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Periodic Monitoring Report for Vapor-Sampling Activities at Material Disposal Area T, Consolidated Unit 21-016(a)-99, at Technical Area 21, February and April 2009

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EXECUTIVE SUMMARY

This periodic monitoring report summarizes the latest results of the vapor-monitoring activities (February and April 2009) conducted at Material Disposal Area (MDA) T, Consolidated Unit 21-016(a)-99, within Technical Area 21 at Los Alamos National Laboratory (LANL or the Laboratory). The objectives of continued vapor-monitoring activities at MDA T are (1) to collect additional vapor samples from boreholes previously sampled at MDA T and (2) to compare the results with previously detected volatile organic compound (VOC) concentrations and tritium activities beneath MDA T.

Two rounds of vapor samples were collected in February and April 2009 from three vapor-monitoring wells: 21-603058, 21-603059, and 21-25264. Wells 21-603058 and 21-603059 are located just outside the MDA T nuclear facility boundary, approximately 35 to 40 ft away from borehole locations 21-25263 and 21-25262. Borehole 21-25264 is also located just outside the MDA T nuclear facility boundary, approximately 225 ft southeast of borehole 21-603058. To date, these wells have been sampled for 6 rounds, from October 2007 to April 2009. Only pore-gas data collected during the last two rounds, February (round 5) and April (round 6) of 2009, are presented and evaluated in this report; 2007–2008 vapor data obtained during rounds 1 to 4 were previously presented and evaluated in the fiscal year 2008 periodic monitoring report.

A total of 22 VOCs plus tritium were detected in MDA T pore gas during the February and April 2009 monitoring activities, and the results are consistent with trends previously observed in 2007–2008 (rounds 1 to 4). Methylene chloride, chloroform, and carbon tetrachloride pore-gas concentrations increased with depth in wells 21-603058, 21-603059, and 21-25264, whereas tetrachloroethene decreased in concentration with depth. Trichloroethene increased with depth in some instances but decreased in others. All other VOC concentrations either decreased with depth or remained consistently low. Tritium activities also decreased with depth or remained consistently low.

VOCs in pore gas were also compared to screening levels (SLs), based on equilibrium partitioning of vapor with groundwater cleanup levels. Consistent with the results obtained from rounds 1 to 4, methylene chloride was the only VOC that exceeded the SL (13 out of 26 results) during rounds 5 and 6.

Monitoring of wells 21-603058, 21-603059, and 21-25264 is scheduled to be performed monthly in conjunction with the installation and sampling of several additional vapor-monitoring wells at MDA T as outlined in the approved MDA T Phase III investigation work plan and associated New Mexico Environment Department correspondence. The data will continue to be presented and evaluated in future periodic monitoring and investigation reports.

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1.0 INTRODUCTION

This report presents the results of continued vapor-monitoring activities, conducted in February and April 2009, at Material Disposal Area (MDA) T, Consolidated Unit 21-016(a)-99, in Technical Area 21 (TA-21) at Los Alamos National Laboratory (LANL or the Laboratory). The objectives of the MDA T vapor-monitoring activities are (1) to collect additional vapor samples from boreholes previously sampled at MDA T and (2) to compare the results with previously detected volatile organic compound (VOC) concentrations and tritium activities beneath MDA T. In addition, this report presents the results of a screening evaluation of the pore-gas VOC data. This screening evaluation compares maximum concentrations of VOCs in pore gas to pore-gas screening levels (SLs) based on equilibrium Henry's law partitioning with groundwater cleanup levels. This conservative screening process evaluates the potential for the observed VOC concentrations to result in contamination of groundwater above cleanup levels.

To date, a total of six rounds of pore-gas sampling have been completed at MDA T well locations 21-603058, 21-603059, and 21-25264. All pore-gas samples were submitted for off-site analysis of VOCs and tritium. This report primarily discusses results obtained from the latest (February [round 5] and April 2009 [round 6]) monitoring activities; results obtained from rounds 1–4 were presented previously and evaluated in the periodic monitoring report for vapor-sampling activities at MDA T in fiscal year (FY) 2008 (LANL 2009, 105187). However, for completeness, results from rounds 1 to 4 are briefly discussed, as appropriate, in the data evaluation section of this report (section 5).

Pore-gas monitoring activities, as required by the MDA T vapor-monitoring plan and the associated New Mexico Environment Department (NMED) approval with modifications letter (LANL 2007, 098944; NMED 2007, 098946), were completed in January 2009, as presented in the FY2008 periodic monitoring report (LANL 2009, 105187). Continued pore-gas sampling of wells 21-603058, 21-603059, and 21-25264 for two additional rounds was conducted in February and April 2009 per recommendations presented in the FY2008 periodic monitoring report (LANL 2009, 105187). Completion of these latest MDA T vapor-monitoring activities partially fulfills the requirements outlined in the NMED approval with modifications letter for the MDA T Phase III investigation work plan (NMED 2009, 105691). Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with U.S. Department of Energy policy.

1.1 Site Location and Description

MDA T is located within TA-21 on DP Mesa and contains the following waste storage and disposal sites: (1) four absorption beds (subsurface), (2) multiple buried shafts (subsurface), and (3) a former Retrievable Waste Storage Area (subsurface) (Figures 1.0-1 and 1.0-2). Current vegetation at MDA T includes grasses, chamisa bushes, and two young ponderosa pines. The top of the regional aquifer occurs approximately 1300 ft below MDA T, based on water-level information from regional well R-6 (Kleinfelder 2005, 091693). The MDA T investigation report (LANL 2006, 094151) presents further details regarding MDA T waste storage and disposal sites, operations, and historical investigation activities.

2.0 SCOPE OF ACTIVITIES

As directed by the approved MDA T vapor-monitoring plan (LANL 2007, 098944; NMED 2007, 098946), six rounds of pore-gas field-screening and sampling activities have been completed to date at MDA T. Monitoring was completed at well locations 21-603058, 21-603059, and 21-25264 (Figure 1.0-2) in October 2007 (round 1), February 2008 (round 2), May 2008 (round 3), September 2008 (round 4), February 2009 (round 5), and April 2009 (round 6). For each sampling round, vapor samples were collected at wells 21-603058 and 21-25264 from five separate sampling ports installed at the following intervals: (1) borehole total depth (TD) (sampling port 5), (2) base elevation of the nearby disposal unit (sampling port 1, 69–81 ft), and (3) depths correlated to the 2005–2006 sampling port depths at locations 21-25262 and 21-25263 (sampling ports 2–4). At well 21-603059, pore-gas characterization samples were collected from six separate sampling ports installed at the following intervals: (1) borehole TD (sampling port 6), (2) base elevation of the nearby disposal unit (sampling port 1, 69–81 ft), and (3) depths correlated to the 2005–2006 sampling port depths at locations 21-25262 and 21-25263 (sampling ports 2 to 5). Field duplicate (FD) samples were collected at a minimum frequency of 1:10.

During rounds 5 and 6, a total of 37 pore-gas samples (29 characterization and 8 quality assurance/quality control [QA/QC]) were collected for VOC analysis and 33 samples (29 characterization and 4 QA/QC) for tritium analysis from five ports in wells 21-25264 and 21-603059 and from four ports in well 21-603058. A summary of all February and April 2009 pore-gas sampling depths and sample collection dates by well location is presented in Table 2.0-1. A summary of all February and April 2009 samples collected at MDA T monitoring wells 21-603058, 21-603059, and 21-25264 and their respective analyses are presented in Table 2.0-2.

All samples were collected in accordance with the current version of standard operating procedure (SOP) EP-ERSS-SOP-5074, Sampling for Sub-Atmospheric Air, and submitted to off-site analytical laboratories for the analysis of VOC using U.S. Environmental Protection Agency (EPA) Method TO-15 and for tritium analysis using EPA Method 906.0. Further discussion of the field methods used for pore-gas field screening and sample collection are presented in Appendix B. Field chain of custody (COC) forms and sample collection logs are provided in Appendix D. No investigation-derived waste was generated during execution of vapor-monitoring activities at MDA T.

The February and April 2009 pore-gas field screening results are presented in section 4 of this report; evaluation of the February and April 2009 pore-gas analytical results is presented in section 5. Any deviations to the scope of activities as presented in the approved MDA T vapor-monitoring plan and associated NMED correspondence (LANL 2007, 098944; NMED 2007, 098946) are presented in the following section.

2.1 Deviations

Pore-gas samples were not collected from port 2 in either monitoring well 21-603058 or 21-603059 during implementation of the February and April 2009 monitoring activities at MDA T. Pore-gas sampling port 2, installed in monitoring well 21-603058 at a depth of 160.5–165.5 ft below ground surface (bgs), stopped producing pore-gas after February 2008 (round 2) either because of a mechanical failure or because it was installed within a massive welded unit (LANL 2009, 105187). Pore-gas sampling port 2, installed in monitoring well 21-603059 at a depth of 112.5–117.5 ft bgs, has never produced pore-gas since it was installed, again probably because of its positioning within a massive welded unit (LANL 2009, 105187).

3.0 REGULATORY CRITERIA

The March 1, 2005, Compliance Order on Consent (the Consent Order) does not identify any cleanup standards, risk-based screening levels (SLs), risk-based cleanup goals, or other regulatory criteria for pore gas at MDA T. Therefore, an analysis was conducted to evaluate the potential for contamination of groundwater by VOCs in pore gas using SLs based on groundwater cleanup levels in the Consent Order. The analysis evaluated the groundwater concentration that will be in equilibrium with the maximum concentrations of VOCs detected at MDA T during the two most recent monitoring events (February and

April 2009). The equilibrium relationship between air and water concentrations is described by the following equation.

$$C_{water} = C_{air} H' \qquad \textbf{Equation 3.0-1}$$

Where C_{water} = the volumetric concentration of contaminant in water,

C_{air} = the volumetric concentration of contaminant in air, and

H' = dimensionless form of Henry's law constant.

If the predicted concentration of a particular VOC in groundwater is less than the SL, then no potential exists for an exceedance of the groundwater cleanup level. The February and April 2009 MDA T VOC pore-gas data are discussed in section 5.2.

Because no SLs for pore gas address the potential for groundwater contamination, the screening evaluation was based on groundwater standards or tap water SLs and Henry's law constants that describe the equilibrium relationship between vapor and water concentrations. The source of the Henry's law constants is the NMED technical background document (NMED 2006, 092513) or the EPA regional screening tables (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm). The following dimensionless form of Henry's law constant was used:

$$H' = \frac{C_{air}}{C_{water}} \qquad \textbf{Equation 3.0-2}$$

Equation 3.0-2 can be used to calculate the following screening value (SV):

$$SV = \frac{C_{air}}{1000 \times H' \times SL} \qquad \textbf{Equation 3.0-3}$$

where C_{air} is the concentration of a particular VOC in the pore-gas sample ($\mu g/m^3$), H' is the dimensionless Henry's law constant, SL is the screening level (µg/L), and 1000 is a conversion factor from L to m^3. The SLs are the standards or tap water SLs. The groundwater standards are the EPA maximum contaminant level (MCL) or New Mexico Water Quality Control Commission (NMWQCC) groundwater standard, whichever is lower. If there is no MCL or NMWQCC standard, the EPA regional tap water SL (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm) is used and adjusted to 10^{-5} risk for carcinogens. The numerator in Equation 3.0-3 is the actual concentration of the VOC in pore gas, and the denominator represents the pore-gas concentration needed to exceed the SL. Therefore, if the SV is less than 1, the concentration of the VOC in pore gas does not exceed the SL, even if the VOC plume were in contact with groundwater. Table 3.0-1 presents the calculated concentrations of contaminants in pore gas corresponding to groundwater SLs.

4.0 FIELD-SCREENING RESULTS

Before each sampling event, field screening was performed in each well and targeted sampling interval to ensure percent carbon dioxide (%CO_2) and oxygen (%O_2) levels at each sample port had stabilized at values representative of subsurface pore-gas conditions. A summary of all field-screening results collected during the February and April 2009 sampling events at MDA T monitoring wells 21-603058, 21-603059, and 21-25264 by sampling port and sampling round is presented in Table 4.0-1.

5.0 ANALYTICAL DATA RESULTS

Analytical results for VOCs in pore gas were produced from laboratory analyses of vapor collected in SUMMA canisters and analyzed for VOCs using EPA Method TO-15. Analytical results for tritium were produced from laboratory analysis of vapor collected in silica gel columns and analyzed for tritium using EPA Method 906.0. All analytical data were subject to extensive QA/QC and data validation reviews in accordance with Laboratory guidance and procedures (LANL 1995, 049738; LANL 1996, 054609; LANL 2000, 071233). The QA/QC and data validation review for February and April 2009 MDA T pore-gas data are presented in Appendix C. All validated analytical results from February and April 2009 pore-gas sampling are presented on a CD in Appendix D. The February and April 2009 pore-gas analytical results are discussed below.

A systematic low bias in previously reported tritium pore-vapor measurements has been identified (Whicker et al. 2009, 106429); tritium data presented in Table 5.0-2 have been corrected for this bias (Marczak 2009, 106500). The bias resulted from the properties of silica gel, the medium used to collect water vapor from pore-gas samples. Silica gel contains water bound to the silica gel molecules that cannot be completely removed by drying, before it is used in sampling, without degrading the silica gel properties. Thus, when water vapor is collected from the pore gas, the tritiated water vapor is diluted into the water bound to the silica gel molecules. The tritium results were corrected using the percent moisture value determined by the analytical laboratory. The corrected tritium results are reported in Table 5.0-2 and in Appendix D.

5.1 VOC Pore-Gas Results

VOC results from rounds 5 and 6 are summarized in Table 5.1-1. Pore-gas vertical trend plots for VOC results from samples collected during rounds 5 and 6 are presented in Figures 5.1-1 through 5.1-11.

As illustrated by Figures 5.1-1 through 5.1-11, MDA T pore-gas VOC concentrations from rounds 5 and 6 show the following general trends:

- Chloroform, carbon tetrachloride, methylene chloride, and trichloroethene (TCE) concentrations generally increased with depth
- Tetrachloroethene (PCE) concentrations decreased with depth
- Acetone; benzene; bromodichloromethane; butanone[2-]; carbon disulfide; cyclohexane; dichlorobenzene[1,4-]; dichlorodifluoromethane; dichloroethane[1,2-]; dichloroethene[cis-1,2-]; ethanol; propylene; toluene; trichloro-1,2,2-trifluoroethane[1,1,2-]; and trichloroethane[1,1,1-] showed no trends. These VOCs were variably detected at very low concentrations (concentrations at or near the standard quantitation limit [SQL]).
- Dichloroethene[1,1-] and trichloroethane[1,1,2-] also showed no trends. These two VOCs were highly variable in detection status as well as the concentration range down the well and/or between sampling rounds.
- Fourteen chemicals previously detected during rounds 1 to 4 (bromoform; butanol[1-]; chlorodibromomethane; ethylbenzene; ethyltoluene[4-]; hexane; hexanone[2-]; methyl-2-pentanone[4-]; n-heptane; propanol[2-]; tetrahydrofuran; trimethylbenzene[1,3,5-]; xylene[1,2-]; and xylene[1,3-]+xylene[1,4-]) were not detected during rounds 5 and 6. These VOCs were detected infrequently (1% to 12% frequency) in 2007–2008 and at very low concentrations (at or near the SQL).

Methylene chloride showed an increase in concentration with depth in all three monitoring wells throughout the 2009 monitoring period, as shown in Figure 5.1-7. Methylene chloride concentrations ranged from (well top to TD) 5.6 to 2400 µg/m^3 (344.5 ft bgs) in well 21-603058; 4 to 1100 µg/m^3 (377.5 ft bgs) in well 21-603059; and 20 to 2200 µg/m^3 (354.5 ft bgs) in well 21-25264. Only during round 6 (April 2009) at well 21-603059 did methylene chloride concentrations partially decrease from 292.5 ft bgs to TD (377.5 ft bgs). Similar increasing trends of methylene chloride concentrations with depth were observed previously in the pore-gas data collected in 2007–2008 (LANL 2009, 105187). The one exception to the increasing trend of methylene chloride in the 2007–2008 data was noted in October 2007, when methylene chloride concentrations decreased from 250 ft bgs to TD (344.5 ft bgs) in well 21-603058.

Chloroform concentrations showed a general increase with depth in two of the three monitoring wells (21-25264 and 21-603058) throughout the 2009 monitoring period; however, in well 21-603059, on average, chloroform concentrations decreased with depth in the 2009 samples (Figure 5.1-8). Chloroform concentrations ranged from 590 to 1500 µg/m^3 in well 21-603058; 94 to 1100 µg/m^3 in well 21-603059; and 430 to 1000 µg/m^3 in well 21-25264. The trends observed for the 2009 chloroform data reflect the chloroform trends observed in the pore-gas data collected in 2007–2008 and are most clearly illustrated by the data collected from well 21-25264 (LANL 2009, 105187).

In wells 21-25264 and 21-603059, carbon tetrachloride concentrations, on average, increased with depth to approximately 300 ft bgs but then decreased, as illustrated by Figure 5.1-9. In well 21-603058, carbon tetrachloride concentrations continued to increase with depth to TD. Carbon tetrachloride concentrations ranged from (well top to TD): 74 to 750 µg/m^3 (344.5 ft bgs) in well 21-603058; 73 to 750 µg/m^3 (297.5 ft bgs) in well 21-603059; and 150 to 500 µg/m^3 (328 ft bgs) in well 21-25264. In the pore-gas data collected in 2007–2008, carbon tetrachloride showed similar trends, except that the general decrease in carbon tetrachloride concentration with depth after approximately 300 ft bgs occurred in wells 21-603058 and 21-603059, while well 21-25264 showed an increase in concentration with depth to TD (354.5 ft bgs).

Concentrations of TCE in well 21-603058 generally increased with depth in 2009 but showed less consistency in the other two wells, especially well 21-603059 (Figure 5.1-10). In well 21-603059, TCE concentrations in round 5 showed reverse trends from round 6 at the shallowest and deepest depths, with agreement and a generally increasing trend at intermediate depths. In well 21-25264, TCE concentrations were in agreement between rounds 5 and 6, with decreasing concentrations to 155 ft bgs followed by a gradual increase to TD (354.5 ft bgs). In the pore-gas data collected in 2007–2008, TCE showed similar trends, except the 2007–2008 concentrations in well 21-603058 decreased with depth after approximately 250 ft bgs.

PCE is the only VOC that consistently showed an overall decrease in concentrations with depth in all three wells throughout the 2009 monitoring period, as shown in Figure 5.1-11. PCE concentrations ranged from (well top to TD) 810 to 74 µg/m^3 in well 21-603058; 1600 to 120 µg/m^3 in well 21-603059; and 3500 to 30 µg/m^3 (354.5 ft bgs) in well 21-25264. Again, this trend is consistent with those observed at these wells during the 2007–2008 monitoring period.

5.2 VOC Screening Evaluation

The VOC results from the February and April 2009 sampling were screened to evaluate whether the concentrations of VOCs are a potential source of groundwater contamination. Because no SLs for pore gas address the potential for groundwater contamination, the screening evaluation was based on groundwater standards or tap water SLs and Henry's law constants that describe the equilibrium relationship between vapor and water concentrations (see section 3.0).

Equation 3.0-3 was used to calculate SVs for the maximum concentrations of VOCs detected at MDA T during the February and April 2009 sampling. The evaluation included the 20 detected VOCs in MDA T samples for which there are MCLs, NMWQCC standards, or EPA regional tap water SLs. Ethanol and propylene were detected but do not have MCLs, NMWQCC standards, or EPA SLs and were not evaluated. Table 5.2-1 presents the results of the pore-gas screening. SVs were less than 1.0 for all detected VOCs except methylene chloride. The concentration of methylene chloride in 13 out of 29 samples collected resulted in an SV greater than 1, with a maximum value of 5.3. This trend is consistent with the 2007–2008 pore-gas data collected from wells 21-603058, 21603059, and 21-25264 during rounds 1 to 4, where a total of 22 out of 58 methylene chloride samples collected resulted in an SV greater than 1.

5.3 Pore-Vapor Tritium Results

The results of the February and April 2009 vapor sampling for tritium are summarized on Table 5.3-1 and presented in Figure 5.3-1.

Pore-gas tritium activities were significantly higher in the February and April 2009 samples collected from well 21-25264 than in the February and April 2009 samples collected from wells 21-603058 and 21-603059. The maximum tritium activity in well 21-25264 (120,741 pCi/L) was from a sample collected at port 2 (at 155.5 ft bgs) during round 6. For both sampling rounds, tritium activities in well 21-25264 showed an increase to maximum values at approximately 150 ft bgs, followed by a decrease to TD (Figure 5.3-1). Similar trends in tritium were found at well 21-25264 during the 2007–2008 monitoring activities; the maximum tritium activity (170,123 pCi/L) was also from a sample collected at 155.5 ft bgs during round 3 (May 2008).

The maximum tritium activity in pore vapor detected in well 21-603058 (6340 pCi/L) was from a sample collected at port 3 (at 222 ft bgs) during round 5. The activities of samples collected during round 6 were below 1200 pCi/L (Figure 5.3-1). Tritium trends for well 21-603058 for rounds 5 and 6 were generally consistent with the 2007–2008 monitoring data. The maximum tritium activity (25,118 pCi/L) was also from a sample collected at 222 ft bgs during round 2 (February 2008). The maximum tritium activity (at 222 ft bgs) was detected in Qbt 1v (just above the Qbt 1v/Qbt 1g contact).

Tritium activities in well 21-603059 generally showed reverse trends to the other two wells, with activities initially decreasing to approximately 190 ft bgs, followed by an increase in activity to TD (Figure 5.3-1). In addition, the minimum and maximum detected tritium activities for this sampling period, 353 pCi/L and 6358 pCi/L, respectively, were both observed at port 1 (at 82.5 ft bgs) but during different sampling rounds (round 6 for minimum and round 5 for maximum). However, activity levels reported in round 6 were lower, in general, than in round 5. The maximum tritium activity in pore vapor detected in the 2007–2008 samples in well 21-603059 (5749 pCi/L) was from a sample collected at TD (at 377.5 ft bgs) during round 3 (May 2008). High tritium activities observed at TD (at 377.5 ft bgs) in well 21-603059 correlate to the Cerro Toledo interval (Qct).

6.0 SUMMARY

The objectives of the MDA T vapor-monitoring activities are (1) to collect additional vapor samples from boreholes previously sampled at MDA T and (2) to compare the results with previously detected VOC concentrations and tritium activities beneath MDA T. Three wells were sampled (21-603058, 21-603059, and 21-25264) for two additional rounds (February and April 2009) per recommendations presented in the FY2008 periodic monitoring report (LANL 2009, 105187). The results of these latest monitoring activities (rounds 5 and 6) indicate similar trends to those observed during FY2007 and FY2008 monitoring activities (rounds 1 to 4).

The results of the February and April 2009 monitoring activities identified a total of 23 chemicals of potential concern (22 VOCs plus tritium) in the pore gas beneath MDA T (Tables 5.1-1 and 5.2-1). Concentrations for 18 of the 22 VOCs detected in MDA T pore gas decreased with depth, were consistently detected at or near the SQL, or their detections and ranges of concentrations varied during the sampling rounds. These observations are consistent with the data trends observed during the 2007–2008 monitoring period.

Four VOCs (methylene chloride, chloroform, carbon tetrachloride, and TCE) showed pore-gas concentrations that generally increased with depth in wells 21-603058, 21-603059, and 21-25264 (during all 6 rounds of monitoring). Methylene chloride showed an increase in concentrations to TD in all three wells. The concentrations for chloroform, carbon tetrachloride, and TCE are not as consistent as those for methylene chloride, with variable results at intermediate depths; however, the concentrations were generally higher at TD than near the surface.

VOCs in pore gas were also compared to SLs based on equilibrium partitioning of vapor with groundwater cleanup levels. Methylene chloride was the only VOC detected whose concentration in pore gas exceeded the SV based on Henry's law partitioning with groundwater cleanup levels.

Analytical laboratory results for tritium have been corrected to account for the impact of silica gel–bound water. All values presented in this report (including those provided in Appendix D) have been corrected. All discussions of data values, detections, and trends present the corrected tritium concentrations.

Tritium in pore vapor was substantially higher in samples collected from well 21-25264 than in samples collected from wells 21-603058 and 21-603059. Tritium activities in well 21-25264 showed an increase to maximum values at approximately 150 ft bgs followed by a decrease to TD in all six sampling rounds. The maximum tritium activity in pore vapor detected in well 21-603058 was from a sample collected at 222 ft bgs during round 5. The activities of samples collected during the other rounds were substantially lower. The maximum tritium activity in pore vapor detected in well 21-603059 were from samples collected at the shallowest depth and at TD (377.5 ft bgs) during round 5. Tritium activities in pore-vapor samples collected during the other rounds were substantially lower. For all wells, the pore-vapor tritium activities showed similar trends to tritium activities observed during the 2007–2008 monitoring activities.

Vapor-monitoring activities are scheduled to continue at MDA T per the requirements outlined in the MDA T Phase III investigation work plan and the associated NMED approval correspondence (LANL 2009, 105645; NMED 2009, 106455; NMED 2009, 105691). Wells 21-603058, 21-603059, and 21-25264 will be monitored on a monthly basis for up to 1 yr in conjunction with the sampling (on completion and installation) of new monitoring wells at MDA T (as approved by NMED). Data obtained during future monitoring activities at wells 21-603058, 21-603059, and 21-25264 will be presented and evaluated, as available, in future quarterly monitoring reports and the MDA T Phase III investigation report as scheduled in the approved MDA T Phase III investigation work plan (LANL 2009, 105645; NMED 2009, 106455; NMED 2009, 105691).

7.0 REFERENCES AND MAP DATA SOURCES

7.1 References

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text *citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.*

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

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NMED (New Mexico Environment Department), May 4, 2009. “Approval with Modifications, Phase III Work Plan for Material Disposal Area T, Consolidated Unit 21-016(a)-99,” New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2009, 105691)

NMED (New Mexico Environment Department), May 26, 2009. “Correction, Approval with Modifications, Phase III Work Plan for Material Disposal Area T, Consolidated Unit 21-016(a)-99,” New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2009, 106455)

Whicker, J.J., J.M. Dewart, S.P. Allen, W.F. Eisele, M.C. McNaughton, and A.A. Green, June 17, 2009. “Corrections for Measurement of Tritium in Subterranean Vapor Using Silica Gel,” Los Alamos National Laboratory document LA-UR-09-03837, Los Alamos, New Mexico. (Whicker et al. 2009, 106429)

7.2 Map Data Sources

Data sources used in original figures created for this report are described below and identified by legend title.

Legend Item	Data Source
LANL boundary	LANL Areas Used and Occupied; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 19 September 2007.
Major paved road	New Mexico roads; Earth Data Analysis Center, Albuquerque, NM; 01 December1995.
Paved road	Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 October 2008.
Structure	Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 October 2008.
TA boundary	Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 19 September 2007.
Contours	2000 LIDAR data; Los Alamos National Laboratory, Earth & Environmental division; 09 July 2000
MDA T	Material Disposal Area; Los Alamos National Laboratory, Remediation Services Project, 23 April 2004; as published 27 March 2007
Fence	Fencing, security and industrial, Los Alamos National Laboratory; KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 03 June 2009
Rio Grande	Drainage Arcs; Los Alamos National Laboratory; Water Quality and Hydrology Group; 03 June 2003

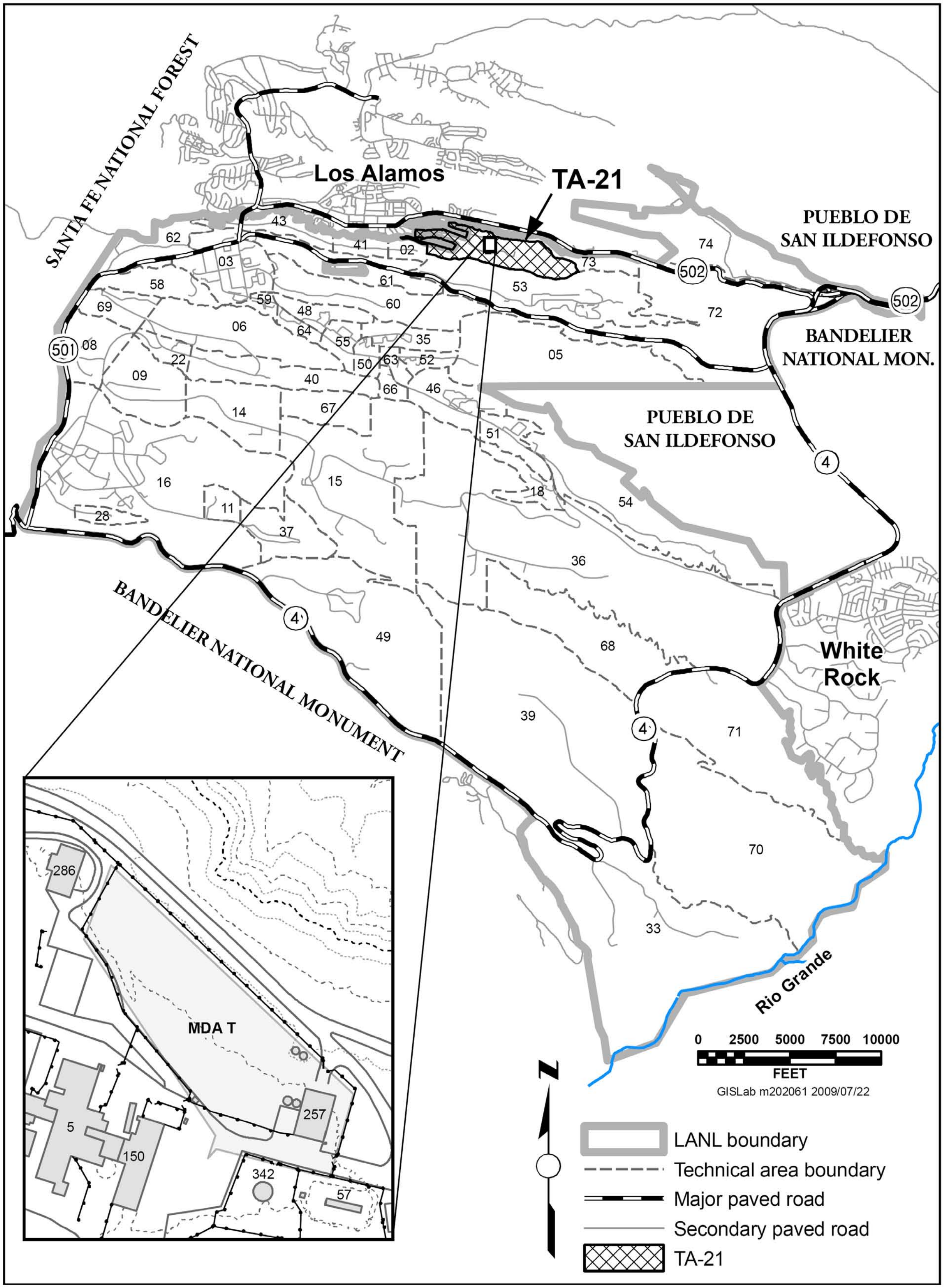


Figure 1.0-1 Location of MDA T at TA-21

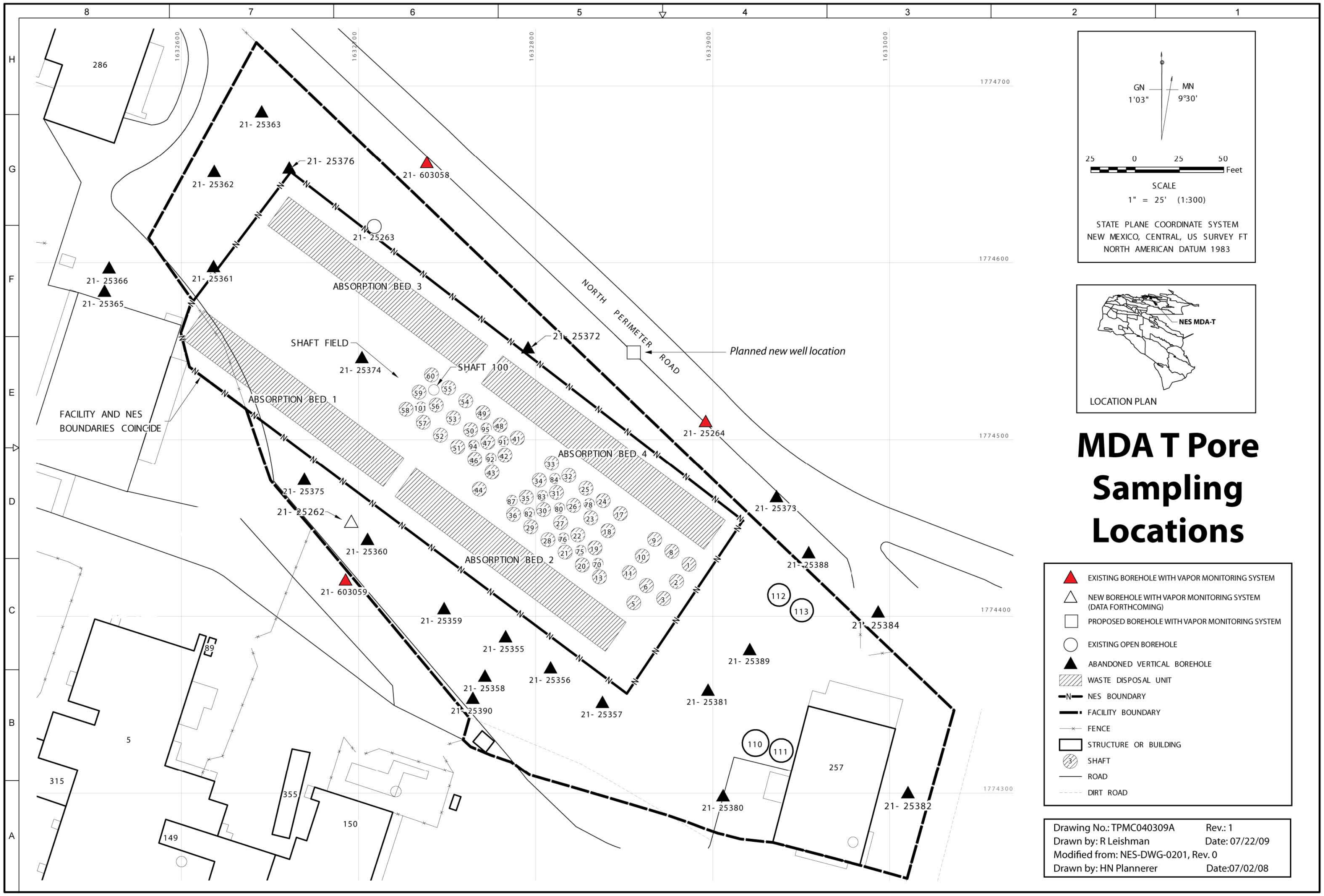


Figure 1.0-2 Locations of MDA T monitoring wells and associated structures and features

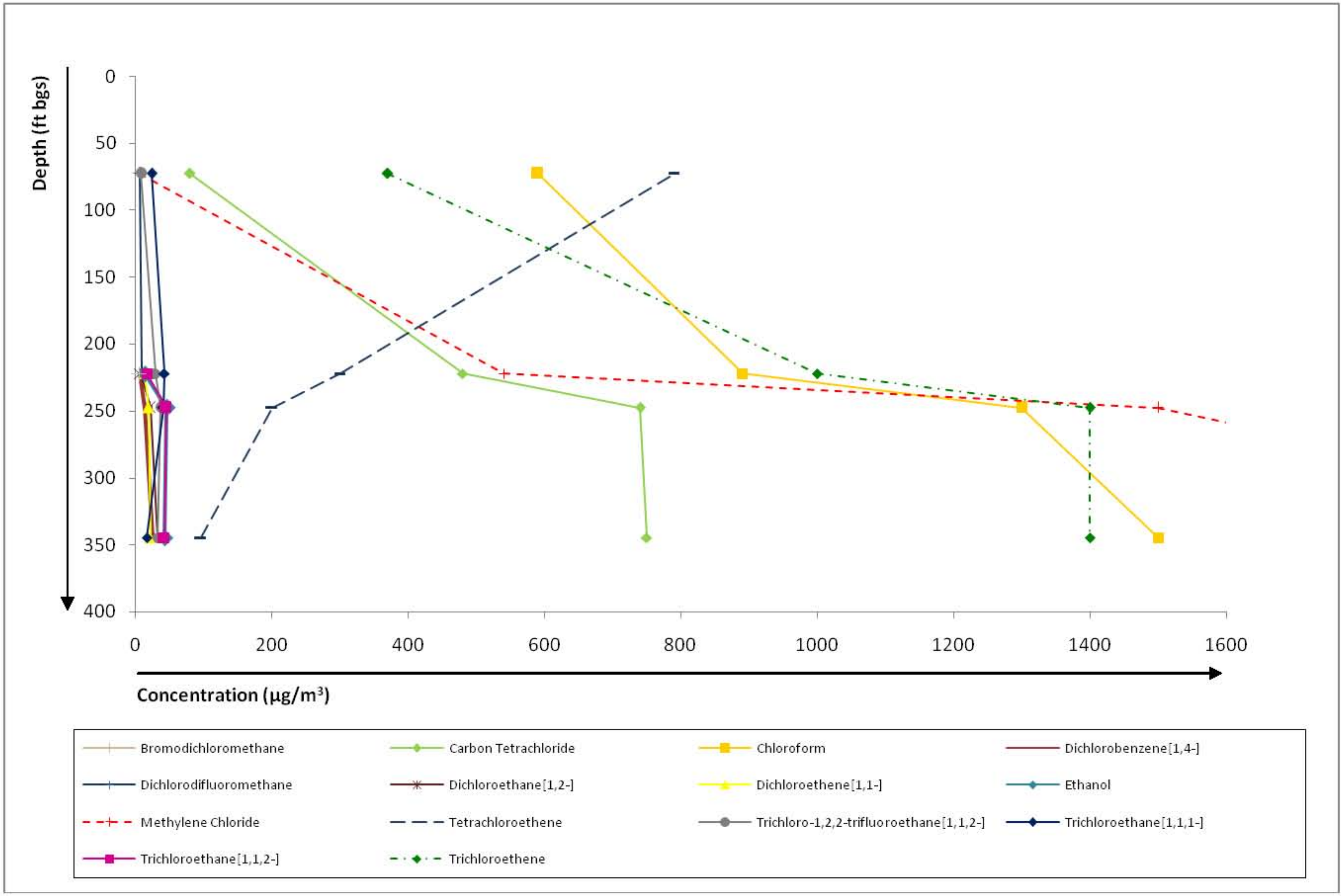


Figure 5.1-1 Vertical profile of detected VOCs in pore-gas monitoring well 21-603058, round 5, February 2009

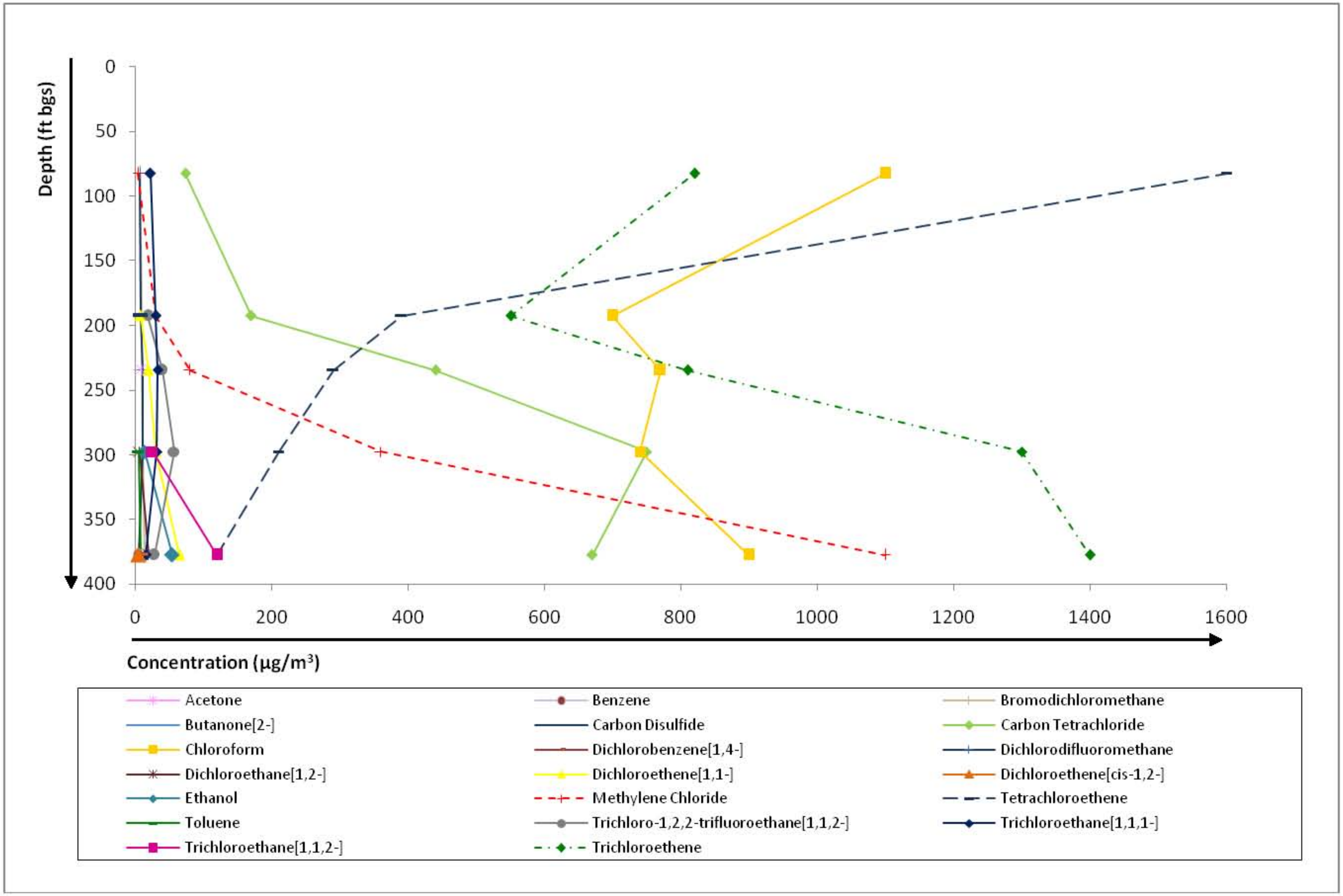


Figure 5.1-2 Vertical profile of detected VOCs in pore-gas monitoring well 21-603059, round 5, February 2009

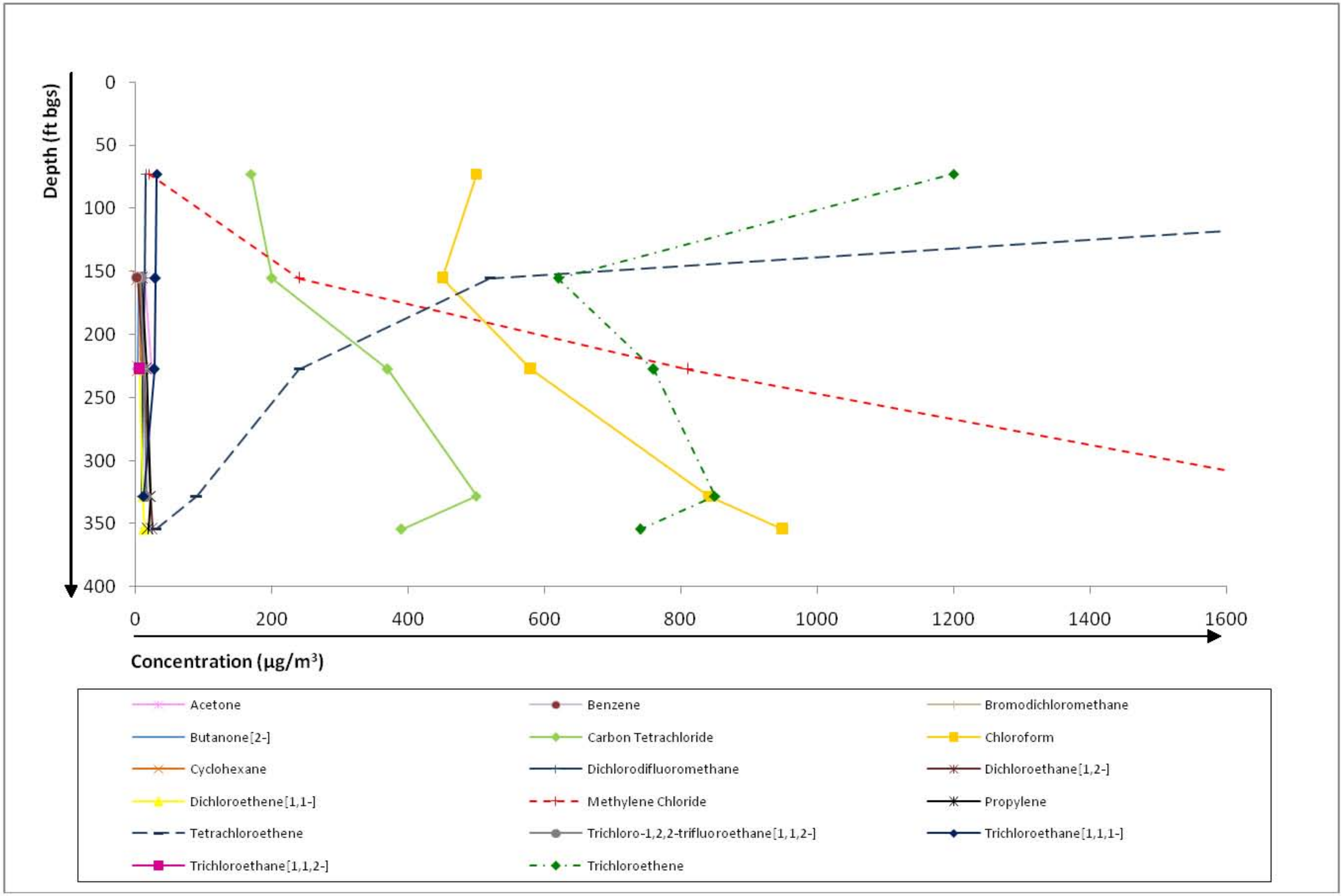


Figure 5.1-3 Vertical profile of detected VOCs in pore-gas monitoring well 21-25264, round 5, February 2009

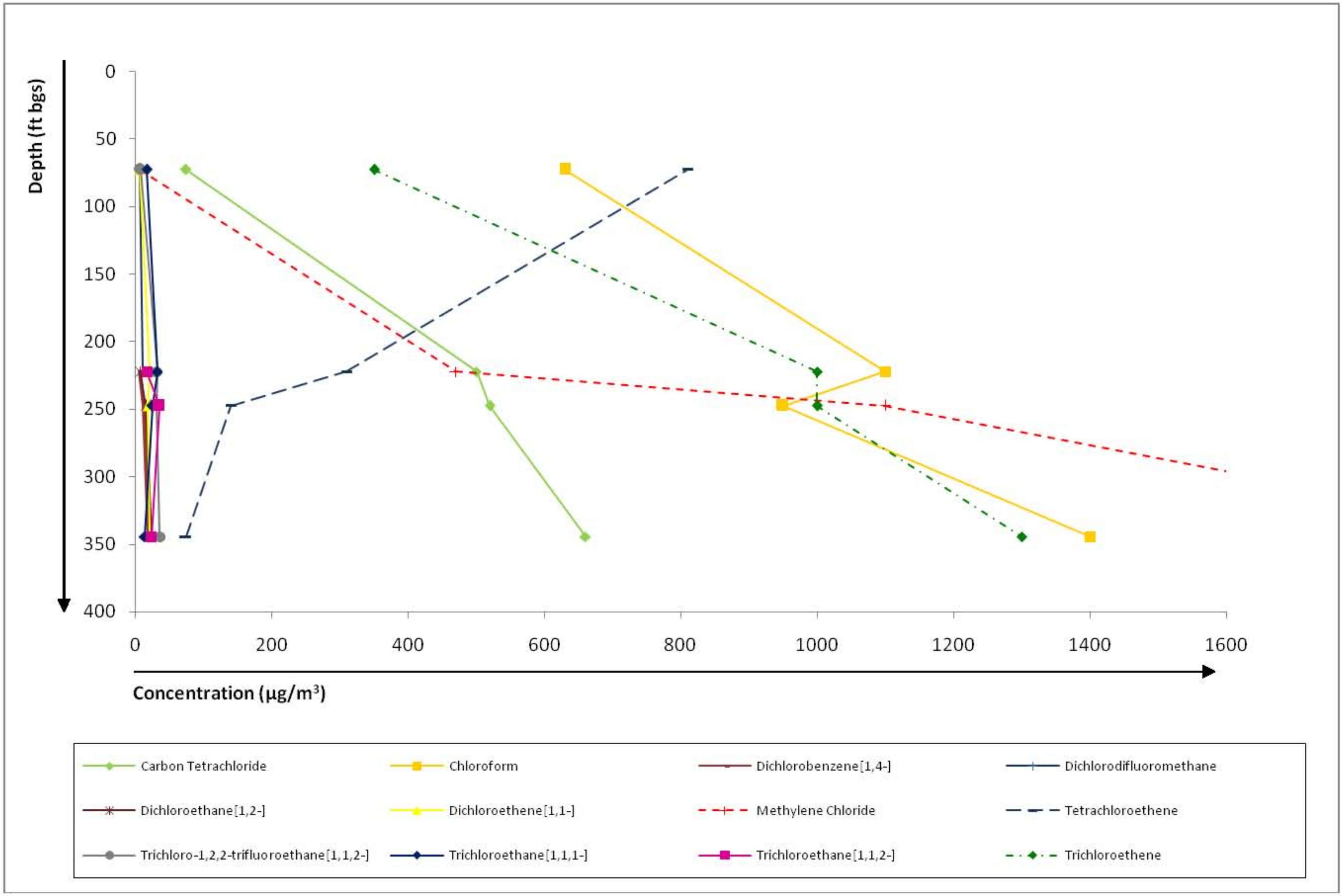


Figure 5.1-4 Vertical profile of detected VOCs in pore-gas monitoring well 21-603058, round 6, April 2009

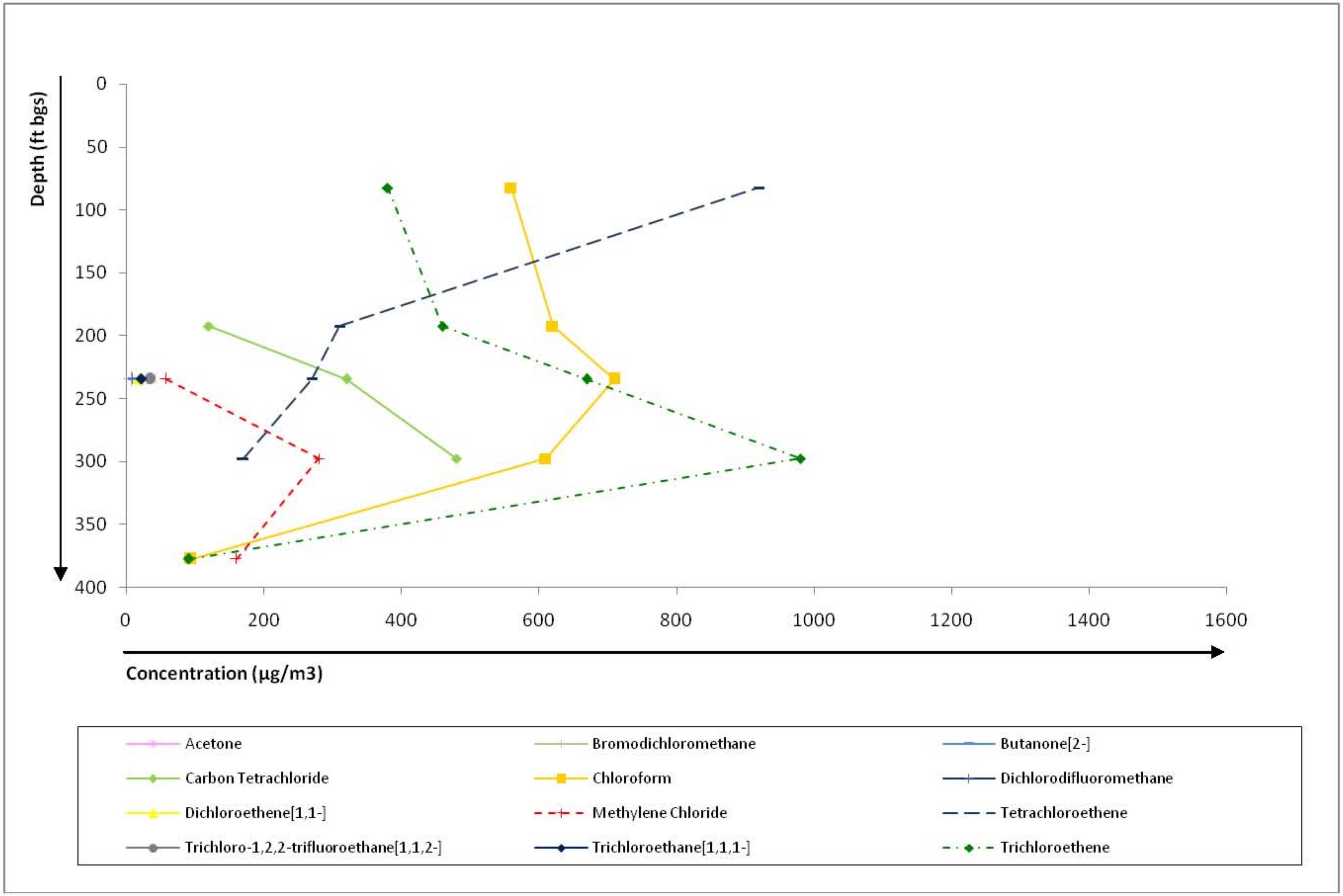


Figure 5.1-5 Vertical profile of detected VOCs in pore-gas monitoring well 21-603059, round 6, April 2009

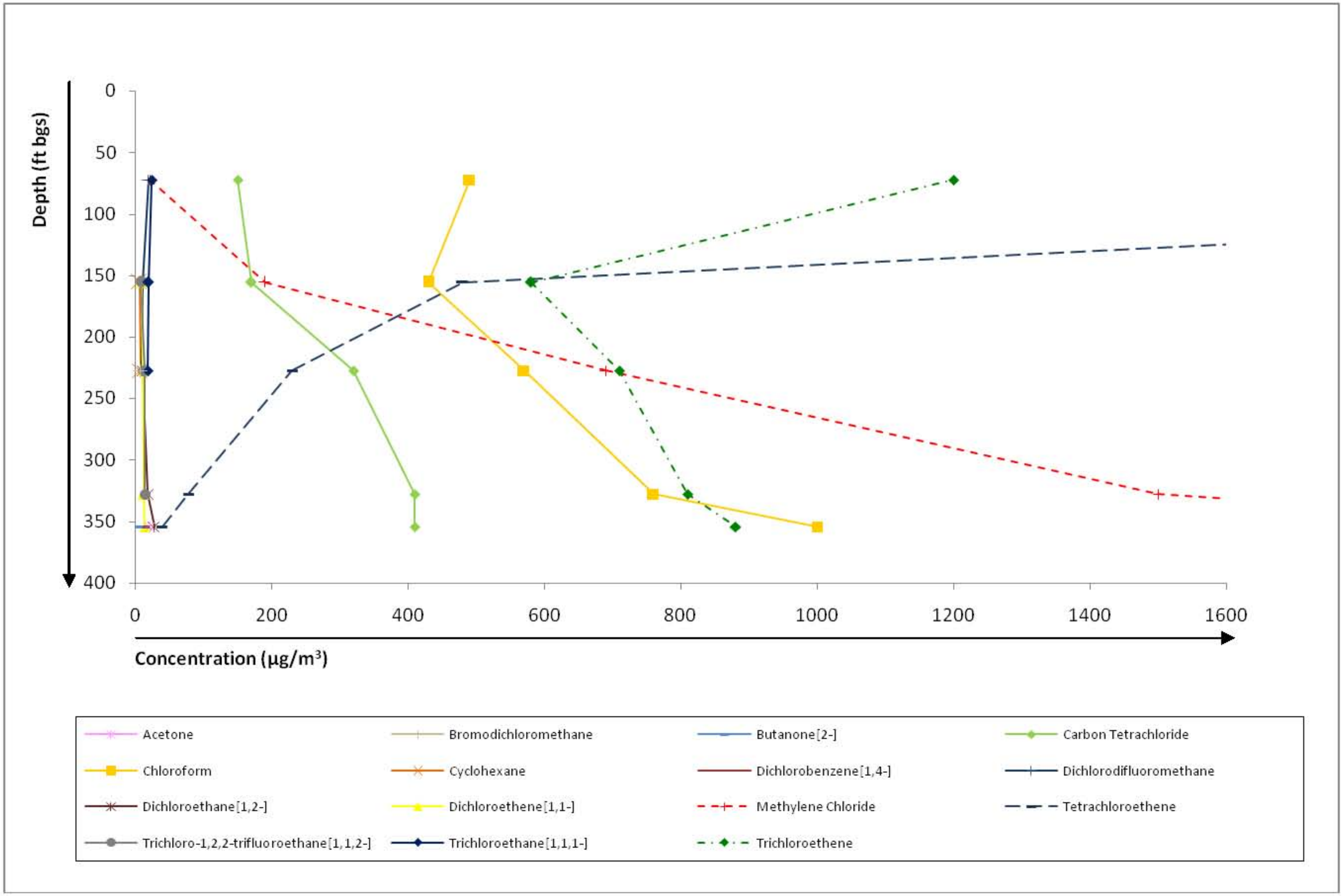


Figure 5.1-6 Vertical profile of detected VOCs in pore-gas monitoring well 21-25264, round 6, April 2009

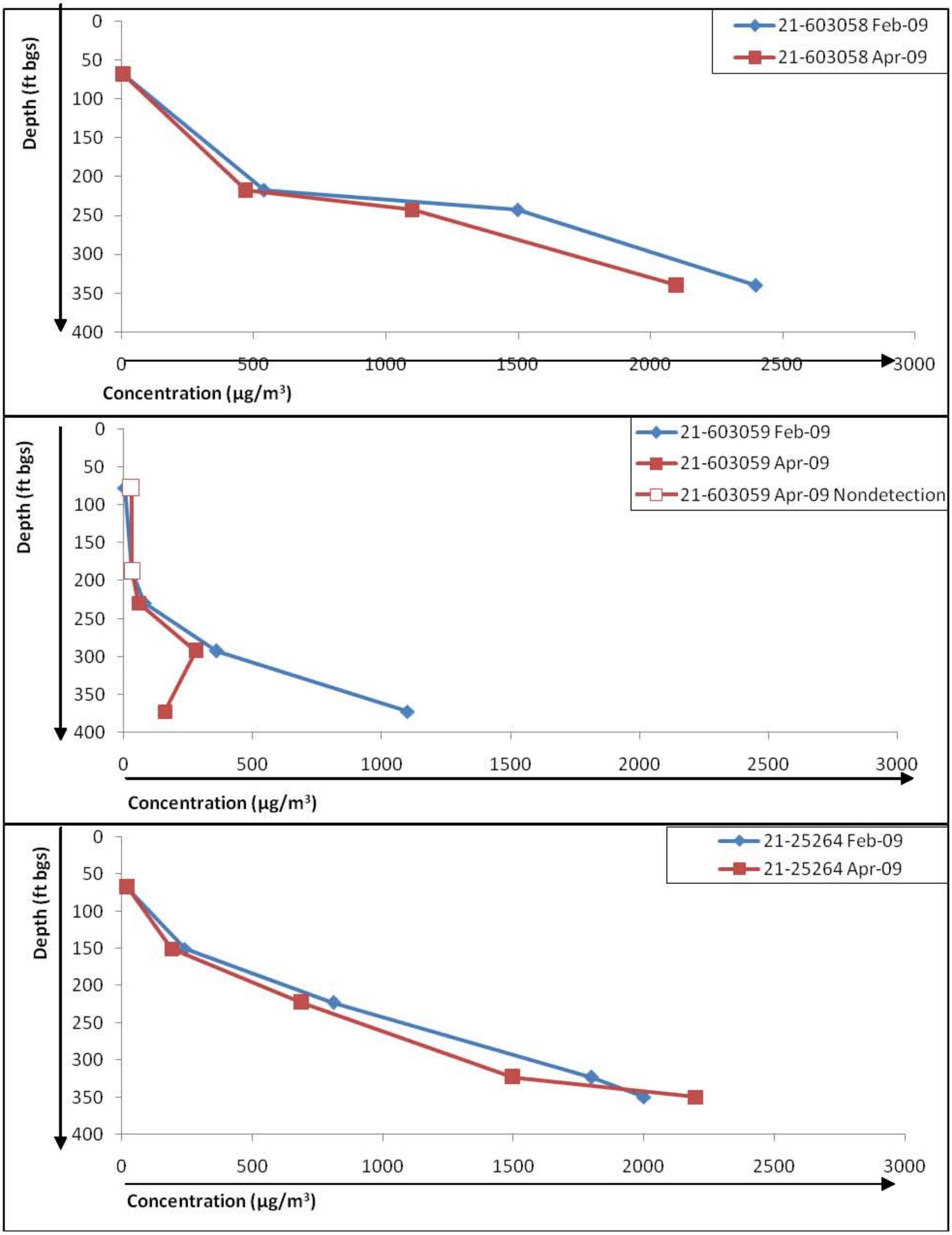


Figure 5.1-7 **Vertical profile of methylene chloride in pore-gas monitoring wells 21-603058, 21-603059, and 21-25264, February and April 2009**

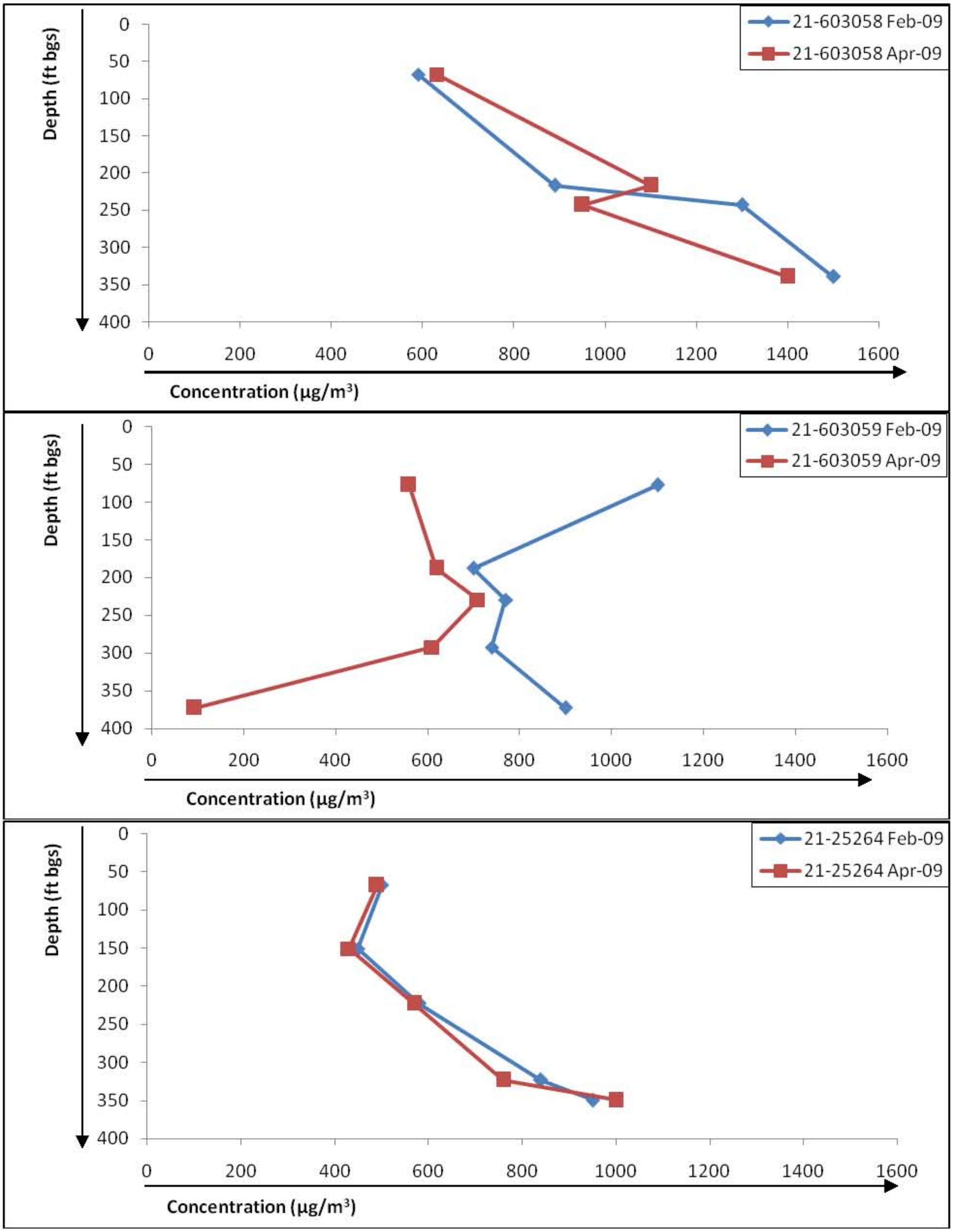


Figure 5.1-8 **Vertical profile of chloroform in pore-gas monitoring wells 21-603058, 21-603059, and 21-25264, February and April 2009**

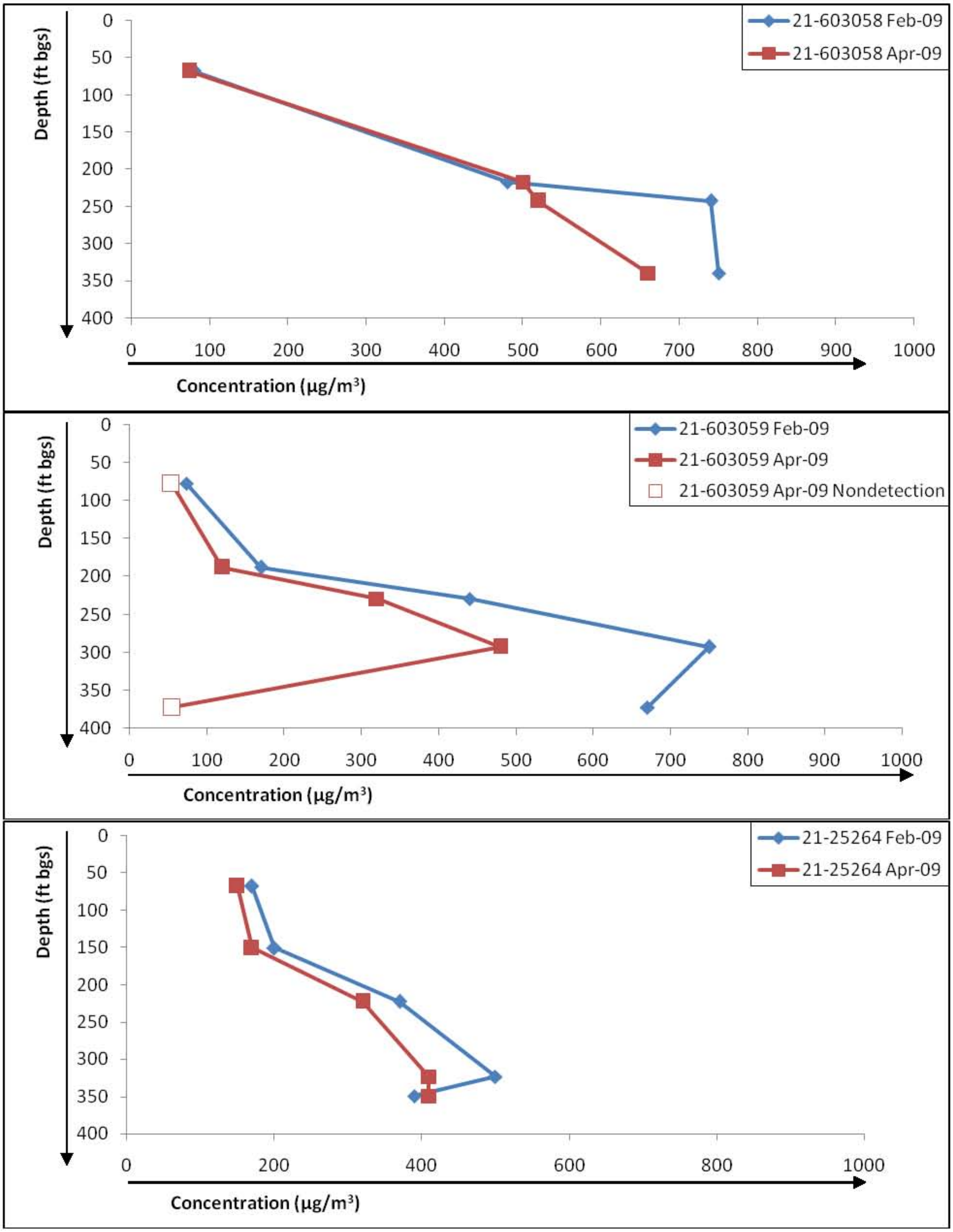


Figure 5.1-9 **Vertical profile of carbon tetrachloride in pore-gas monitoring wells 21-603058, 21-603059, and 21-25264, February and April 2009**

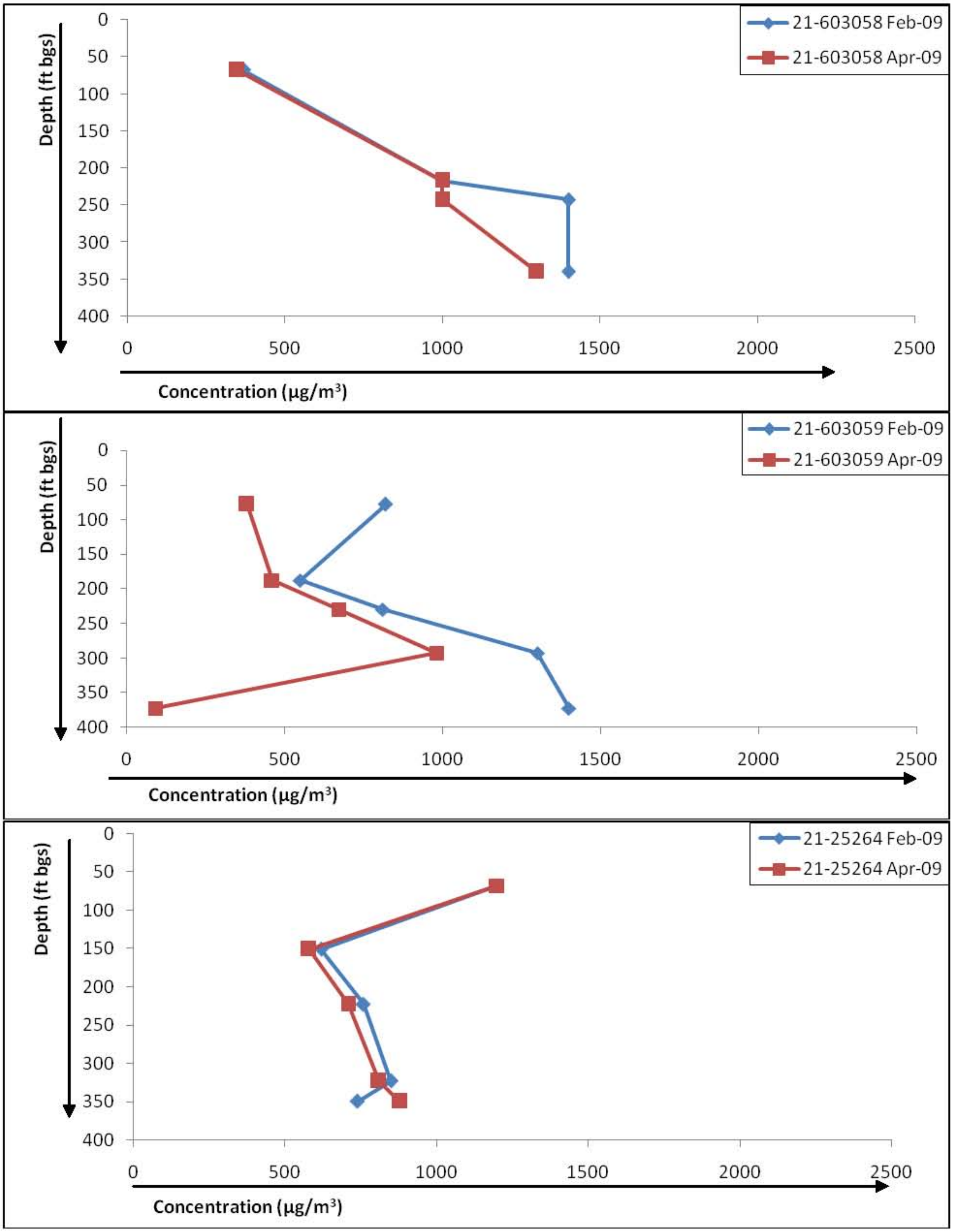


Figure 5.1-10 **Vertical profile of TCE in pore-gas monitoring wells 21-603058, 21-603059, and 21-25264, February and April 2009**

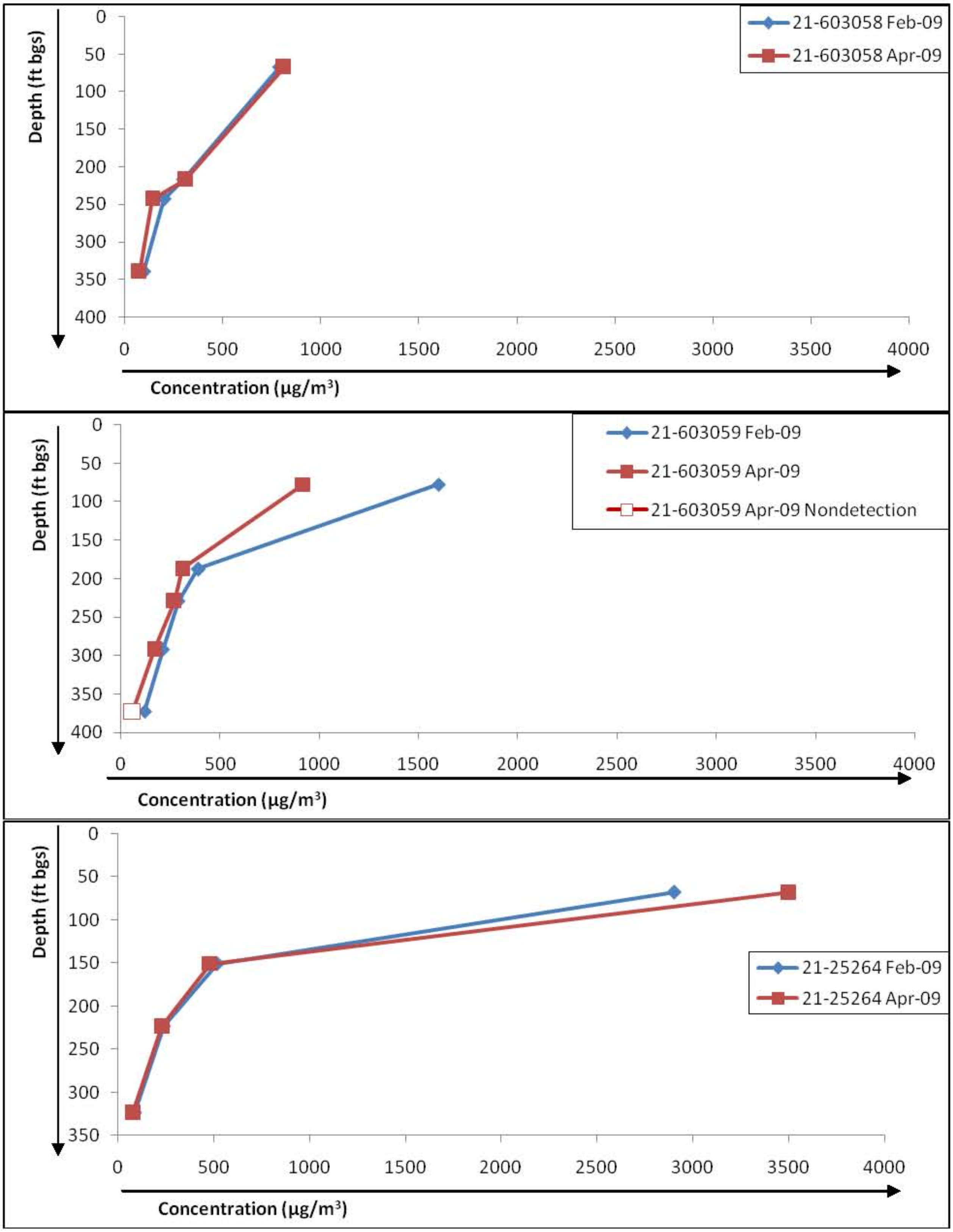
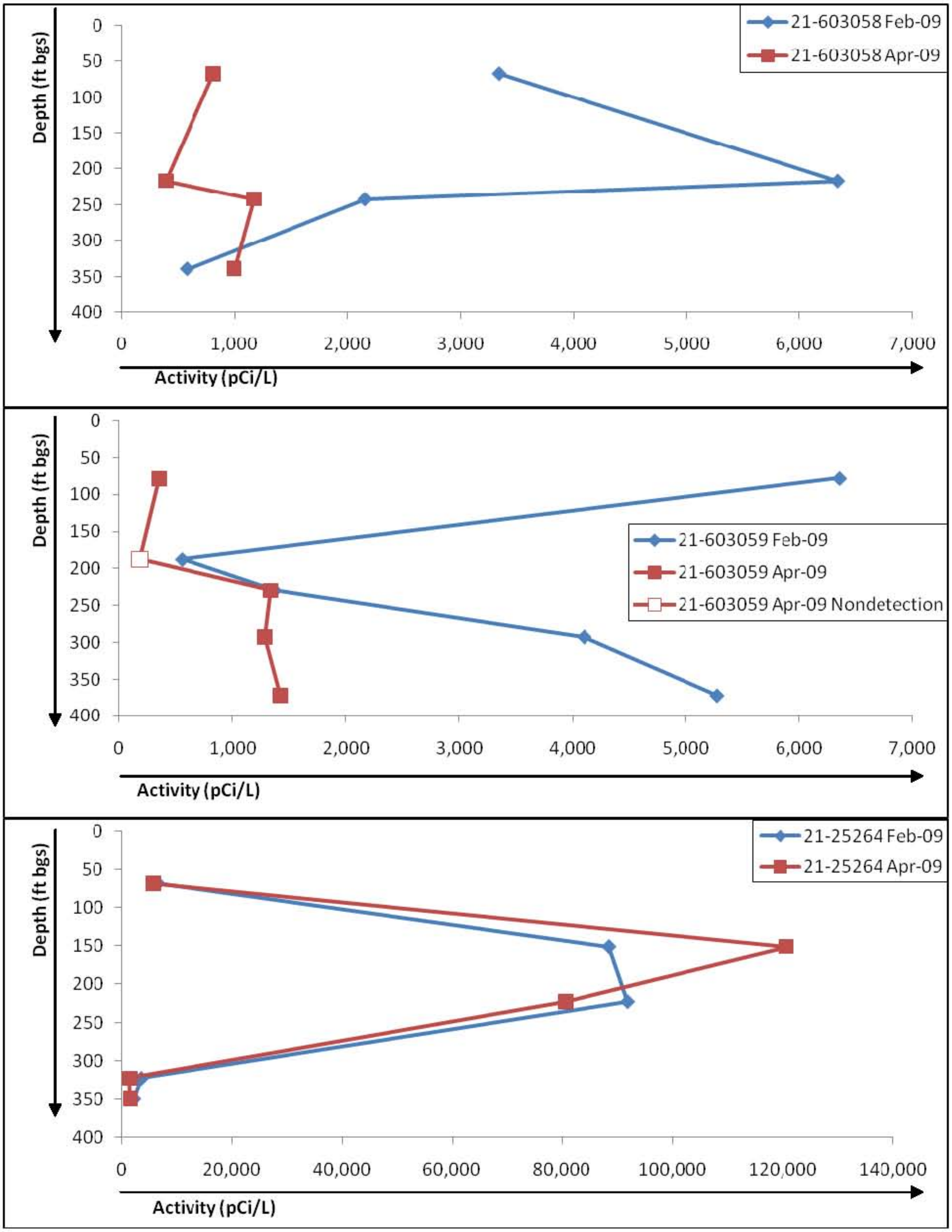


Figure 5.1-11 Vertical profile of PCE in pore-gas monitoring wells 21-603058, 21-603059, and 21-25264, February and April 2009



Note: There is a scale change for well 21-25264.

Figure 5.3-1 **Vertical profile of tritium in vapor monitoring wells 21-603058, 21-603059, and 21-25264, February and April 2009**

Table 2.0-1
MDA T Pore-Gas Sampling Depths and Collection Dates, February and April 2009

Location ID	Sampling Port	Begin Depth (ft bgs)	End Depth (ft bgs)	February 2009, Round 5 Collection Date (Event ID 649)	April 2009, Round 6 Collection Date (Event ID 751)
21-25264	1	67.5	72.5	2/4/2009	4/16/2009
21-25264	2	150.5	155.5	2/4/2009	4/17/2009
21-25264	3	222.5	227.5	2/3/2009	4/17/2009
21-25264	4	323	328	2/3/2009	4/17/2009
21-25264	5	349.5	354.5	2/3/2009	4/16/2009
21-603058	1	67.5	72.5	2/5/2009	4/14/2009
21-603058	2	160.5	165.5	—[a]	—
21-603058	3	217	222	2/5/2009	4/14/2009
21-603058	4	242.5	247.5	2/5/2009	4/15/2009
21-603058	5	339.5	344.5	2/5/2009	4/15/2009
21-603059	1	77.5	82.5	2/8/2009	4/13/2009
21-603059	2	112.5	117.5	—	—
21-603059	3	187.5	192.5	2/6/2009	4/10/2009
21-603059	4	229.5	234.5	2/8/2009	4/20/2009[b]
21-603059	5	292.5	297.5	2/6/2009	4/10/2009
21-603059	6	372.5	377.5	2/6/2009	4/13/2009

Note: Event IDs refer to the SCL and COC packages provided in Appendix D.

[a] — = Sample not collected. See section 2.1 for further explanation.

[b] Port 4 of 21-603059 was originally sampled on 4/13/2009; however, due to limited vapor collection, the port was resampled on 4/20/2009.

Table 2.0-2
Summary of Pore-Gas Samples Collected at MDA T, February and April 2009

Sample ID	Location ID	Depth (ft)	Collection Date	Field QC Type	Tritium	VOCs
MD21-09-3564	21-25264	67.5–72.5	2/4/09	n/a[a]	09-812	09-811
MD21-09-3563	21-25264	150.5–155.5	2/4/09	n/a	09-812	09-811
MD21-09-3565	21-25264	150.5–155.5	2/4/09	Field Duplicate	09-812	09-811
MD21-09-3560	21-25264	222.5–227.5	2/3/09	n/a	09-812	09-811
MD21-09-3561	21-25264	323–328	2/3/09	n/a	09-812	09-811
MD21-09-3562	21-25264	349.5–354.5	2/3/09	n/a	09-812	09-811
MD21-09-7164	21-25264	67.5–72.5	4/16/09	n/a	09-1505	09-1504
MD21-09-7166	21-25264	150.5–155.5	4/17/09	n/a	09-1510	09-1509
MD21-09-7168	21-25264	222.5–227.5	4/17/09	n/a	09-1510	09-1509
MD21-09-7167	21-25264	323–328	4/17/09	n/a	09-1510	09-1509
MD21-09-7165	21-25264	349.5–354.5	4/16/09	n/a	09-1505	09-1504
MD21-09-7174	21-25264	349.5–354.5	4/16/09	Field Duplicate	09-1505	09-1504
MD21-09-3559	21-603058	0–0	2/8/09	Field Blank	—[b]	09-842
MD21-09-3553	21-603058	67.5–72.5	2/5/09	n/a	09-836	09-835
MD21-09-3554	21-603058	217–222	2/5/09	n/a	09-836	09-835
MD21-09-3558	21-603058	217–222	2/5/09	Field Duplicate	09-836	09-835
MD21-09-3555	21-603058	242.5–247.5	2/5/09	n/a	09-836	09-835
MD21-09-3556	21-603058	339.5–344.5	2/5/09	n/a	09-836	09-835
MD21-09-7169	21-603058	0–0	4/15/09	Field Blank	—	09-1494
MD21-09-7159	21-603058	67.5–72.5	4/14/09	n/a	09-1491	09-1476
MD21-09-7160	21-603058	217–222	4/14/09	n/a	09-1491	09-1476
MD21-09-7162	21-603058	242.5–247.5	4/15/09	n/a	09-1495	09-1494
MD21-09-7161	21-603058	339.5–344.5	4/15/09	n/a	09-1495	09-1494
MD21-09-7172	21-603058	339.5–344.5	4/15/09	Field Duplicate	09-1495	09-1494
MD21-09-3552	21-603059	0–0	2/6/09	Field Blank	—	09-842
MD21-09-3546	21-603059	77.5–82.5	2/8/09	n/a	09-843	09-842
MD21-09-3545	21-603059	187.5–192.5	2/6/09	n/a	09-843	09-842
MD21-09-3547	21-603059	229.5–234.5	2/8/09	n/a	09-843	09-842
MD21-09-3549	21-603059	292.5–297.5	2/6/09	n/a	09-836	09-835
MD21-09-3550	21-603059	372.5–377.5	2/6/09	n/a	09-836	09-835
MD21-09-7170	21-603059	0–0	4/20/09	Field Blank	—	09-1513
MD21-09-7155	21-603059	77.5–82.5	4/13/09	n/a	09-1455	09-1454
MD21-09-7154	21-603059	187.5–192.5	4/10/09	n/a	09-1453	09-1452
MD21-09-7157	21-603059	229.5–234.5	4/13/09	n/a	09-1455	09-1454
MD21-09-7163	21-603059	229.5–234.5	4/20/09	n/a	09-1514	09-1513

Table 2.0-2 (continued)

Sample ID	Location ID	Depth (ft)	Collection Date	Field QC Type	Tritium	VOCs
MD21-09-7153	21-603059	292.5–297.5	4/10/09	n/a	09-1453	09-1452
MD21-09-7156	21-603059	372.5–377.5	4/13/09	n/a	09-1455	09-1454

Note: Numbers in analyte columns are request numbers.

[a] n/a = Not applicable.

[b] — = Sample not collected.

Table 3.0-1
Henry's Law Constants, Groundwater SLs, and Calculated Concentrations Corresponding to Groundwater SLs for Detected VOCs in Pore Gas

VOC	Henry's Law Constant[a] (dimensionless)	Groundwater SL (µg/L)	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard (µg/m³)
Acetone	0.0016	22,000[b]	35,200
Benzene	0.228	5[c]	1140
Bromodichloromethane	0.0656	1.2[b]	79
Butanone[2-]	0.0011	7100[b]	7810
Carbon disulfide	1.2	1000[b]	1,200,000
Carbon tetrachloride	1.25	5[c]	6250
Chloroform	0.15	100[d]	15,000
Cyclohexane	6.1[b]	13,000[b]	79,300,000
Dichlorobenzene[1,4-]	0.0996	75[c]	7470
Dichlorodifluoromethane	4.1	390[b]	1,600,000
Dichloroethane[1,2-]	0.0401	5[c]	200
Dichloroethene[1,1-]	1.1	5[d]	5500
Dichloroethane[cis-1,2-]	0.167	70[c]	11,700
Ethanol	na[e]	na	na
Methylene chloride	0.09	5[c]	450
Propylene	na	na	na
Tetrachloroethene	0.754	5[c]	3770
Toluene	0.272	750[d]	204,000
Trichloro-1,2,2-trifluoroethane[1,1,2-]	21.4	59,000[b]	1,260,000,000
Trichloroethane[1,1,1-]	0.705	60[d]	42,300
Trichloroethane[1,1,2-]	0.0374	5[c]	187
Trichloroethene	0.422	5[c]	2110

Note: Calculated concentrations in pore gas corresponding to groundwater standard derived from denominator of Equation 3.0-3.

[a] NMED (2006, 092513, Appendix B) unless otherwise noted.

[b] EPA regional Henry's law constants and tapwater screening levels (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm).

[c] EPA MCL (40 Code of Federal Regulations 141.61).

[d] NMWQCC groundwater standard (20.6.2.3103 New Mexico Administrative Code).

[e] na = Not available.

Table 4.0-1
Summary of Pore-Gas Field Screening Results, February and April 2009

Event ID	Collection Date	FY2009 Sampling Round	Location ID	Sample Port Number	Top Depth (ft bgs)	Bottom Depth (ft bgs)	Percent CO_2	Percent O_2
649	2/4/2009	5	21-25264	1	67.5	72.5	1.3	19.9
751	4/16/2009	6	21-25264	1	67.5	72.5	1.0	19.3
649	2/4/2009	5	21-25264	2	150.5	155.5	1.4	20.1
751	4/17/2009	6	21-25264	2	150.5	155.5	1.0	19.9
649	2/3/2009	5	21-25264	3	222.5	227.5	1.0	20.2
751	4/17/2009	6	21-25264	3	222.5	227.5	1.2	19.7
649	2/3/2009	5	21-25264	4	323	328	0.8	20.1
751	4/17/2009	6	21-25264	4	323	328	0.8	20.1
649	2/3/2009	5	21-25264	5	349.5	354.5	0.2	20.5
751	4/16/2009	6	21-25264	5	349.5	354.5	0.6	19.9
649	2/5/2009	5	21-603058	1	67.5	72.5	1.1	19.8
751	4/14/2009	6	21-603058	1	67.5	72.5	1.0	19.6
649	2/5/2009	5	21-603058	3	217	222	0.9	19.9
751	4/14/2009	6	21-603058	3	217	222	0.7	19.7
649	2/5/2009	5	21-603058	4	242.5	247.5	1.0	20.1
751	4/15/2009	6	21-603058	4	242.5	247.5	0.7	19.7
649	2/5/2009	5	21-603058	5	339.5	344.5	1.2	19.8
751	4/15/2009	6	21-603058	5	339.5	344.5	0.7	19.7
649	2/8/2009	5	21-603059	1	77.5	82.5	0.8	20.1
751	4/13/2009	6	21-603059	1	77.5	82.5	0.7	19.7
649	2/6/2009	5	21-603059	3	187.5	192.5	0.8	20.3
751	4/10/2009	6	21-603059	3	187.5	192.5	0.7	20.2
649	2/8/2009	5	21-603059	4	229.5	234.5	1.1	20.1
751	4/13/2009	6	21-603059	4	229.5	234.5	0.6	19.9
751	4/20/2009	6	21-603059	4	229.5	234.5	0.9	19.8
649	2/6/2009	5	21-603059	5	292.5	297.5	0.8	20.6
751	4/10/2009	6	21-603059	5	292.5	297.5	0.8	18.9
649	2/6/2009	5	21-603059	6	372.5	377.5	0.6	20.0
751	4/13/2009	6	21-603059	6	372.5	377.5	0.2	20.0

Table 5.1-1
Summary of VOCs Detected in Pore-Gas Samples at MDA T, February and April 2009

Sample ID	Location ID	Depth (ft)	Collection Date	Acetone	Benzene	Bromodichloromethane	Butanone[2-]	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Cyclohexane	Dichlorobenzene[1,4-]	Dichlorodifluoromethane	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Ethanol	Methylene Chloride	Propylene	Tetrachloroethene	Toluene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene
MD21-09-3564	21-25264	67.5–72.5	2/4/09	—*	—	—	—	—	170	500	—	—	15	—	—	—	—	20	—	2900	—	—	31	—	1200
MD21-09-7164	21-25264	67.5–72.5	4/16/09	—	—	—	—	—	150	490	—	—	19	—	—	—	—	21	—	3500	—	—	24	—	1200
MD21-09-3563	21-25264	150.5–155.5	2/4/09	14	2.8	—	4.3	—	200	450	5.8	—	13	3.8	—	—	—	240	9.4	520	—	8	29	—	620
MD21-09-7166	21-25264	150.5–155.5	4/17/09	—	—	—	—	—	170	430	6.1	—	11	—	8.5	—	—	190	—	480	—	7.8	19	—	580
MD21-09-3560	21-25264	222.5–227.5	2/3/09	23	—	7.7	3.5	—	370	580	7.6	—	11	12	6.7	—	—	810	16	240	—	12	28	5	760
MD21-09-7168	21-25264	222.5–227.5	4/17/09	—	—	6.8	—	—	320	570	7.3	—	9	10	11	—	—	690	—	230	—	13	18	—	710
MD21-09-3561	21-25264	323–328	2/3/09	—	—	—	—	—	500	840	—	—	9.2	22	11	—	—	1800	22	90	—	16	12	—	850
MD21-09-7167	21-25264	323–328	4/17/09	—	—	—	—	—	410	760	—	—	—	18	12	—	—	1500	—	78	—	14	—	—	810
MD21-09-3562	21-25264	349.5–354.5	2/3/09	—	—	—	—	—	390	950	—	—	—	25	13	—	—	2000	19	30	—	—	—	—	740
MD21-09-7165	21-25264	349.5–354.5	4/16/09	22	—	—	6.4	—	410	1000	—	11	—	28	14	—	—	2200	—	39	—	—	—	—	880
MD21-09-3553	21-603058	67.5–72.5	2/5/09	—	—	—	—	—	80	590	—	—	6	—	—	—	—	6.6	—	790	—	7.9	24	—	370
MD21-09-7159	21-603058	67.5–72.5	4/14/09	—	—	—	—	—	74	630	—	—	7	—	5.6	—	—	5.6	—	810	—	7.5	17	—	350
MD21-09-3554	21-603058	217–222	2/5/09	—	—	6.2	—	—	480	890	—	6.1	8.5	7.7	13	—	14	540	—	300	—	29	42	17	1000
MD21-09-7160	21-603058	217–222	4/14/09	—	—	—	—	—	500	1100	—	5.8	11	6.9	21	—	—	470	—	310	—	32	32	17	1000
MD21-09-3555	21-603058	242.5–247.5	2/5/09	—	—	—	—	—	740	1300	—	14	—	22	19	—	46	1500	—	200	—	37	41	45	1400
MD21-09-7162	21-603058	242.5–247.5	4/15/09	—	—	—	—	—	520	950	—	12	—	15	18	—	—	1100	—	140	—	31	25	35	1000
MD21-09-3556	21-603058	339.5–344.5	2/5/09	—	—	—	—	—	750	1500	—	25	—	33	22	—	43	2400	—	96	—	33	17	42	1400
MD21-09-7161	21-603058	339.5–344.5	4/15/09	—	—	—	—	—	660	1400	—	20	—	23	21	—	—	2100	—	74	—	36	13	23	1300
MD21-09-3546	21-603059	77.5–82.5	2/8/09	—	—	6.4	—	—	73	1100	—	—	6.4	—	—	—	—	4	—	1600	—	—	22	—	820
MD21-09-7155	21-603059	77.5–82.5	4/13/09	—	—	—	—	—	—	560	—	—	—	—	—	—	—	—	—	920	—	—	—	—	380
MD21-09-3545	21-603059	187.5–192.5	2/6/09	—	—	8.7	4.1	6.8	170	700	—	—	7.8	—	7.2	—	—	29	—	390	—	18	30	—	550
MD21-09-7154	21-603059	187.5–192.5	4/10/09	—	—	—	—	—	120	620	—	—	—	—	—	—	—	—	—	310	—	—	—	—	460
MD21-09-3547	21-603059	229.5–234.5	2/8/09	9	—	8.6	—	—	440	770	3.1 (J)	—	10	—	19	—	—	80	—	290	—	39	33	—	810
MD21-09-7157	21-603059	229.5–234.5	4/13/09	—	—	—	—	—	130	400	—	—	—	—	—	—	—	—	—	130	—	—	—	—	320
MD21-09-7163	21-603059	229.5–234.5	4/20/09	37	—	7.6	10	—	320	710	—	—	8.3	—	19	—	—	58	—	270	—	34	22	—	670
MD21-09-3549	21-603059	292.5–297.5	2/6/09	—	—	11	—	—	750	740	—	—	11	6.1	30	—	13	360	—	210	4.8	57	31	25	1300
MD21-09-7153	21-603059	292.5–297.5	4/10/09	—	—	—	—	—	480	610	—	—	—	—	—	—	—	280	—	170	—	—	—	—	980
MD21-09-3550	21-603059	372.5–377.5	2/6/09	—	4.1	14	—	—	670	900	—	7.8	5.3	19	65	4.1	54	1100	—	120	7.5	28	15	120	1400
MD21-09-7156	21-603059	372.5–377.5	4/13/09	—	—	—	—	—	—	94	—	—	—	—	—	—	—	160	—	—	—	—	—	—	91

Note: Results are in μg/m^3.

*— = Not detected.

Table 5.2-1
Screening of VOCs Detected in Pore Gas at MDA T

VOCs	Maximum Pore-Gas Concentration (μg/m^3)	Groundwater SL (μg/L)	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard (μg/m^3)	SV (unitless)
Acetone	37	22,000[a]	35,200	0.0010
Benzene	4.1	5[b]	1140	0.0036
Bromodichloromethane	14	1.2[a]	79	0.18
Butanone[2-]	10	7100[a]	7810	0.0013
Carbon disulfide	6.8	1000[a]	1,200,000	0.0000057
Carbon tetrachloride	750	5[b]	6250	0.12
Chloroform	1500	100[c]	15,000	0.10
Cyclohexane	7.6	13,000[a]	79,300,000	0.000000096
Dichlorobenzene[1,4-]	25	75[b]	7470	0.0033
Dichlorodifluoromethane	19	390[a]	1,600,000	0.000012
Dichloroethane[1,2-]	33	5[b]	200	0.17
Dichloroethene[1,1-]	65	5[c]	5500	0.012
Dichloroethane[cis-1,2-]	4.1	70[b]	11,700	0.00035
Methylene chloride	2400	5[b]	450	5.3
Tetrachloroethene	3500	5[b]	3770	0.93
Toluene	7.5	750[c]	204,000	0.000037
Trichloro-1,2,2-trifluoroethane[1,1,2-]	57	59,000[a]	1,260,000,000	0.000000045
Trichloroethane[1,1,1-]	42	60[c]	42,300	0.00099
Trichloroethane[1,1,2-]	120	5[b]	187	0.64
Trichloroethene	1400	5[b]	2110	0.66

Note: Calculated concentrations in pore gas corresponding to groundwater SLs derived from denominator of Equation 3.0-3.

[a] EPA regional tap water screening levels (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm).

[b] EPA MCL (40 Code of Federal Regulations 141.61).

[c] NMWQCC groundwater standard (20.6.2.3103 New Mexico Administrative Code).

Table 5.3-1
Summary of Tritium Results in Pore-Vapor Samples at MDA T, February and April 2009

Sample ID	Location ID	Depth (ft)	Collection Date	Tritium (pCi/L)
MD21-09-3564	21-25264	67.5–72.5	2/4/2009	6608
MD21-09-7164	21-25264	67.5–72.5	4/16/2009	5647
MD21-09-3563	21-25264	150.5–155.5	2/4/2009	88,524
MD21-09-7166	21-25264	150.5–155.5	4/17/2009	120,741
MD21-09-3560	21-25264	222.5–227.5	2/3/2009	91,887
MD21-09-7168	21-25264	222.5–227.5	4/17/2009	80,588
MD21-09-3561	21-25264	323–328	2/3/2009	3614
MD21-09-7167	21-25264	323–328	4/17/2009	1421
MD21-09-3562	21-25264	349.5–354.5	2/3/2009	2228
MD21-09-7165	21-25264	349.5–354.5	4/16/2009	1558
MD21-09-3553	21-603058	67.5–72.5	2/5/2009	3347
MD21-09-7159	21-603058	67.5–72.5	4/14/2009	812
MD21-09-3554	21-603058	217–222	2/5/2009	6340
MD21-09-7160	21-603058	217–222	4/14/2009	390
MD21-09-3555	21-603058	242.5–247.5	2/5/2009	2156
MD21-09-7162	21-603058	242.5–247.5	4/15/2009	1172
MD21-09-3556	21-603058	339.5–344.5	2/5/2009	582
MD21-09-7161	21-603058	339.5–344.5	4/15/2009	997
MD21-09-3546	21-603059	77.5–82.5	2/8/2009	6358
MD21-09-7155	21-603059	77.5–82.5	4/13/2009	353
MD21-09-3545	21-603059	187.5–192.5	2/6/2009	557
MD21-09-3547	21-603059	229.5–234.5	2/8/2009	1369
MD21-09-7157	21-603059	229.5–234.5	4/13/2009	756
MD21-09-7163	21-603059	229.5–234.5	4/20/2009	1333
MD21-09-3549	21-603059	292.5–297.5	2/6/2009	4105
MD21-09-7153	21-603059	292.5–297.5	4/10/2009	1284
MD21-09-3550	21-603059	372.5–377.5	2/6/2009	5278
MD21-09-7156	21-603059	372.5–377.5	4/13/2009	1421

Appendix A

Acronyms and Abbreviations,
Metric Conversion Table, and Data Qualifier Definitions

A-1.0 ACRONYMS AND ABBREVIATIONS

%R	percent recovery
bgs	below ground surface
CCV	continuing calibration verification
COC	chain of custody
DER	duplicate error ratio
DP	Delta Prime
EPA	Environmental Protection Agency (U.S.)
FD	field duplicate
ICV	initial calibration verification
LANL	Los Alamos National Laboratory
LCS	laboratory control sample
MCL	maximum contaminant level
MDA	material disposal area
MDC	minimum detectable concentration
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
MS	matrix spike
PB	performance blank
PCE	tetrachloroethene
QA	quality assurance
QC	quality control
SCL	sample collection log
SL	screening level
SMO	Sample Management Office
SOP	standard operating procedures
SOW	statement of work
SQL	standard quantitation limit
SV	screening value
TA	technical area
TCE	trichloroethene
TD	total depth
VOC	volatile organic compound

A-2.0 METRIC CONVERSION TABLE

Multiply SI (Metric) Unit	by	To Obtain U.S. Customary Unit
kilometers (km)	0.622	miles (mi)
kilometers (km)	3281	feet (ft)
meters (m)	3.281	feet (ft)
meters (m)	39.37	inches (in.)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.394	inches (in.)
millimeters (mm)	0.0394	inches (in.)
micrometers or microns (µm)	0.0000394	inches (in.)
square kilometers (km^2)	0.3861	square miles (mi^2)
hectares (ha)	2.5	acres
square meters (m^2)	10.764	square feet (ft^2)
cubic meters (m^3)	35.31	cubic feet (ft^3)
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter (g/cm^3)	62.422	pounds per cubic foot (lb/ft^3)
milligrams per kilogram (mg/kg)	1	parts per million (ppm)
micrograms per gram (µg/g)	1	parts per million (ppm)
liters (L)	0.26	gallons (gal.)
milligrams per liter (mg/L)	1	parts per million (ppm)
degrees Celsius (°C)	9/5 + 32	degrees Fahrenheit (°F)

A-3.0 DATA QUALIFIER DEFINITIONS

Data Qualifier	Definition
U	The analyte was analyzed for but not detected.
J	The analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.
J+	The analyte was positively identified, and the result is likely to be biased high.
J-	The analyte was positively identified, and the result is likely to be biased low.
UJ	The analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific detection or quantitation limit.
R	The data are rejected as a result of major problems with quality assurance/quality control parameters.

Appendix B

Field Methods

B-1.0 INTRODUCTION

This appendix summarizes the field methods used during the February and April 2009 vapor-monitoring activities at Material Disposal Area (MDA) T, Consolidated Unit 21-016(a)-99, in Technical Area 21 at Los Alamos National Laboratory (LANL or the Laboratory). All activities were conducted in accordance with the applicable standard operating procedures (SOPs), quality procedures, Laboratory implementation requirements, and Laboratory procedural requirements. Table B-1.0-1 provides a summary of the specific field methods followed; Table B-1.0-2 lists the general procedures followed.

B-2.0 FIELD METHODS

All work was conducted per a site-specific health and safety plan and an integrated work document. Field activities conducted according to SOPs are discussed below.

B-2.1 Volatile Organic Compound Pore-Gas Field-Screening and Sample Collection

All volatile organic compound (VOC) samples are collected in accordance with the current version of the Environment and Remediation Support Services EP-ERSS-SOP-5074, Sampling for Sub-Atmospheric Air.

Before each sampling event, each sample port is purged and monitored with a Landtec GEM2000 instrument (or equivalent) until the percent carbon dioxide and oxygen levels stabilize at values representative of subsurface pore-gas conditions. In addition, the vapor-sample tubing is purged of stagnant air by drawing air from the sampling interval through the line. To ensure that the sample collected is representative of the subsurface air at depth, every sampling activity includes a purge cycle. Once purging and field screening are complete, vapor samples intended for VOC analysis are collected using SUMMA canisters and the sample information is recorded on the appropriate sample collection log (SCL). Field-screening results are also recorded on the appropriate SCL and/or in the field logbook. Field chains of custody and SCLs are provided in Appendix D.

In addition to the characterization samples, two types of quality assurance/quality control (QA/QC) samples are collected and analyzed for VOCs using SUMMA canisters: a field duplicate (FD) sample, and an equipment blank of ultra-pure nitrogen. FD and field blank samples are collected at a frequency greater than or equal to 10% per sampling event in accordance with the current version of EP-ERSS-SOP-5059, Field Quality Control Samples. A summary of all 2009 QA/QC samples collected from MDA T monitoring wells 21-603058, 21-603059, 21-25264, and their respective analyses is presented in Table 2.0-2 of the monitoring report.

All samples are submitted to the Sample Management Office (SMO) for processing and transport to off-site contract analytical laboratories.

B-2.2 Tritium Pore-Gas Sample Collection

All tritium samples are collected in accordance with the current version of EP-ERSS-SOP-5074, Sampling for Sub-Atmospheric Air.

Water vapor intended for tritium analysis is collected from pore gas by pulling a pore-gas sample through a canister of silica gel and the sample information recorded on the appropriate SCL (Appendix D). Silica gel column FD samples are also collected at a frequency greater than or equal to 10% per sampling event in accordance with the current version of EP-ERSS-SOP-5059.

Following delivery of the canister and silica gel sample to the analytical laboratory, the silica gel is heated and the moisture driven off is collected for liquid scintillation counting. Dry silica gel contains bound water, which dilutes the tritium sample. A correction factor for this dilution is developed for each sample, based on the percent moisture value determined by the analytical laboratory (Marczak 2009, 106500; Whicker et al. 2009, 106429).

Silica gel is prepared for sampling by drying it at a temperature above 100°C; however, this drying process does not remove bound water. Before sample collection, the amount of silica gel used in each sample is weighed (typically about 135 g) as well as the sample canister with silica gel. EP-ERSS-SOP-5074 requires that at least 5 g of moisture be collected. After sampling, sample canister with silica gel is weighed again.

The sample (canister plus silica gel) is shipped to the analytical laboratory where the canister with silica gel is weighed again. The silica gel is emptied into a distillation apparatus and heated to 110°C, driving moisture off the silica gel. This moisture is collected and analyzed for tritium by liquid scintillation. The laboratory also weighs the empty canister. The laboratory calculates the percent moisture of the sample, as the amount of moisture collected divided by the calculated weight of the wet silica gel. The value of the tritium concentration and the calculated percent moisture are reported to the Laboratory in the analytical data package and the electronic data deliverable.

The correction factor for the impact of bound water is determined for each sample. The correction factors for the tritium concentration data presented in this report are determined from the percent moisture values provided by the analytical laboratory (Marczak 2009, 106500).

B-3.0 REFERENCES

The following list includes all documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate’s Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Marczak, S., July 2009. “Technical Implementation of the Correction Factor Calculation for Tritium in Pore-Gas Data,” Los Alamos National Laboratory document LA-UR-09-4629, Los Alamos, New Mexico. (Marczak 2009, 106500)

Whicker, J.J., J.M. Dewart, S.P. Allen, W.F. Eisele, M.C. McNaughton, and A.A. Green, June 17, 2009. “Corrections for Measurement of Tritium in Subterranean Vapor Using Silica Gel,” Los Alamos National Laboratory document LA-UR-09-03837, Los Alamos, New Mexico. (Whicker et al. 2009, 106429)

Table B-1.0-1
Summary of Field Methods

Method	Summary
General Instructions for Field Investigations	This general procedure provides an overview of instructions regarding activities to be performed before, during, and after field investigations. It is assumed that field investigations involve standard sampling equipment, personal protective equipment, waste management, and site-control equipment/materials. The procedure covers premobilization activities, mobilization to the site, documentation and sample collection activities, sample media evaluation, surveillance, and completion of lessons learned.
Sample Containers and Preservation	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on the U.S. Environmental Protection Agency guidance for environmental sampling, preservation, and QA. Specific requirements are met for each sample and are printed in the sample collection logs provided by the Laboratory's SMO (size and type of container, preservatives, etc.). All samples are preserved by placing them in insulated containers with ice to maintain a temperature of 4°C.
Handling, Packaging, and Transporting Field Samples	Field team members seal and label samples before packing to ensure that the sample containers and the containers used for transport are free of external contamination. All environmental samples are collected, preserved, packaged, and transported to the SMO under chain of custody. The SMO arranges for shipping of the samples to analytical laboratories. Any levels of radioactivity (i.e., action-level or limited-quantity ranges) are documented in sample collection logs submitted to the SMO.
Sample Control and Field Documentation	The collection, screening, and transport of samples are documented in standard forms generated by the SMO. These forms include SCLs, chain-of-custody forms, sample container labels, and custody seals. Collection logs are completed at the time of sample collection and are signed by the sampler and a reviewer who verifies the logs for completeness and accuracy. Corresponding labels are initialed and applied to each sample container, and custody seals are placed around container lids or openings. Chain-of-custody forms are completed and signed to verify that the samples are not left unattended.
Field QC Samples	Field QC samples are collected as follows: FDs are collected at a frequency of 10% at the same time as a regular sample and submitted for the same analyses. Field blanks, required for all field events that include collecting samples for VOC analyses, are collected. Field blanks are kept with the other sample containers during the sampling process and are submitted for laboratory analyses.
Sampling of Sub-Atmospheric Air	Vapor sampling was performed on three monitoring wells in accordance with the current version of EP-ERSS-SOP-5074 and analyzed for VOCs and tritium. This SOP describes the process of sampling subatmospheric air from vapor ports in monitoring wells and boreholes. Procedure covers presampling activities, sampling to detect and quantify gaseous organic concentration in air, SUMMA sampling (a passive collection and containment system of laboratory-quality air samples), adsorbent column sampling, and sampling through the packer system (a sampling system that uses inflatable bladders to seal off a desired interval in an open borehole or at the end of drill casing to obtain a sample from a discrete section), and postsampling activities

Table B-1.0-2
List of Applicable General Procedures for MDA T Pore-Gas Monitoring Activities

Document Number	LANL Procedure Title
EP-ERSS-SOP-5055	General Instructions for Field Investigations
P 101-6	Personal Protective Equipment
SOP-5181	Notebook Documentation for Environmental Restoration Technical Activities
SOP-5228	ADEP Reporting Requirements for Abnormal Events

Appendix C

Quality Assurance/Quality Control Program

C-1.0 INTRODUCTION

This appendix discusses the analytical methods and data quality review for the February and April 2009 pore-gas samples collected at Material Disposal Area (MDA) T, Consolidated Unit 21-016(a)-99, in Technical Area 21 at Los Alamos National Laboratory (LANL or the Laboratory).

Quality assurance (QA), quality control (QC), and data validation procedures were implemented in accordance with the "Quality Assurance Project Plan Requirements for Sampling and Analysis" (LANL 1996, 054609), and the Laboratory's statement of work (SOW) for analytical services (LANL 2000, 071233). The results of the QA/QC activities were used to estimate the accuracy, bias, and precision of the analytical measurements. QC samples, including method blanks, matrix spikes (MSs), laboratory control samples (LCSs), internal standards, initial calibration verifications (ICVs) and continuing calibration verifications (CCVs), surrogates, and tracers, were used to assess laboratory accuracy and bias.

The type and frequency of QC analyses are described in the analytical services SOW (LANL 2000, 071233). Other QC factors, such as sample preservation and holding times, were also assessed. The requirements for sample preservation and holding times are presented in the standard operating procedure (SOP) EP-ERSS-SOP-5056, Sample Containers and Preservation. Evaluating these QC indicators allows estimates to be made of the accuracy, bias, and precision of the analytical suites. A focused data validation was also performed for all the data packages (identified by request number) that included a more detailed review of the raw data results. The SOPs used for data validation are presented in Table C-1.0-1. Copies of the analytical data, laboratory logbooks, and instrument printouts are provided in Appendix D (on CD included with this document).

A systematic low bias in previously reported tritium pore-vapor measurements was identified (Whicker et al. 2009, 106429), and all tritium data presented in this report are corrected for this bias (Marczak 2009, 106500). The tritium results were corrected using the percent moisture value determined by the analytical laboratory. Details are discussed in section C-4.0.

Analytical data were reviewed and evaluated based on U.S. Environmental Protection Agency (EPA) National Functional Guidelines for organic chemical data review, where applicable (EPA 1994, 048639; EPA 1999, 066649). Data have also been assessed using guidelines established in SW-846 (EPA 1997, 057589). As a result of the data validation and assessment efforts, qualifiers have been assigned to the appropriate analytical records. Definitions of the data qualifiers are presented in Appendix A.

C-2.0 ANALYTICAL DATA ORGANIZATION AND VINTAGE

The 2009 MDA T pore-gas analytical data are obtained from 37 samples (29 characterization and 8 QA/QC) collected during two sampling events (February and April 2009) from vapor-monitoring well locations 21-25264, 21-603058, and 21-603059. Complete data packages and sample documentation for the 2009 samples are provided in Appendix D.

C-3.0 ORGANIC CHEMICAL ANALYSIS METHODS

MDA T pore-gas samples were submitted for analysis of volatile organic compounds (VOCs) as presented in Table C-3.0-1. Table 2.0-2 of the periodic monitoring report summarizes all 2009 pore-gas samples collected to date at MDA T and the requested analyses. All VOC results are provided on CD in Appendix D.

C-3.1 Organic Chemical QA/QC Samples

The QC samples are designed to produce a qualitative measure of the reliability of a specific part of an analytical procedure. The methods for validating organic chemical results on the basis of the various QA/QC sample types are specified in the SOPs. The validation of organic chemical data using QA/QC samples and other methods may have resulted in the rejection of the data or the assignment of various qualifiers to individual sample results.

Calibration verifications, LCSs, method blanks, surrogates, and internal standards were analyzed to assess the accuracy and precision of organic chemical analyses. Each of these QA/QC sample types is defined in the analytical services SOW (LANL 2000, 071233), described in the applicable validation SOPs, and summarized below.

Calibration verification is the establishment of a quantitative relationship between the response of the analytical instrument and the concentration of the target analyte. There are two aspects of calibration verification: initial and continuing. The initial calibration verifies the linearity of the calibration curve as well as the individual calibration standards used to perform the calibration. The continuing calibration verifies that the initial calibration is still linear and valid. The continuing calibration also serves to determine that analyte identification criteria, such as retention times and spectral matching, are being met.

The LCS is a sample of the same matrix spiked with the target analytes and serves to monitor the overall performance. Following Laboratory SOP guidance, analytical results were qualified according to EPA National Functional Guidelines (EPA 1999, 066649) if the individual LCS recoveries were not within method-specific acceptance criteria.

A method blank is an analyte-free matrix to which reagents are added in the same volumes or proportions as those used in the environmental sample processing and is extracted and analyzed in the same manner as the corresponding environmental samples. Method blanks are used to assess the potential for sample contamination during extraction and analysis.

A surrogate compound (surrogate) is an organic chemical used in the analyses of target analytes. The surrogate is similar in composition and behavior to the target analytes but is not normally found in environmental samples. Surrogates are added to every blank, sample, and spike to evaluate the efficiency with which analytes are recovered during extraction and analysis. The recovery percentage of the surrogates must be within specified ranges, or the sample may be rejected or assigned a qualifier.

Internal standards are chemical compounds added to every blank, sample, and standard extract at a known concentration. Internal standards are used as the basis for quantitation of target analytes. The percent recovery (%R) for internal standards should be within the range of 50% to 200%.

The quality of the 2009 MDA T VOC pore-gas data is summarized below.

C-3.1.1 MDA T Pore-Gas VOC Data

During the February and April 2009 monitoring period, 29 characterization samples and 8 QA/QC samples were collected and submitted for VOC analysis.

No VOC data were rejected.

A single cyclohexane result was qualified as estimated (J) because the analytical laboratory qualified the result as estimated and requalification of the data via data validation did not occur.

A total of 97 VOC results (57 characterization and 40 QA/QC) were qualified as estimated and not detected (UJ) either because

- the ICV exceeded the percent relative standard deviation criteria and/or the associated multipoint calibration correlation coefficient is <0.995 (9 benzyl chloride results; 18 butanol[1-] results; 9 methanol results; 22 methyl tert butyl ether results; and 9 methyl-2-pentanone[4-] results); or
- the ICV and/or CCV were recovered outside the method-specific limits (1 chlorodifluoromethane result; 7 chloroethane results; and 22 ethyltoluene[4-] results).

A total of 1455 characterization and 858 QA/QC VOC results were qualified as not detected because the analytical laboratory qualified the result as a nondetect, and requalification of the data via data validation did not occur.

C-4.0 RADIONUCLIDE ANALYSIS METHODS

MDA T vapor samples collected in 2009 were analyzed by EPA Method 906.0 for tritium (Table C-3.0-1). Table 2.0-2 summarizes all 2009 vapor samples collected to date at MDA T and the requested analyses. All tritium results are provided on CD in Appendix D.

During a technical review of EP-ERSS-SOP-5074, Sampling Sub-Atmospheric Air, the Laboratory determined that analytical results were not being corrected for water bound in silica gel used to collect vapor samples, thereby identifying a systematic low bias in previously reported tritium results (Whicker et al. 2009, 106429). The bias results from the properties of silica gel, the sample medium used to collect water vapor from pore-gas samples. Silica gel contains nontritiated water vapor bound to the silica gel molecules that cannot be completely removed by drying before it is used in sampling without degrading the silica gel properties. Thus, when water vapor is collected from the pore gas, the tritiated sample water vapor is mixed/diluted into the clean water bound to the silica gel molecules. The amount of dilution is proportional to the amount of silica gel–bound water in the original sample and the amount of moisture collected in the sample. The tritium results were corrected using the percent moisture values determined by the analytical laboratory (Marczak 2009, 106500). The corrected tritium results are reported in Table 5.3-1 and in Appendix D.

C-4.1 Radionuclide QA/QC Samples

The minimum detectable concentration (MDC) for tritium in performance blanks (PBs), method blanks, laboratory duplicates, tracer/carrier recovery, LCSs, and MS samples were analyzed as part of the MDA T pore-gas evaluation to assess the accuracy and precision of the radionuclide analysis. The qualifiers and sample types for radionuclides are defined in the analytical services SOW (LANL 1995, 049738; LANL 2000, 071233), described in the applicable validation SOPs, and discussed briefly below. The validation of radionuclide data using QA/QC samples and other methods may have resulted in the rejection of data or the assignment of various qualifiers to individual sample results.

The MDC for each radionuclide is defined as the minimum activity concentration that the analytical laboratory equipment can detect in 95% of the analyzed samples and is used to assess analytical performance.

Uncertainty and minimum detectable activity concentration results for tritium have been modified in the same manner as the analytical results to account for the bound water found in silica gel used for sample collection.

The PBs and method blanks are used to measure bias and assess potential cross-contamination of samples during preparation and analysis. Blank results should be less than the MDC for each radionuclide.

Laboratory duplicates are used to assess or demonstrate acceptable laboratory method precision at the time of analysis as well as to assess the long-term precision of an analytical method on various matrices. Duplicate results are used to calculate a duplicate error ratio (DER). The DER is based on 1 standard deviation of the sample and the duplicate sample and should be less than 4.

The LCS serves as a monitor of the overall performance of each step during the analysis, and the acceptance criteria for LCSs are method-specific. For radionuclide methods, LCS %Rs should fall into the control limits of 80% to 120%.

The accuracy of radionuclide analyses is also assessed using MS samples. These samples are designed to provide information about the effect of the sample matrix on the sample preparation procedures and analytical technique. The MS %Rs should be within the acceptance range of 75% to 125%; however, if the sample result is more than 4 times the amount of the spike added, these acceptance criteria do not apply.

The quality of the 2009 MDA T tritium data is summarized below.

C-4.1.1 MDA T Pore-Gas Tritium Data

During the February and April 2009 monitoring period, 29 characterization samples and 4 QA/QC samples were collected and submitted for tritium analysis.

No tritium data were rejected.

A single tritium result from monitoring well 21-603059 (sample ID MD21-09-7154) was qualified as not detected because the associated sample concentration was less than or equal to the MDC.

No other data quality issues were identified.

All tritium data collected in 2009 from MDA T pore gas were used to evaluate tritium trends over the monitoring period. Validated analytical results have been corrected for bound-water dilution under reporting.

C-5.0 REFERENCES

The following list includes all documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate’s Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

EPA (U.S. Environmental Protection Agency), February 1994. “USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,” EPA-540/R-94/013, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1994, 048639)

EPA (U.S. Environmental Protection Agency), 1997. “Test Methods for Evaluating Solid Waste, Laboratory Manual, Physical/Chemical Methods,” SW-846, 3rd ed., Update III, Office of Solid Waste and Emergency Response, Washington, D.C. (EPA 1997, 057589)

EPA (U.S. Environmental Protection Agency), October 1999. “USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review,” EPA540/R-99/008, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1999, 066649)

LANL (Los Alamos National Laboratory), July 1995. “Statement of Work (Formerly Called "Requirements Document") - Analytical Support, (RFP number 9-XS1-Q4257), (Revision 2 - July, 1995),” Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 1995, 049738)

LANL (Los Alamos National Laboratory), March 1996. “Quality Assurance Project Plan Requirements for Sampling and Analysis,” Los Alamos National Laboratory document LA-UR-96-441, Los Alamos, New Mexico. (LANL 1996, 054609)

LANL (Los Alamos National Laboratory), December 2000. “University of California, Los Alamos National Laboratory (LANL), I8980SOW0-8S, Statement of Work for Analytical Laboratories,” Rev. 1, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2000, 071233)

Marczak, S., July 2009. “Technical Implementation of the Correction Factor Calculation for Tritium in Pore-Gas Data,” Los Alamos National Laboratory document LA-UR-09-4629, Los Alamos, New Mexico. (Marczak 2009, 106500)

Whicker, J.J., J.M. Dewart, S.P. Allen, W.F. Eisele, M.C. McNaughton, and A.A. Green, June 17, 2009. “Corrections for Measurement of Tritium in Subterranean Vapor Using Silica Gel,” Los Alamos National Laboratory document LA-UR-09-03837, Los Alamos, New Mexico. (Whicker et al. 2009, 106429)

Table C-1.0-1
Data Validation Procedures

Procedure	Title	Effective Date
SOP-5161, Rev. 0	Routine Validation of Volatile Organic Compound (VOC) Analytical Data	6/10/2008
SOP-5166, Rev. 0	Routine Validation of Gamma Spectroscopy, Chemical Separation Alpha Spectrometry, Gas Proportional Counting, and Liquid Scintillation Analytical Data	6/30/2008

Table C-3.0-1
Analytical Methods for MDA T Pore-Gas Samples

Analytical Method	Analytical Description	Analytical Suite
EPA Method TO-15	Gas Chromatography/Mass Spectrometry	VOC
EPA Method 906	Liquid Scintillation	Tritium

Appendix D

Analytical Suites and Results and Analytical Reports
(on CD included with this document)