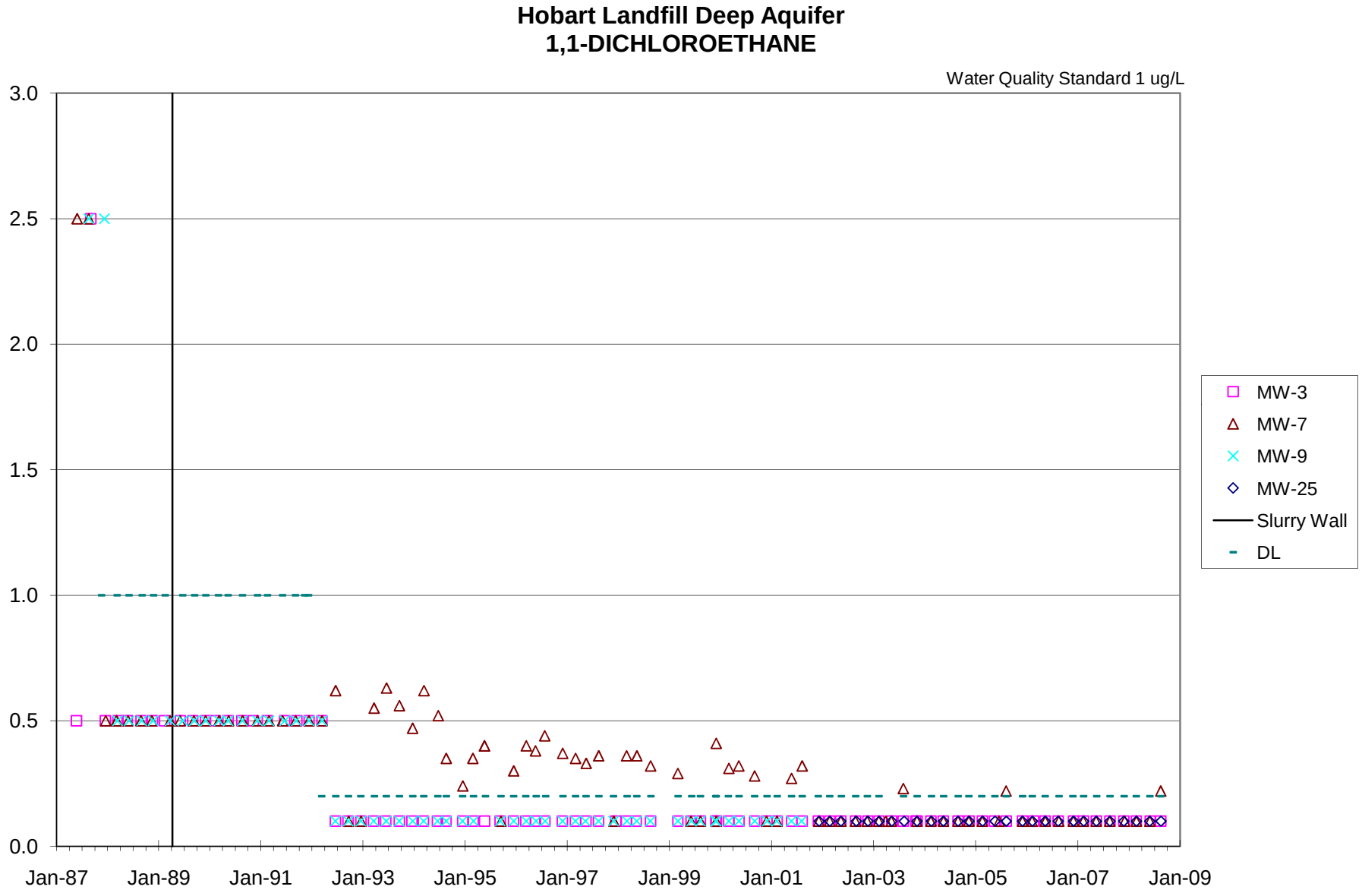

Hobart Landfill Deep Aquifer
MAGNESIUM
25
20
15
10
5
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-3
MW-7
MW-9
MW-25
Slurry Wall


Hobart Landfill Deep Aquifer
POTASSIUM
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-3
MW-7
MW-9
MW-25
Slurry Wall


Hobart Landfill Deep Aquifer
SODIUM
14
12
10
8
6
4
2
0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-3
MW-7
MW-9
MW-25
Slurry Wall


Hobart Landfill Deep Aquifer
IRON
Water Quality Standard 0.3 mg/L
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-3
MW-7
MW-9
MW-25
Slurry Wall


Hobart Landfill Deep Aquifer
MANGANESE
Water Quality Standard 0.05 mg/L
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-3
MW-7
MW-9
MW-25
Slurry Wall


Hobart Landfill Deep Aquifer
1,1-DICHLOROETHANE
Water Quality Standard 1 ug/L
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
MW-3
MW-7
MW-9
MW-25
Slurry Wall
DL

Hobart Landfill Deep Aquifer
VINYL CHLORIDE

APPENDIX F

Hobart Closed Landfill Groundwater Monitoring Data

Hobart Closed Landfill Groundwater Monitoring Data

The Hobart Closed Landfill Groundwater Monitoring Data are available as Portable Document Format (PDF) files. To view PDF files you must have Adobe® Acrobat® Reader® software. With the Adobe® Acrobat® Reader® software**,** you can review and print PDF files across a broad range of hardware and operating systems.

Appendix E content	Filename	Description
F1	GWfield.pdf	This file contains qualified data from field measurements for Groundwater Field Parameters such as pH, specific conductance, temperature, etc…
F2	GW waterlevel.pdf	This file contains Groundwater Elevations from field measurements.
F3	GWconventionals.pdf	This file contains qualified data for Groundwater Conventional Parameters, such as pH, specific conductance, nitrate, chloride, etc…
F4	GWmetals.pdf	This file contains qualified data for Groundwater Dissolved Metal Parameters such as arsenic, iron, manganese, etc…
F5	GWrads.pdf	This file contains qualified data for Groundwater Radionuclide Parameters, such as radium 226, radium 228, etc…
F6	GWvolatiles.pdf	This file contains qualified data for Groundwater Volatile Organic Compound Parameters, such as dichloroethane, methylene chloride, vinyl chloride, total xylenes, etc…
F7	GWpestherb.pdf	This file contains qualified data for Groundwater Pesticide and Herbicide Parameters such as aroclor, endrin, 4,4'-DDT, toxaphene, etc…

KING COUNTY SOLID WASTE DIVISION
QUALIFIER INFORMATION *(Updated 5/19/2005)*

QUAL	QUALIFIER DESCRIPTION
B	Analyte Found In Associated Method Blank
D	Compound Analyzed at a Secondary Dilution Factor.
E	Exceed The Calibration or Linear Range.
J	Estimated Value Less Than Practical Quantitation Limit And Greater Than The Method Detection Limit.
M	Raised Detection Limit. Due to Matrix Interference.
O	Analyzed Beyond Specified Holding Time.
P	Pesticide/PCBs > 25% Difference Between Columns.
R	Rejected Data
U	Analyte Not Detected at Given Value.
CG	Confluent Growth (Bacterial Analyses Only)
ED	Excess Debris on Growth Media (Bacterial Analyses Only).

More than one qualifier can be applied to any analytical result.

Non-numeric result NOTATIONS:

NM – Coliforms 'Not Measured' in sample (no CO_2 production).
P – Coliforms 'Present' in sample (CO_2 production) but can't be quantifed.
NA Not Analyzed
NT Not Tested

Others:

TNTC - Too Numerous To Count