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**Periodic Monitoring Report for  
Vapor-Sampling Activities at  
Material Disposal Area H,  
Solid Waste Management  
Unit 54-004, at Technical Area 54,  
Fourth Quarter Fiscal Year 2009**


Prepared by the Environmental Programs Directorate

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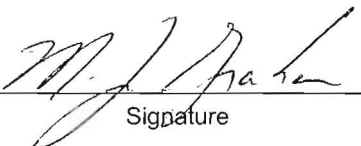
# Periodic Monitoring Report for Vapor-Sampling Activities at Material Disposal Area H, Solid Waste Management Unit 54-004, at Technical Area 54, Fourth Quarter Fiscal Year 2009

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## **EXECUTIVE SUMMARY**

This periodic monitoring report summarizes vapor-monitoring activities conducted during the fourth quarter of fiscal year (FY) 2009 at Material Disposal Area (MDA) H, Solid Waste Management Unit 54-004, at Technical Area 54 at Los Alamos National Laboratory. The objective of the monitoring is to evaluate trends in volatile organic compound (VOC) concentrations and tritium activity levels over time in subsurface vapor at MDA H.

Monitoring conducted during the fourth quarter of FY2009 included field screening and collecting vapor samples from 15 sampling ports within 3 vapor-monitoring boreholes at MDA H. Vapor samples were submitted for laboratory analyses of VOCs and tritium. Tritium concentrations have been corrected to account for the effects of silica gel-bound water.

The analytical results continue to confirm the presence of VOCs and tritium in pore-vapor samples collected at MDA H and are consistent with previous sampling results. The maximum concentrations of all VOCs detected in pore gas during fourth quarter FY2009 and during all of FY2009 were less than concentrations needed to exceed groundwater screening levels. No immediate potential threat to groundwater is posed by VOCs measured at MDA H monitoring locations. Tritium values decreased with distance from MDA H and with depth in borehole location 54-01023.



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## 1.0 INTRODUCTION

This periodic monitoring report presents the results of vapor-monitoring activities conducted during the fourth quarter of fiscal year (FY) 2009 at Material Disposal Area (MDA) H, Solid Waste Management Unit 54-004, at Technical Area 54 (TA-54) at Los Alamos National Laboratory (LANL or the Laboratory).

MDA H is located in the east-central portion of the Laboratory at TA-54 (Figure 1.0-1) on Mesita del Buey. MDA H is a 70-ft by 200-ft (0.3-acre) fenced area consisting of nine inactive vertical disposal shafts arranged in a line approximately 15 ft within, and parallel to, its southern fence line (Figure 1.0-2). Each shaft is cylindrical, 6 ft in diameter, and 60 ft deep. The shafts are filled with solid-form waste to a depth of 6 ft below ground surface (bgs). The waste in Shafts 1 to 8 is covered by a 3-ft layer of concrete placed over 3 ft of crushed tuff; the waste in Shaft 9 is covered by 6 ft of concrete. The regional aquifer beneath MDA H is estimated to be at an average depth of approximately 1040 ft bgs, based on data from nearby wells and the predictions of the hydrogeologic conceptual model for the Pajarito Plateau (LANL 1998, 059599).

From May 1960 to August 1986, MDA H functioned as the Laboratory's primary disposal area for classified solid-form waste. Between periods of waste disposal, each shaft was covered with a padlocked steel plate to prevent unauthorized access to classified materials. Much of the classified waste was nonhazardous; however, various hazardous chemicals, radionuclide-contaminated materials, and materials contaminated by high explosives were also disposed of at MDA H. These materials included scraps and shapes contaminated with depleted uranium, drummed radioactive waste, fuel elements, a tritium-contaminated unit, plutonium-contaminated shapes, and decontamination and decommissioning scrap.

Vapor monitoring at MDA H consists of screening 15 sampling ports in three vapor-monitoring boreholes (Figure 1.0-2). Volatile organic compound (VOC) and tritium samples are collected from each of the 15 sampling ports completed within each stratigraphic unit. Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to the New Mexico Environment Department (NMED) in accordance with U.S. Department of Energy policy.

Vapor monitoring at MDA H has been conducted since the second quarter of FY2005. The NMED-approved vapor-monitoring boreholes and the corresponding sampling intervals that were field screened and sampled are presented in Table 1.0-1. A summary of vapor-monitoring activities follows.

- On April 11, 2003, NMED sent a letter (NMED 2003, 075939) approving the Resource Conservation and Recovery Act facility investigation report for MDA H (LANL 2001, 070158) and subsequent addendum to the report (LANL 2002, 073270).
- In May 2003, the Laboratory submitted the corrective measures study for MDA H (LANL 2003, 076039) identifying a preferred remedy. Comments were received from NMED, and the report was reissued in June 2005 (LANL 2005, 089332).
- In December 2004, NMED sent a letter (NMED 2004, 092217) requesting the Laboratory collect quarterly subsurface vapor-monitoring samples from borehole locations 54-15461, 54-15462, and 54-01023 to provide data to facilitate NMED's selection of an appropriate remedy for MDA H.
- In February 2005, the Laboratory began quarterly pore-gas monitoring using an inflatable packer sampling system. In March 2006, the Laboratory installed dedicated Flexible Liner Underground Technology (FLUTE) sampling membranes into each MDA H pore-gas monitoring location.

- In May 2005, NMED sent a letter (NMED 2005, 092219) requesting the Laboratory continue to collect quarterly subsurface vapor-monitoring samples from borehole locations 54-15461, 54-15462, and 54-01023.
- NMED reviewed the 2007 pore-gas monitoring report and, based on packer sampling results for trichloroethene (TCE) in pore-gas samples collected before dedicated sampling equipment (FLUTE) was installed, suggested the FLUTE membrane was adsorbing VOCs (NMED 2007, 099277; NMED 2008, 100480). VOCs in subsurface vapor samples was compared during the second and third quarters of FY2008 to evaluate the FLUTE system currently used at MDA H versus the packer system used from 2001 to 2006 to collect subsurface vapor samples. The results of this study are discussed in "Pilot Test Report for Comparing Packer and FLUTE Vapor-Sampling Systems at Material Disposal Area H" (LANL 2008, 103889). Pore gas was sampled using the FLUTE membrane system during the second quarter sampling event; however, the FLUTE membrane was damaged during the removal process to accommodate packer sampling for the comparison study. The membrane was sent to the manufacturer for repair before it was reinstalled for third quarter sampling activities, which were conducted as planned. During the membrane removal, the tubing was disconnected from the manifold and subsequently misaligned when it was reinstalled before third quarter FY2008 sampling activities were conducted.
- During the first quarter FY2009 (December 2008) sampling event, the field crew observed that one tube connecting the FLUTE membrane's subsurface sampling port to the surface manifold in borehole location 54-15462 did not correspond to the correct fitting for that depth interval on the manifold. The borehole was sampled in the observed tubing configuration (with the exception of the 60-ft port depth, which was not sampled), and the membrane was removed following sampling. After the membrane was removed, it was determined that five of the six tubes were not connected to the correct fittings for the depth intervals on the manifold. In addition, one sampling port (60-ft depth) was not reconnected to any sample tubing at that time.
- As a result of the tubing misalignment, the samples collected from the borehole during the third and fourth quarter FY2008 sampling events and the first quarter FY2009 sampling event were assigned to the wrong depth intervals. Although the misalignment of the tubing in borehole location 54-15462 was not discovered until the first quarter FY2009 sampling event, the ambient-air values measured in the port indicated the tubing may have been disconnected in the 60-ft port depth during the fourth quarter FY2008 sampling event. Therefore, the 60-ft port depth was not sampled during the fourth quarter FY2008 and first quarter FY2009 sampling events. The 60-ft port depth was sampled during the third quarter FY2008 sampling event; however, the results are not representative of formation air at this port depth.
- Because of the problems with the tubing configuration in borehole location 54-15462, the Laboratory corrected the field documentation (sample collection logs and field notebooks) for the third and fourth quarter FY2008 sampling events and for the first quarter FY2009 sampling event.
- The Sample Management Database records were updated to correlate the results to the correct port depths sampled in borehole location 54-15462 during the third and fourth quarters of FY2008 and the first quarter of FY2009.
- Analytical results and their associated port depths were reported correctly in "Periodic Monitoring Report for Vapor-Sampling Activities at Material Disposal Area H, Solid Waste Management Unit 54-004, at Technical Area 54, Fiscal Year 2008" (LANL 2009, 105191).
- The third quarter FY2008 pore-gas results presented in "Pilot Test Report for Comparing Packer and FLUTE Vapor-Sampling Systems at Materials Disposal Area H" were incorrect (LANL 2008, 103889). The information presented in this report was revised, and the report was resubmitted to

NMED in February 2009 as "Pilot Test Report for Comparing Packer and FLUTe Vapor-Sampling Systems at Materials Disposal Area H, Revision 1" (LANL 2009, 105076).

- Although pore-gas screening and analytical data for borehole location 54-15462 reported for the third and fourth quarters of FY2008 and the first quarter of FY2009 were corrected in all field and laboratory documentation to correlate the results to the actual depths monitored, NMED rejected all data for this borehole collected during these three events because the misalignment of the sampling ports to the manifold may have resulted in inadequate purge volumes (NMED 2009, 105599).
- On August 20, 2009, NMED sent a letter to the Laboratory discussing the presence of VOCs and tritium in the subsurface at MDA H, discrepancies between Tables 3.0-1 and 5.2-1 (LANL 2009, 106656), and the rejection of tritium in the third and fourth quarters of FY2008 and the first quarter of FY2009 because of inadequate purge times. The discrepancies were corrected, and the tables were resubmitted. The Laboratory rejected the VOC sampling results because the purge time for the three quarters was not adequate. The Laboratory includes the tritium data NMED rejected because tritium analysis is dependent on weight accumulation of water vapor, not on purge time (NMED 2009, 106786).

Subsurface vapor-field screening and sampling are being performed to characterize VOC concentration and tritium-activity level trends in subsurface vapor over time. Field-screening data and analytical laboratory results for the fourth quarter of FY2009 and the previous three quarters are presented in this report.

## 2.0 SCOPE OF ACTIVITIES

The following sampling activities were completed at MDA H during the fourth quarter of FY2009, as directed by NMED in a December 21, 2004, letter to the Laboratory (NMED 2004, 092217) and in a May 17, 2005, letter to the Laboratory (NMED 2005, 092219). Fourth quarter vapor-monitoring activities were conducted from August 5 to August 10, 2009. Table 1.0-1 shows the vapor-monitoring borehole identification numbers and sampling port depths. The vapor-monitoring borehole locations are shown in Figure 1.0-2.

- Each sampling interval was purged to ensure that formation air was sampled in accordance with Standard Operating Procedure EP-ERSS-SOP-5074, Sampling of Sub-Atmospheric Air.
- Pore gas from each sampling interval was field screened for carbon dioxide (CO<sub>2</sub>) and oxygen (O<sub>2</sub>) using a Landtec GEM-500 and for selected VOCs, CO<sub>2</sub>, and water vapor using a Brüel and Kjær (B&K) Type 1302 multigas photoacoustic analyzer. The pressure differential was also measured at each sampling interval.
- Vapor samples were collected from each sampling interval in SUMMA canisters for laboratory analyses of VOCs using U.S. Environmental Protection Agency (EPA) Method TO-15.
- Tritium samples were collected from each sampling interval with silica gel columns for laboratory analysis using EPA Method 906.0.
- A total of 15 VOC samples were collected from 15 ports in three boreholes.
- A total of 15 tritium samples were collected from 15 ports in three boreholes.

No investigation-derived waste was generated during quarterly monitoring.

### Fourth Quarter FY2009 Deviations

The required vapor-monitoring locations and sampling intervals for MDA H are presented in Table 1.0-1. No deviations from the sampling plan occurred during the fourth quarter FY2009 sampling event.

### 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 H. 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 H during the most recent monitoring event. The equilibrium relationship between air and water concentrations is described by the following equation.

$$C_{water} = C_{air}H' \quad \text{Equation 3.0-1}$$

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 exceedances of groundwater cleanup levels. The analysis of the fourth quarter MDA H VOC pore gas data is presented in section 5.0.

Because there are no SLs for pore gas that 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 2009, 106420) or the EPA regional screening tables ([http://www.epa.gov/region06/6pd/rcra\\_c/pd-n/screen.htm](http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm)). The following dimensionless form of Henry's law constant was used:

$$H' = \frac{C_{air}}{C_{water}} \quad \text{Equation 3.0-2}$$

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

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

where  $C_{air}$  is the concentration of a particular VOC in the pore-gas sample ( $\mu\text{g}/\text{m}^3$ ),  $H'$  is the dimensionless Henry's law constant,  $SL$  is the screening level ( $\mu\text{g}/\text{L}$ ), and 1000 is a conversion factor from  $\text{L}$  to  $\text{m}^3$ . The SLs are the groundwater 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 no MCL or NMWQCC standard is available, the EPA regional tap water SL ([http://www.epa.gov/region06/6pd/rcra\\_c/pd-n/screen.htm](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 direct contact with groundwater. Table 3.0-1 presents the calculated concentrations of contaminants in pore gas corresponding to groundwater SLs for the four quarters of FY2009. Table 3.0-2 shows the SVs calculated for the maximum detected VOCs during fourth quarter FY2009. Table 3.0-3 shows the SVs calculated for the maximum detected VOCs during all four quarters of FY2009.

#### 4.0 FIELD-SCREENING RESULTS

Fourth quarter FY2009 vapor-monitoring field-screening activities were conducted at MDA H from August 5 to August 10, 2009. Before sampling, each sample interval was purged to ensure formation air was collected. The vapor from each port was field screened using a Landtec GEM-500 photoionization detector equipped with an 11.7-electron volt lamp to measure percent CO<sub>2</sub> and O<sub>2</sub>. Each interval was monitored with the Landtec until CO<sub>2</sub> and O<sub>2</sub> readings stabilized. The stabilized percent CO<sub>2</sub> and O<sub>2</sub> values measured at each sampling location during the fourth quarter of FY2009 and the previous three quarters are provided in Table 4.0-1. After the tubing was purged and stabilized, VOC field-screening results were collected using a B&K Type 1302 multigas photoacoustic analyzer to estimate VOC concentrations. The B&K was calibrated for analysis of four VOCs, including trichlorofluoromethane (Freon-11); tetrachloroethene (PCE); 1,1,1-trichloroethane (TCA); and TCE. It also measured CO<sub>2</sub> and water vapor. The stabilized B&K field-monitoring values measured at each sampling location for the fourth quarter of FY2009 and the previous three quarters at each sampling location are provided in Table 4.0-2. The field-screening quality assurance/quality control (QA/QC) program is summarized in Appendix B, section B-5.0.

A regression analysis was conducted between the B&K field-screening results and the VOC analytical data results for FY2009. The resulting VOC screening concentrations measured were at the lower range of B&K instrument operability and demonstrated limited correlation between the field-screening results and the VOC fixed-base analytical results. As such, regression analysis results are not provided for MDA H VOC data.

#### 5.0 ANALYTICAL DATA RESULTS

Fourth quarter FY2009 vapor-sampling activities were conducted at MDA H from August 5 to August 10, 2009. Sampling locations and depths are provided in Table 1.0-1. Analytical vapor samples were collected in SUMMA canisters and submitted for laboratory analyses of VOCs according to EPA Method TO-15. Analytical vapor samples were collected in silica gel columns and submitted for laboratory analyses of tritium according to EPA Method 906.0. Table 5.0-1 presents analytical results for detected VOCs in samples collected during the fourth quarter of FY2009 and the three previous quarters. Detected VOC concentrations for the fourth quarter FY2009 are shown in Figure 5.0-1. Table 5.0-2 presents analytical results for detected activity levels of tritium in samples collected during the fourth quarter of FY2009 and the three previous quarters. Detected tritium activity levels for the fourth quarter FY2009 are shown in Figure 5.0-2. Analytical data and reports for the fourth quarter FY2009 and the three previous quarters are included in Appendix C (on CD included with this report). Tritium and VOC analytical data were reviewed in accordance with the QA/QC program presented in Appendix B.

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 low bias (Marczak 2009, 106500). The low bias resulted from the properties of silica gel, the medium used to collect water vapor from pore-gas samples. Drying the silica gel before it is used in sampling cannot completely remove the water bound to the silica gel molecules 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. To analyze the sample, all the water (including the bound water) is driven off of the silica gel at a much higher temperature than for the initial drying done before sampling. The tritium concentrations were corrected to account for dilution from the bound water using the percent moisture value measured by the analytical laboratory.

## 5.1 Data Summary

During the fourth quarter of FY2009, fixed-lab analyses detected 21 VOCs in the 15 vapor samples collected from MDA H. Dichlorodifluoromethane and TCA were detected in all 15 samples and Freon-11 was detected in 14 samples. Ten samples had detections of 1,1,2-trichloro-1,2,2-trifluoroethane. Chlorobenzene was detected in nine samples. There were eight estimated detections of 1-butanol. Toluene was detected in six samples. TCE was detected in five samples collected from borehole location 54-01023, carbon disulfide was detected in five samples, and 2-propanol was detected in four samples collected from borehole location 54-15462. PCE was detected in two vapor samples collected from borehole location 54-01023. The two highest concentrations of VOCs collected in the fourth quarter were an estimated concentration of  $600 \mu\text{g}/\text{m}^3$  (200 ppbv) of 1-butanol and a concentration of  $410 \mu\text{g}/\text{m}^3$  (170 ppbv) of 2-propanol in vapor samples collected from borehole location 54-15462 at the 254-ft port depth. Fourth quarter FY2009 2-propanol and estimated 1-butanol concentrations were about twice the magnitude of concentrations reported in the other three quarters of FY2009 for those chemicals in that same borehole. With the exception of 2-propanol and 1-butanol, fourth quarter FY2009 VOC concentrations were generally consistent with VOC concentrations observed during the three previous sampling events (Table 5.0-1).

During FY2009, only 17 of the 31 VOCs detected at MDA H were detected in vapor samples collected from borehole location 54-01023, which is nearest the MDA H shafts. Because vapor samples were collected from all six port depths in each quarter, 24 possible samples could have contained VOCs. Dichlorodifluoromethane and Freon-11 were detected in all 24 vapor samples collected in FY2009, with maximum detections of  $29 \mu\text{g}/\text{m}^3$  (5.8 ppbv) and  $75 \mu\text{g}/\text{m}^3$  (13 ppbv), respectively. These VOC concentrations are so small no trending with depth or over time is apparent. Other VOCs frequently detected in vapor samples collected from borehole location 54-01023 include 17 detections each of TCA and 1,1,2-trichloro-1,2,2-trifluoroethane, with maximum concentrations of  $28 \mu\text{g}/\text{m}^3$  (5.2 ppbv) and  $19 \mu\text{g}/\text{m}^3$  (2.4 ppbv), respectively. There were 15 detections of chlorobenzene at borehole location 54-01023 in FY2009, with a maximum detection of  $44 \mu\text{g}/\text{m}^3$  (9.6 ppbv). This is the only MDA H borehole location where PCE was detected in six vapor samples with a maximum concentration of  $14 \mu\text{g}/\text{m}^3$  (2.1 ppbv). Chlorobenzene concentrations increased with depth during all four quarters. None of the other VOC concentrations had obvious trends with depth or over time. Methylene chloride and 1,2-dichloropropane were detected in one vapor sample each from this borehole location and were not detected at the other two boreholes during FY2009. Other VOCs detected in vapor samples collected from this borehole location in FY2009 are TCE, acetone, 1-butanol, 2-butanone, carbon tetrachloride, carbon disulfide, 1,1-dichloroethene, tetrahydrofuran, and toluene.

Only seven VOCs were detected in vapor samples collected from borehole location 54-15461 north of the MDA H shafts in FY2009. Of the 12 vapor samples collected at three port depths, dichlorofluoromethane was detected in 11 samples, and Freon-11 and TCA were both detected in 10 samples, with maximum concentrations from borehole location 54-15461 of  $17 \mu\text{g}/\text{m}^3$  (3.5 ppbv) for dichlorofluoromethane,  $16 \mu\text{g}/\text{m}^3$  (2.9 ppbv) for Freon-11, and  $11 \mu\text{g}/\text{m}^3$  (2 ppbv) for TCA. Other VOCs detected in vapor samples collected from this borehole location are carbon disulfide, acetone, 2-butanone, and toluene.

In the 23 vapor samples collected during F2009 from the six port depths of borehole location 54-15462 southeast of the MDA H shafts, 28 different VOCs were detected. Nine of the VOCs, including 1,3-butadiene, carbon tetrachloride, chloroform, cyclohexane, 1,4-dichlorobenzene, ethanol, ethylbenzene, methanol, and n-heptane, were detected in only one or two vapor samples during the year. Of the five most prevalent VOCs detected at MDA H, 21 vapor samples collected from borehole location 54-15462 contained dichlorofluoromethane with a maximum concentration of  $37 \mu\text{g}/\text{m}^3$  (7.4 ppbv), 20 samples contained Freon-11 with a maximum concentration of  $36 \mu\text{g}/\text{m}^3$  (6.4 ppbv), 17 samples contained TCA with a maximum concentration of  $74 \mu\text{g}/\text{m}^3$  (14 ppbv), 15 samples contained chlorobenzene with a maximum concentration of  $110 \mu\text{g}/\text{m}^3$  (25 ppbv), and 14 samples contained 1,1,2-trichloro-1,2,2-trifluoroethane with a maximum concentration of  $25 \mu\text{g}/\text{m}^3$  (3.3 ppbv). Toluene was detected in 20 vapor samples from this borehole location, with a maximum concentration of  $1000 \mu\text{g}/\text{m}^3$  (280 ppbv), which was the highest VOC concentration of any vapor sample collected from MDA H boreholes in FY2009. Chlorobenzene concentrations increased with depth in all four quarters. Toluene and 2-propanol concentrations increased with depth in the fourth quarter only; detections of 2-propanol during the other three quarters were insufficient to analyze a trend, and high toluene concentrations were detected at the 10-ft and 60-ft port depths during the first and second quarters, so the trend was not consistent. None of the other VOC detections had obvious trends with depth or over time. Other VOCs detected in vapor samples collected from this borehole location are acetone, 2-butanone, benzene, 1-butanol, 2-propanol, 1,1-dichloroethene, 1,3-xylene+1,4-xylene, carbon disulfide, tetrahydrofuran, 1,2-xylene, propylene, TCE, and hexane.

During the fourth quarter of FY2009, tritium was detected in all 15 vapor samples collected with activity levels ranging from 476 pCi/L to 6,836,460 pCi/L. The highest tritium activity levels were detected in vapor samples collected from borehole location 54-01023, the monitoring borehole nearest MDA H, indicating a tritium source in the shafts. During the fourth quarter of FY2009, tritium activity levels in this borehole location decreased with depth from 6,836,460 pCi/L at the top port depth (10 ft bgs) to 699,163 pCi/L at the second lowest port depth (200 ft bgs). The second highest tritium level (2,963,040 pCi/L) was measured at the second highest depth (60 ft bgs) from borehole location 54-01023. During all four quarters of FY2009, tritium activity levels at borehole location 54-01023 generally decreased with depth.

Tritium activity levels in borehole locations 54-15461 and 54-15462 in the fourth quarter of FY2009 ranged from 476 pCi/L to 3113 pCi/L. Tritium activity levels at these two borehole locations were similar in the fourth quarter versus the previous three quarters. The highest activity level in these outer locations is more than 200 times less than the lowest tritium activity level at borehole location 54-01023 (699,163 pCi/L), indicating that tritium activity levels decrease with distance from the MDA H source area.

The highest and second highest tritium activity levels measured in all four quarters of FY2009 were in vapor samples collected from borehole location 54-01023 at the top two port depths (10 ft and 60 ft bgs). The highest tritium activity levels measured in FY2009 were in the third quarter from samples collected in early May. The highest tritium activity level in the third quarter (16,424,700 pCi/L) was 3.3 times the highest activity level in the first quarter (5,020,150 pCi/L), 3.5 times the highest activity level in the second quarter (4,635,190 pCi/L), and 2.4 times the highest activity level in the fourth quarter (6,836,460 pCi/L). The second highest tritium activity level in the third quarter (9,284,720 pCi/L) was also 2 to 3 times the magnitude of the second highest activity levels for the other three quarters.

The lowest tritium activity levels in all four quarters of FY2009 were in vapor samples collected from the deep ports in the two boreholes farthest from the MDA H shafts, borehole locations 54-15462 and 54-15461. Tritium activity levels at these two borehole locations generally decreased with depth, except for anomalous measurements in the first quarter at borehole location 54-15462 and the second quarter at

borehole location 54-15461. Vapor samples collected from the 150-ft port depth at borehole location 54-15462 in the first quarter of FY2009 measured a tritium activity level of 6223 pCi/L, 9 times the second highest activity level that quarter and 4 times the magnitude of the next highest activity level measured during FY2009 in that location. Tritium activity level measurements collected from borehole location 54-15461 during the second quarter of FY2009 increased with depth, from 2370 pCi/L at the 10-ft port depth to 21,855 pCi/L at the 95-ft port depth. This highest measurement was more than 4 times the magnitude of the second highest tritium activity level measured in that borehole. With the exception of these measured values, activity levels at these two outer borehole locations are usually 150 to 400 times lower than the lowest tritium levels measured at borehole location 54-01023.

## 5.2 Data Evaluation

The VOC results from the fourth quarter of FY2009 were screened to evaluate whether the concentrations of VOCs are a potential source of groundwater contamination. Because there are no SLs for pore gas that 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).

SVs were calculated for the maximum concentrations of VOCs detected at MDA H using Equation 3.0-3 during the fourth quarter of FY2009. Twenty-one VOCs were detected during the fourth quarter of FY2009. The evaluation included the 18 VOCs detected in MDA H samples for which there are MCLs, NMWQCC standards, or EPA regional tap water SLs ([http://www.epa.gov/region06/6pd/rcra\\_c/pd-n/screen.htm](http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm)). Table 3.0-2 shows the SVs calculated for the relevant VOCs for fourth quarter FY2009. SVs were less than 1.0 for all detected VOCs, indicating VOC concentrations in the pore gas beneath MDA H are not an immediate potential threat to groundwater.

SVs were calculated using Equation 3.0-3 for the maximum concentrations of VOCs detected in pore-gas samples at MDA H during all four quarters of FY2009. Thirty-one VOCs were detected during FY2009. The evaluation included the 26 VOCs detected for which MCLs, NMWQCC standards, or EPA regional tap water SLs are available. Table 3.0-3 shows the SVs calculated for the relevant VOCs for all of FY2009. All SVs were below 1.0 for FY2009, indicating VOC concentrations in the pore gas beneath MDA H are not an immediate potential threat to groundwater.

## 6.0 SUMMARY

The purpose of the quarterly pore-gas monitoring activities at MDA H is to evaluate trends in VOC concentrations and tritium activities in subsurface vapor at MDA H over time. The results from the fourth quarter FY2009 monitoring event are summarized as follows.

- Maximum concentrations of all VOCs observed in pore gas during fourth quarter FY2009 as well as all of FY2009 were less than concentrations needed to exceed groundwater SLs. No immediate potential threat to groundwater is posed by VOCs measured at MDA H monitoring locations.
- VOCs were present at low concentrations ( $\leq 600 \mu\text{g}/\text{m}^3$  or  $\leq 200 \text{ ppbv}$ ) in subsurface vapor and are generally consistent with concentrations observed during the three previous quarterly sampling events.
- Maximum detected concentrations of VOCs were present in borehole location 54-15462 at the 254-ft port depth. VOC concentrations varied but were within the same order of magnitude at each borehole location, with the exception of chlorobenzene, 2-propanol, and toluene.



Concentrations of these three VOCs increased with depth in borehole location 54-15462 during the fourth quarter. Chlorobenzene concentrations also increased with depth in borehole location 54-01023.

- During FY2009, 31 VOCs were detected in vapor samples collected from the monitoring boreholes at MDA H. Seventeen of these VOCs were detected in vapor samples collected from borehole location 54-01023, 7 were detected in samples from borehole location 54-15461, and 28 were detected in samples from borehole location 54-15462.
- Three prevalent VOCs detected in vapor samples at all three borehole locations every quarter were dichlorofluoromethane, Freon-11, and TCA. Chlorobenzene and 1,1,2-trichloro-1,2,2-trifluoroethane were also detected in more than half the vapor samples collected from borehole locations 54-01023 and 54-15462 during the year.
- Eleven VOCs were detected in only one or two vapor samples during the year: 1,3-butadiene; carbon tetrachloride; chloroform; cyclohexane; 1,4-dichlorobenzene; 1,2-dichloropropane; ethanol; ethylbenzene; methanol; methylene chloride; and n-heptane.
- Tritium in pore vapor was detected in 15 samples analyzed during the fourth quarter of FY2009; the activity levels in borehole locations 54-15461 and 54-15462 are generally consistent with those detected during the three previous quarterly sampling events. The tritium activity levels in borehole location 54-01023 decreased from the third quarter to levels in the same order of magnitude as the first and second quarters of FY2009.
- Tritium activity levels in pore vapor at borehole location 54-01023 were about 200 times higher than activities from borehole locations 54-15461 and 54-15462 at similar depths. Tritium activities decreased laterally within a short distance from MDA H. Tritium activity levels in borehole location 54-01023 decreased with depth. The activity levels did not decrease or increase with depth in the other two boreholes.
- The highest two tritium activity levels measured in all four quarters of FY2009 were in vapor samples collected from the top two port depths of borehole location 54-01023. The highest two tritium activity levels in FY2009 were detected in the third quarter samples collected in early May.
- Tritium levels in the outer borehole locations 54-15461 and 54-15462 are generally 150 to 400 times lower than the lowest tritium levels measured at borehole location 54-01023.

## 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.*

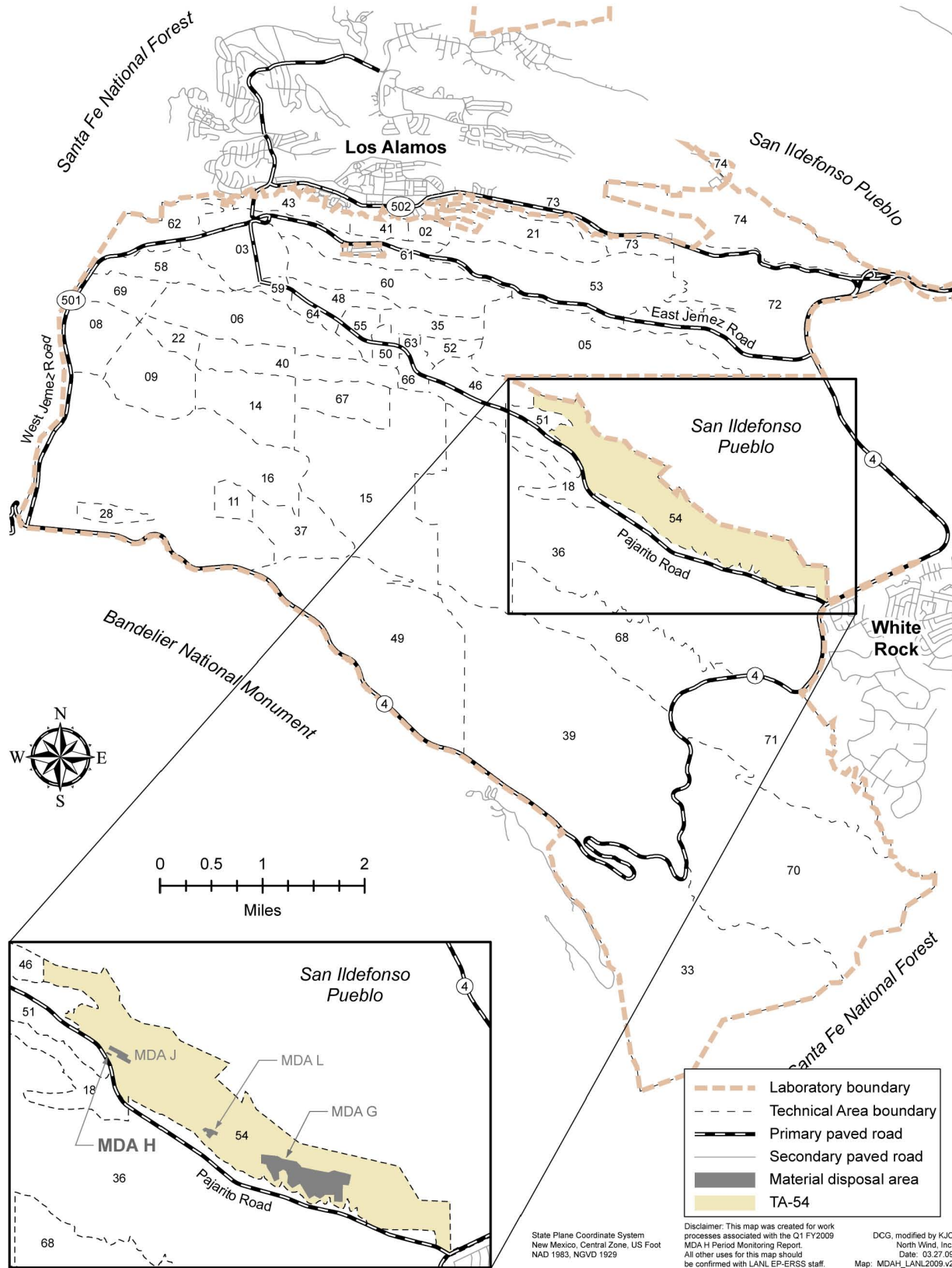
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## 7.2 Map Data Sources

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

Legend Item	Data Source
Disposal pit	Waste Storage Features; LANL, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007.
Disposal shaft	Waste Storage Features; LANL, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007.
Elevation contour	Hypsography, 10, 20, & 100 Foot Contour Intervals; LANL, ENV Environmental Remediation and Surveillance Program; 1991.
Fence	Security and Industrial Fences and Gates; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 10 September 2007.
LANL boundary	LANL Areas Used and Occupied; LANL, Site Planning & Project Initiation Group, Infrastructure Planning Division; 19 October 2008.
MDA	Materials Disposal Areas; LANL, ENV Environmental Remediation and Surveillance Program; ER2004-0221; 1:2,500 Scale Data; 23 April 2004.
Paved road	Paved Road Arcs; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 10 September 2007.
Structure	Structures; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 10 September 2007.
TA boundary	Technical Area Boundaries; LANL, Site Planning & Project Initiation Group, Infrastructure Planning Division; 19 September 2007.
Unpaved road	Dirt Road Arcs; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 10 September 2007.
Vapor-monitoring well	Point Feature Locations of the Environmental Restoration Project Database; LANL, Environment and Remediation Support Services Division, EP2007-0754; 30 November 2007.



**Figure 1.0-1 Location of MDA H in TA-54 with respect to Laboratory TAs and surrounding land holdings**

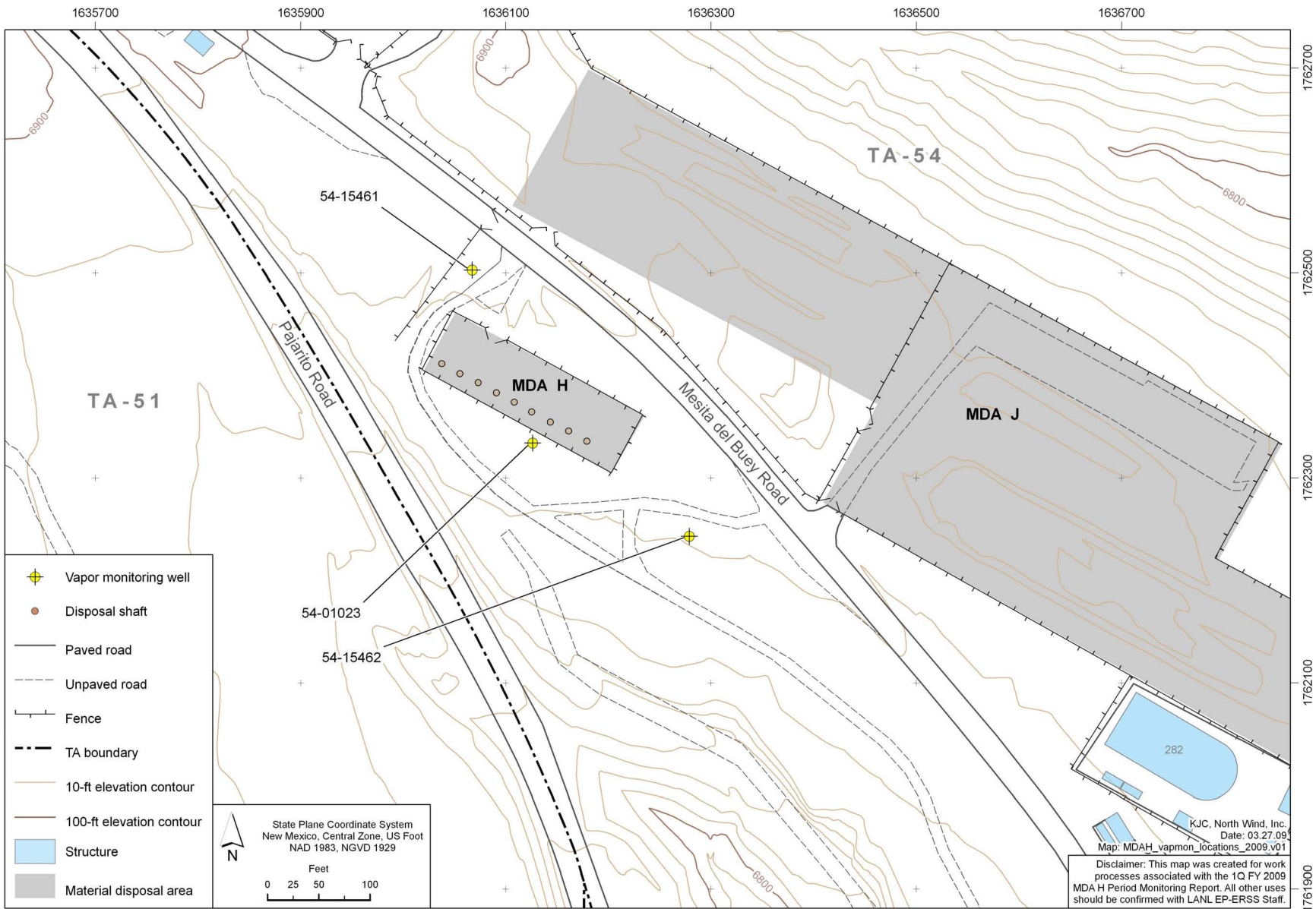


Figure 1.0-2 Locations of MDA H pore-gas monitoring boreholes



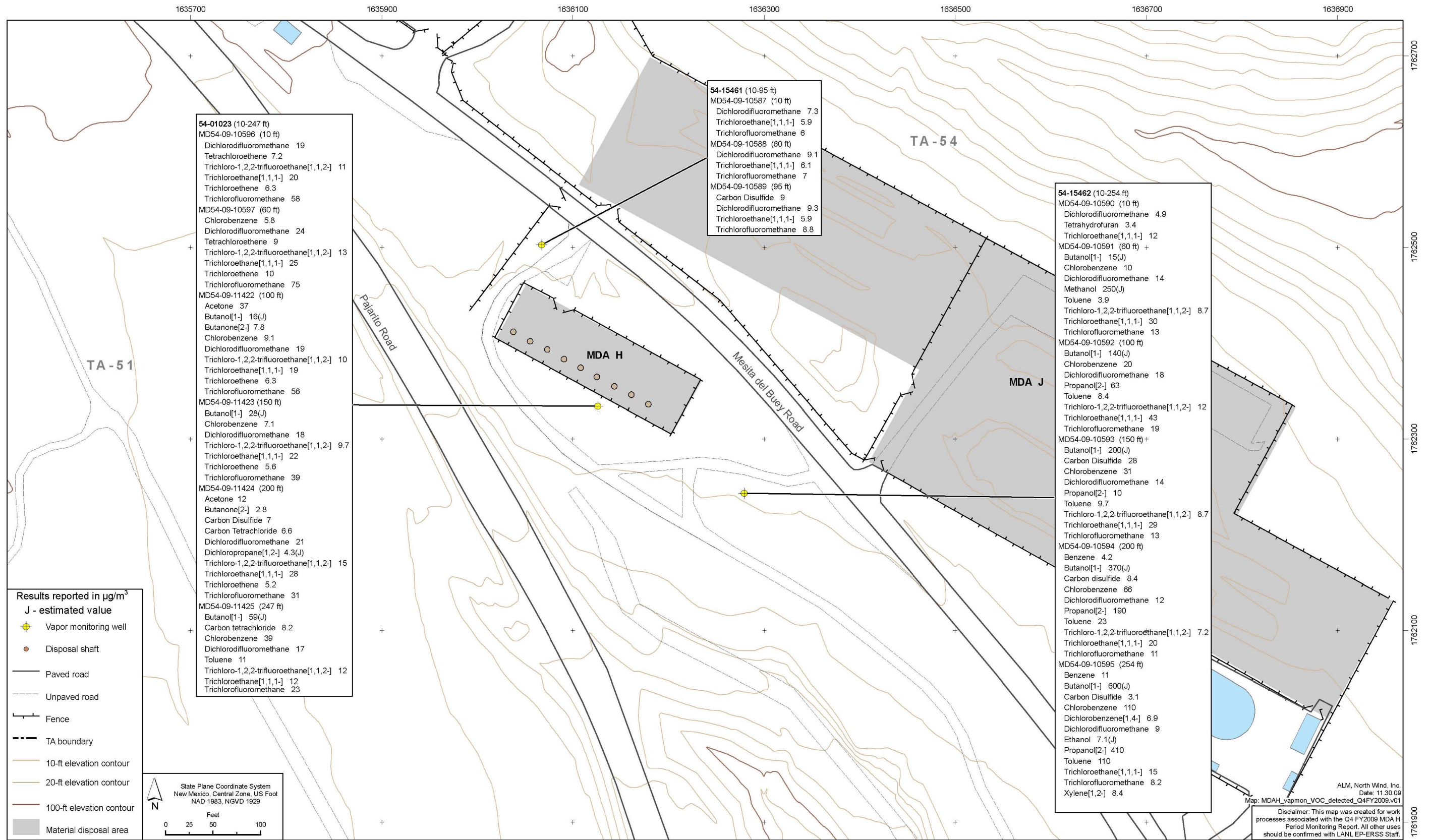


Figure 5.0-1 VOCs detected in vapor samples at MDA H



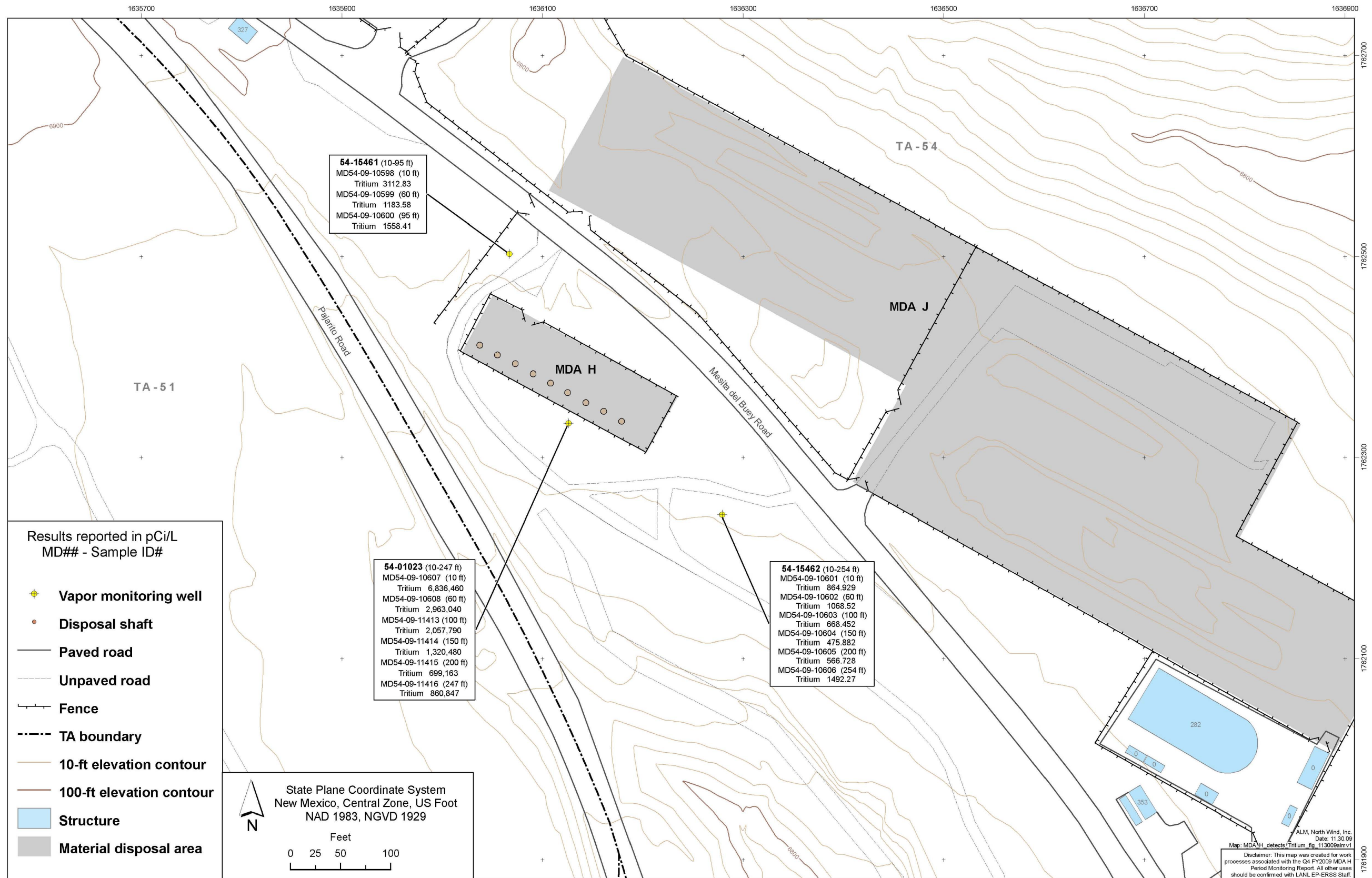


Figure 5.0-2 Tritium detected in vapor samples at MDA H



**Table 1.0-1**  
**MDA H Subsurface Vapor-Monitoring Locations**

Borehole ID	VOC and Tritium Sampling-Port Depth (ft)					
	10 (10-12)	60 (60-62)	100 (100-102)	150 (150-152)	200 (200-202)	247 (247-249)
54-01023	10 (10-12)	60 (60-62)	100 (100-102)	150 (150-152)	200 (200-202)	247 (247-249)
54-15461	10 (10-12)	60 (60-62)	95 (95-97)	—*	—	—
54-15462	10 (10-12)	60 (60-62)	100 (100-102)	150 (150-152)	200 (200-202)	254 (254-256)

Notes: Depths denote locations where VOC and tritium samples were collected. Sampling intervals are given in parentheses.

\* — = Borehole location only has three ports.

**Table 3.0-1**  
**Henry's Law Constants, Groundwater SLs, and the Calculated Concentration**  
**of Detected VOCs during FY2009 in Pore Gas Corresponding to Groundwater Standards**

VOC	Henry's Law Constant <sup>a</sup> (dimensionless)	Groundwater SL (µg/L)	Source of Groundwater SL	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard (µg/m <sup>3</sup> )
Acetone	0.0016	22,000	EPA Regional SL	35,200
Benzene	0.228	5	EPA MCL	1140
Butadiene[1,3-]	3	0.18	EPA Regional SL	540
Butanol[1-]	0.00036	3700	EPA Regional SL	1332
Butanone[2-]	0.0023	7100	EPA Regional SL	16,330
Carbon Disulfide	0.59	1000	EPA Regional SL	590,000
Carbon Tetrachloride	1.1	5	EPA MCL	5500
Chlorobenzene	0.13	100	EPA MCL	13,000
Chloroform	0.15	100	NMWQCC	15,000
Cyclohexane	6.1	13,000	EPA Regional SL	79,300,000
Dichlorobenzene[1,4-]	0.0996	75	EPA MCL	7470
Dichlorodifluoromethane	14	390	EPA Regional SL	5,460,000
Dichloroethene[1,1-]	1.1	5	NMWQCC	5500
Dichloropropane[1,2-]	0.12	5	EPA MCL	600
Ethanol	na <sup>b</sup>	na	na	na
Ethylbenzene	0.323	700	EPA MCL	226,100
Hexane	74	880	EPA Regional SL	65,120,000
Methanol	0.00019	18,000	EPA Regional SL	3420
Methylene Chloride	0.13	5	EPA MCL	650
n-Heptane	na	na	na	na
Propanol[2-]	0.00033	na	na	na
Propylene	na	na	na	na

Table 3.0-1 (continued)

VOC	Henry's Law Constant <sup>a</sup> (dimensionless)	Groundwater SL (µg/L)	Source of Groundwater SL	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard (µg/m <sup>3</sup> )
Tetrachloroethene	0.72	5	EPA MCL	3600
Tetrahydrofuran	na	na	na	na
Toluene	0.272	750	NMWQCC	204,000
Trichloro-1,2,2-trifluoroethane[1,1,2-]	22	59,000	EPA Regional SL	1,298,000,000
Trichloroethane[1,1,1-]	0.705	60	NMWQCC	42,300
Trichloroethene	0.4	5	EPA MCL	2000
Trichlorofluoromethane	4	1300	EPA Regional SL	5,200,000
Xylene[1,2-]	0.213	1400	EPA Regional SL	298,200
Xylene[1,3-]+Xylene[1,4-]	0.27	10,000 <sup>c</sup>	EPA MCL	2,700,000

Notes: Calculated concentrations in pore gas exceeding groundwater standard derived from the denominator of Equation 3.0-3.  
The SV is derived from Equation 3.0-3.

<sup>a</sup> NMED 2009, 106420, Appendix B.

<sup>b</sup> na = Not available.

<sup>c</sup> SL for xylene[1,3-]+xylene[1,4-] is for xylene mixture.

**Table 3.0-2**  
**Screening of VOCs Detected during Fourth Quarter FY2009 in Pore Gas at MDA H**

VOC	Maximum Detected Pore-Gas Concentration (µg/m <sup>3</sup> )	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard (µg/m <sup>3</sup> )	SV (unitless)	Potential for Groundwater Impact <sup>a</sup>
Acetone	37	35,200	0.001	No
Benzene	11	1140	0.0096	No
Butanol[1-]	600	1332	0.45	No
Butanone[2-]	7.8	16,330	0.00047	No
Carbon Disulfide	28	590,000	0.000048	No
Carbon Tetrachloride	8.2	5500	0.0015	No
Chlorobenzene	110	13,000	0.0085	No
Dichlorobenzene[1,4-]	6.9	7470	0.00092	No
Dichlorodifluoromethane	24	5,460,000	0.0000044	No
Dichloropropane[1,2-]	4.3	600	0.0072	No
Ethanol	7.1	na <sup>b</sup>	na	No

Table 3.0-2 (continued)

VOC	Maximum Detected Pore-Gas Concentration ( $\mu\text{g}/\text{m}^3$ )	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard ( $\mu\text{g}/\text{m}^3$ )	SV (unitless)	Potential for Groundwater Impact <sup>a</sup>
Methanol	250	3420	0.073	No
Propanol[2-]	410	na	na	No
Tetrachloroethene	9	3600	0.0025	No
Tetrahydrofuran	3.4	na	na	No
Toluene	110	204,000	0.00054	No
Trichloro-1,2,2-trifluoroethane[1,1,2-]	15	1,298,000,000	0.000000011	No
Trichloroethane[1,1,1-]	43	42,300	0.001	No
Trichloroethene	10	2000	0.005	No
Trichlorofluoromethane	75	5,200,000	0.000014	No
Xylene[1,2-]	8.4	298,200	0.000028	No

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

<sup>a</sup> If the SV is less than 1, the concentration of the VOC in pore gas does not exceed the groundwater SL and the VOC is not a threat to groundwater.

<sup>b</sup> na = Not available.

**Table 3.0-3**  
**Screening of VOCs Detected during FY2009 in Pore Gas at MDA H**

VOCs	Maximum Pore-Gas Concentration ( $\mu\text{g}/\text{m}^3$ )	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard ( $\mu\text{g}/\text{m}^3$ )	SV (unitless)	Potential for Groundwater Impact <sup>a</sup>
Acetone	720	35,200	0.02	No
Benzene	160	1140	0.14	No
Butadiene[1,3-]	23	540	0.043	No
Butanol[1-]	600	1332	0.45	No
Butanone[2-]	25	16,330	0.0015	No
Carbon Disulfide	64	590,000	0.00011	No
Carbon Tetrachloride	40	5500	0.0073	No
Chlorobenzene	110	13,000	0.0085	No
Chloroform	8.6	15,000	0.00057	No
Cyclohexane	9.4	79,300,000	0.00000012	No
Dichlorobenzene[1,4-]	6.9	7470	0.00092	No
Dichlorodifluoromethane	37	5,460,000	0.0000068	No

Table 3.0-3 (continued)

VOCs	Maximum Pore-Gas Concentration ( $\mu\text{g}/\text{m}^3$ )	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard ( $\mu\text{g}/\text{m}^3$ )	SV (unitless)	Potential for Groundwater Impact <sup>a</sup>
Dichloroethene[1,1-]	16	5500	0.0029	No
Dichloropropane[1,2-]	4.3	600	0.0072	No
Ethanol	60	na <sup>b</sup>	na	No
Ethylbenzene	6.3	226,100	0.000028	No
Hexane	38	65,120,000	0.00000058	No
Methanol	250	3420	0.073	No
Methylene Chloride	6.1	650	0.0094	No
n-Heptane	16	na	na	No
Propanol[2-]	410	na	na	No
Propylene	66	na	na	No
Tetrachloroethene	14	3600	0.0039	No
Tetrahydrofuran	17	na	na	No
Toluene	1000	204,000	0.0049	No
Trichloro-1,2,2-trifluoroethane[1,1,2-]	25	1,298,000,000	0.000000019	No
Trichloroethane[1,1,1-]	74	42,300	0.0017	No
Trichloroethene	10	2000	0.005	No
Trichlorofluoromethane	75	5,200,000	0.000014	No
Xylene[1,2-]	10	298,200	0.000034	No
Xylene[1,3-]+Xylene[1,4-]	60	2,700,000	0.000022	No

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

<sup>a</sup> If the SV is less than 1, the concentration of the VOC in pore gas does not exceed the groundwater SL and the VOC is not a threat to groundwater.

<sup>b</sup> na = Not available.

**Table 4.0-1  
Field-Screening Results Using a Landtec GEM-500 at MDA H**

Borehole ID	Port Depth (ft bgs)	Sampling-Port Interval (ft bgs)	Analyte	1st Quarter FY09		2nd Quarter FY09		3rd Quarter FY09		4th Quarter FY09	
				Date	Result (%)	Date	Result (%)	Date	Result (%)	Date	Result (%)
54-01023	Ambient	Ambient	CO <sub>2</sub>	12/3/08	0	3/11/09	0.6	4/30/09	0	8/5/09	0
			O <sub>2</sub>	12/3/08	20.8	3/11/09	21.4	4/30/09	21.7	8/5/09	21.2
	10	10–12	CO <sub>2</sub>	12/3/08	0.1	3/11/09	0.8	4/30/09	0.2	8/5/09	0.5
			O <sub>2</sub>	12/3/08	20.2	3/11/09	21.1	4/30/09	21.3	8/5/09	19.9
	60	60–62	CO <sub>2</sub>	12/3/08	0.1	3/11/09	1	4/30/09	0.4	8/5/09	0.3
			O <sub>2</sub>	12/3/08	19.9	3/11/09	21	4/30/09	21.1	8/5/09	19.9
	100	100–102	CO <sub>2</sub>	12/3/08	0.1	3/11/09	1	4/30/09	0.2	8/5/09	0.3
			O <sub>2</sub>	12/3/08	19.9	3/11/09	20.8	4/30/09	20.3	8/5/09	19.3
	150	150–152	CO <sub>2</sub>	12/3/08	0	3/11/09	0.9	4/30/09	0.1	8/5/09	0.1
			O <sub>2</sub>	12/3/08	20	3/11/09	21	4/30/09	20.2	8/5/09	19.4
	200	200–202	CO <sub>2</sub>	12/3/08	0	3/11/09	0.8	4/30/09	0.2	8/5/09	0
			O <sub>2</sub>	12/3/08	20	3/11/09	20.9	4/30/09	20	8/5/09	19.4
	247	247–249	CO <sub>2</sub>	12/3/08	0	3/11/09	0.8	4/30/09	0.2	8/5/09	0
			O <sub>2</sub>	12/3/08	20.2	3/11/09	21.1	4/30/09	20.1	8/5/09	19.7
54-15461	Ambient	Ambient	CO <sub>2</sub>	12/3/08	0	3/9/09	0	4/29/09	0	8/6/09	0
			O <sub>2</sub>	12/3/08	20.7	3/9/09	20.9	4/29/09	20.8	8/6/09	20.9
	10	10–12	CO <sub>2</sub>	12/3/08	0	3/9/09	1	4/29/09	0.3	8/6/09	0
			O <sub>2</sub>	12/3/08	20.5	3/9/09	20.7	4/29/09	20.7	8/6/09	20.4
	60	60–62	CO <sub>2</sub>	12/3/08	0.1	3/9/09	1.2	4/29/09	0.7	8/6/09	0
			O <sub>2</sub>	12/3/08	19.9	3/9/09	20.6	4/29/09	20.6	8/6/09	20.2
	95	95–97	CO <sub>2</sub>	12/3/08	0.1	3/9/09	1	4/29/09	0.7	8/6/09	0
			O <sub>2</sub>	12/3/08	19.7	3/9/09	20.7	4/29/09	20.5	8/6/09	20.1

Table 4.0-1 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Interval (ft bgs)	Analyte	1st Quarter FY09		2nd Quarter FY09		3rd Quarter FY09		4th Quarter FY09	
				Date	Result (%)	Date	Result (%)	Date	Result (%)	Date	Result (%)
54-15462	Ambient	Ambient	CO <sub>2</sub>	12/5/08	0	4/2/09	0	4/29/09	0	8/6/09	0
			O <sub>2</sub>	12/5/08	20.7	4/2/09	21.8	4/29/09	20.8	8/6/09	21.4
	10	10–12	CO <sub>2</sub>	12/5/08	NS*	4/2/09	0	4/29/09	0.5	8/6/09	0
			O <sub>2</sub>	12/5/08	20.4	4/2/09	21.9	4/29/09	20.1	8/6/09	20.7
	60	60–62	CO <sub>2</sub>	NS	NS	4/2/09	0	4/29/09	0.6	8/6/09	0
			O <sub>2</sub>	NS	NS	4/2/09	21.7	4/29/09	19.4	8/6/09	20.2
	100	100–102	CO <sub>2</sub>	12/5/08	0	4/2/09	0	4/29/09	0.5	8/6/09	0
			O <sub>2</sub>	12/5/08	20.6	4/2/09	21.7	4/29/09	19.3	8/6/09	20.1
	150	150–152	CO <sub>2</sub>	12/5/08	0	4/2/09	0	4/29/09	0.3	8/6/09	0
			O <sub>2</sub>	12/5/08	20.4	4/2/09	21.6	4/29/09	19.6	8/6/09	19.8
	200	200–202	CO <sub>2</sub>	12/5/08	0	4/2/09	0	4/29/09	0.3	8/6/09	0
			O <sub>2</sub>	12/5/08	20.4	4/2/09	22	4/29/09	19.8	8/6/09	19.4
	254	254–256	CO <sub>2</sub>	12/5/08	0	4/2/09	0	4/29/09	0.2	8/6/09	0
			O <sub>2</sub>	12/5/08	19.9	4/2/09	22.1	4/29/09	19.5	8/6/09	19.4

Note: Grey shading indicates data were rejected by NMED (2009, 105599).

\* NS = Not sampled.

**Table 4.0-2  
Field-Screening Results Using a B&K Multigas Analyzer at MDA H**

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte (Unit)	1st Quarter FY09		2nd Quarter FY09		3rd Quarter FY09		4th Quarter FY09	
				Date	Result	Date	Result	Date	Result	Date	Result
54-01023	Ambient	Ambient	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/3/08	758,000	3/11/09	872,000	4/30/09	726,000	8/5/09	1,100,000
			Freon-11 (µg/m <sup>3</sup> )	12/3/08	-401	3/11/09	178	4/30/09	-1000	8/5/09	4.17
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/3/08	5,060,000	3/11/09	3,060,000	4/30/09	19.6 <sup>a</sup>	8/5/09	11,000,000
			PCE (µg/m <sup>3</sup> )	12/3/08	-1870	3/11/09	2690	4/30/09	-4100	8/5/09	2150
			Pressure differential (kPa)	12/3/08	0	3/11/09	0	4/30/09	0	8/5/09	0
			TCA (µg/m <sup>3</sup> )	12/3/08	-4090	3/11/09	2980	4/30/09	-1100	8/5/09	1220
			TCE (µg/m <sup>3</sup> )	12/3/08	2460	3/11/09	4670	4/30/09	2610	8/5/09	1530
	10	10–12	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/3/08	9,180,000	3/11/09	9,470,000	4/30/09	5,060,000	8/5/09	16,500,000
			Freon-11 (µg/m <sup>3</sup> )	12/3/08	-481	3/11/09	-482	4/30/09	253	8/5/09	-218
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/3/08	10,500,000	3/11/09	6,710,000	4/30/09	54.2 <sup>a</sup>	8/5/09	15,100,000
			PCE (µg/m <sup>3</sup> )	12/3/08	-167	3/11/09	-2500	4/30/09	-1400	8/5/09	2450
			Pressure differential (kPa)	12/3/08	0	3/11/09	-0.03	4/30/09	0.03	8/5/09	0
			TCA (µg/m <sup>3</sup> )	12/3/08	-22,900	3/11/09	-42,000	4/30/09	-6900	8/5/09	5910
			TCE (µg/m <sup>3</sup> )	12/3/08	552,000	3/11/09	41.7	4/30/09	-1500	8/5/09	137
	60	60–62	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/3/08	9,810,000	3/11/09	15,200,000	4/30/09	6,160,000	8/5/09	11,900,000
			Freon-11 (µg/m <sup>3</sup> )	12/3/08	-246	3/11/09	-835	4/30/09	140	8/5/09	-173
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/3/08	11,300,000	3/11/09	7,650,000	4/30/09	59 <sup>a</sup>	8/5/09	13,500,000
			PCE (µg/m <sup>3</sup> )	12/3/08	765	3/11/09	-5900	4/30/09	-4200	8/5/09	2020
			Pressure differential (kPa)	12/3/08	0	3/11/09	-0.11	4/30/09	0.05	8/5/09	-0.02
			TCA (µg/m <sup>3</sup> )	12/3/08	-25,000	3/11/09	-65,000	4/30/09	-8300	8/5/09	1390
			TCE (µg/m <sup>3</sup> )	12/3/08	4200	3/11/09	-2500	4/30/09	-248	8/5/09	2200

Table 4.0-2 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte (Unit)	1st Quarter FY09		2nd Quarter FY09		3rd Quarter FY09		4th Quarter FY09	
				Date	Result	Date	Result	Date	Result	Date	Result
54-01023	100	100–102	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/3/08	8,640,000	3/11/09	13,900,000	4/30/09	3,370,000	8/5/09	10,300,000
			Freon-11 (µg/m <sup>3</sup> )	12/3/08	-321	3/11/09	-923	4/30/09	-590	8/5/09	-259
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/3/08	10,000,000	3/11/09	8,030,000	4/30/09	59 <sup>a</sup>	8/5/09	12,700,000
			PCE (µg/m <sup>3</sup> )	12/3/08	508	3/11/09	-5300	4/30/09	-1900	8/5/09	-1200
			Pressure differential (kPa)	12/3/08	-0.02	3/11/09	-0.12	4/30/09	0.05	8/5/09	-0.02
			TCA (µg/m <sup>3</sup> )	12/3/08	-23,400	3/11/09	-57,000	4/30/09	-4000	8/5/09	6300
			TCE (µg/m <sup>3</sup> )	12/3/08	4070	3/11/09	-1700	4/30/09	1580	8/5/09	1600
	150	150–152	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/3/08	6,640,000	3/11/09	12,500,000	4/30/09	3,230,000	8/5/09	7,450,000
			Freon-11 (µg/m <sup>3</sup> )	12/3/08	-498	3/11/09	-685	4/30/09	-642	8/5/09	-47
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/3/08	9,430,000	3/11/09	8,380,000	4/30/09	58.8 <sup>a</sup>	8/5/09	15,600,000
			PCE (µg/m <sup>3</sup> )	12/3/08	1170	3/11/09	-4600	4/30/09	3140	8/5/09	-1600
			Pressure differential (kPa)	12/3/08	-0.1	3/11/09	-0.3	4/30/09	0.03	8/5/09	-0.13
			TCA (µg/m <sup>3</sup> )	12/3/08	-19,700	3/11/09	-50,000	4/30/09	-4200	8/5/09	6200
			TCE (µg/m <sup>3</sup> )	12/3/08	4080	3/11/09	-1700	4/30/09	-767	8/5/09	-351
	200	200–202	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/3/08	6,430,000	3/11/09	9,790,000	4/30/09	4,380,000	8/5/09	6,450,000
			Freon-11 (µg/m <sup>3</sup> )	12/3/08	-876	3/11/09	-568	4/30/09	-483	8/5/09	-457
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/3/08	9,430,000	3/11/09	8,570,000	4/30/09	61 <sup>a</sup>	8/5/09	15,100,000
			PCE (µg/m <sup>3</sup> )	12/3/08	-473	3/11/09	-2200	4/30/09	-1800	8/5/09	686
			Pressure differential (kPa)	12/3/08	-0.05	3/11/09	-0.35	4/30/09	0	8/5/09	-0.19
			TCA (µg/m <sup>3</sup> )	12/3/08	-18,100	3/11/09	-37,000	4/30/09	-2600	8/5/09	2980
			TCE (µg/m <sup>3</sup> )	12/3/08	5030	3/11/09	-1200	4/30/09	1890	8/5/09	1980



Table 4.0-2 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte (Unit)	1st Quarter FY09		2nd Quarter FY09		3rd Quarter FY09		4th Quarter FY09	
				Date	Result	Date	Result	Date	Result	Date	Result
54-01023	247	247–249	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/3/08	6,070,000	3/11/09	8,350,000	4/30/09	4,340,000	8/5/09	5,030,000
			Freon-11 (µg/m <sup>3</sup> )	12/3/08	-315	3/11/09	-759	4/30/09	-1100	8/5/09	-498
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/3/08	10,400,000	3/11/09	8,940,000	4/30/09	58.2 <sup>a</sup>	8/5/09	13,100,000
			PCE (µg/m <sup>3</sup> )	12/3/08	-355	3/11/09	-2700	4/30/09	-3200	8/5/09	-302
			Pressure differential (kPa)	12/3/08	0.03	3/11/09	-0.29	4/30/09	0.06	8/5/09	-0.23
			TCA (µg/m <sup>3</sup> )	12/3/08	-16,000	3/11/09	-30,000	4/30/09	-1300	8/5/09	7210
			TCE (µg/m <sup>3</sup> )	12/3/08	3610	3/11/09	202	4/30/09	1730	8/5/09	3450
54-15461	Ambient	Ambient	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/3/08	630,000	3/9/09	970,000	4/29/09	774,000	8/6/09	811,000
			Freon-11 (µg/m <sup>3</sup> )	12/3/08	-68.7	3/9/09	199	4/29/09	-330	8/6/09	-40
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/3/08	4,250,000	3/9/09	7,780,000	4/29/09	30.3 <sup>a</sup>	8/6/09	9,070,000
			PCE (µg/m <sup>3</sup> )	12/3/08	2670	3/9/09	3290	4/29/09	-1100	8/6/09	1310
			Pressure differential (kPa)	12/3/08	0	3/9/09	0	4/29/09	0	8/6/09	0
			TCA (µg/m <sup>3</sup> )	12/3/08	-1440	3/9/09	-2200	4/29/09	-2700	8/6/09	-114
			TCE (µg/m <sup>3</sup> )	12/3/08	1930	3/9/09	2180	4/29/09	1110	8/6/09	2440
	10	10–12	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/3/08	3,170,000	3/9/09	10,300,000	4/29/09	6,840,000	8/6/09	6,790,000
			Freon-11 (µg/m <sup>3</sup> )	12/3/08	-533	3/9/09	-524	4/29/09	-466	8/6/09	-136
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/3/08	10,800,000	3/9/09	10,900,000	4/29/09	61.3 <sup>a</sup>	8/6/09	20,900,000
			PCE (µg/m <sup>3</sup> )	12/3/08	-2050	3/9/09	-3000	4/29/09	-533	8/6/09	1060
			Pressure differential (kPa)	12/3/08	0	3/9/09	0	4/29/09	0	8/6/09	0
			TCA (µg/m <sup>3</sup> )	12/3/08	5320	3/9/09	-43,000	4/29/09	-11,000	8/6/09	1230
			TCE (µg/m <sup>3</sup> )	12/3/08	4130	3/9/09	-1300	4/29/09	-1600	8/6/09	952,000

Table 4.0-2 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte (Unit)	1st Quarter FY09		2nd Quarter FY09		3rd Quarter FY09		4th Quarter FY09	
				Date	Result	Date	Result	Date	Result	Date	Result
54-15461	60	60–62	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/3/08	9,290,000	3/9/09	13,200,000	4/29/09	11,700,000	8/6/09	5,350,000
			Freon-11 (µg/m <sup>3</sup> )	12/3/08	-521	3/9/09	-835,000	4/29/09	-774	8/6/09	1100
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/3/08	10,200,000	3/9/09	11,600,000	4/29/09	61.8 <sup>a</sup>	8/6/09	22,600,000
			PCE (µg/m <sup>3</sup> )	12/3/08	-299	3/9/09	-5400	4/29/09	-3100	8/6/09	488
			Pressure differential (kPa)	12/3/08	0	3/9/09	0.07	4/29/09	0.02	8/6/09	0.07
			TCA (µg/m <sup>3</sup> )	12/3/08	-5850	3/9/09	-53,000	4/29/09	-14,000	8/6/09	-1700
			TCE (µg/m <sup>3</sup> )	12/3/08	4260	3/9/09	-1900	4/29/09	-618	8/6/09	-3100
	95	95–97	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/3/08	8,750,000	3/9/09	13,800,000	4/29/09	11,500,000	8/6/09	7,640,000
			Freon-11 (µg/m <sup>3</sup> )	12/3/08	-515	3/9/09	-908	4/29/09	-1600	8/6/09	-370
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/3/08	10,200,000	3/9/09	12,100,000	4/29/09	61.7 <sup>a</sup>	8/6/09	19,700,000
			PCE (µg/m <sup>3</sup> )	12/3/08	-222	3/9/09	-5200	4/29/09	-5600	8/6/09	-2000
			Pressure differential (kPa)	12/3/08	0	3/9/09	0.07	4/29/09	0.02	8/6/09	0.08
			TCA (µg/m <sup>3</sup> )	12/3/08	-8510	3/9/09	-54,000	4/29/09	-11,000	8/6/09	2270
			TCE (µg/m <sup>3</sup> )	12/3/08	4540	3/9/09	-2000	4/29/09	3450	8/6/09	13,800
54-15462	Ambient	Ambient	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/5/08	585,000	4/2/09	796,000	4/29/09	871,000	8/6/09	771,000
			Freon-11 (µg/m <sup>3</sup> )	12/5/08	-229	4/2/09	-2600	4/29/09	-1500	8/6/09	553
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/5/08	2,520,000	4/2/09	24,300	4/29/09	35.3 <sup>a</sup>	8/6/09	11,400,000
			PCE (µg/m <sup>3</sup> )	12/5/08	1590	4/2/09	5460	4/29/09	731	8/6/09	1370
			Pressure differential (kPa)	12/5/08	0	4/2/09	0	4/29/09	0	8/6/09	0
			TCA (µg/m <sup>3</sup> )	12/5/08	-1150	4/2/09	-4200	4/29/09	-6100	8/6/09	3380
			TCE (µg/m <sup>3</sup> )	12/5/08	1610	4/2/09	6080	4/29/09	1960	8/6/09	-507
54-15462	10	10–12	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/5/08	2,090,000	4/2/09	2,510,000	4/29/09	8,560,000	8/6/09	3,460,000
			Freon-11 (µg/m <sup>3</sup> )	12/5/08	-143	4/2/09	-2200	4/29/09	153	8/6/09	38.7

Table 4.0-2 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte (Unit)	1st Quarter FY09		2nd Quarter FY09		3rd Quarter FY09		4th Quarter FY09	
				Date	Result	Date	Result	Date	Result	Date	Result
54-15462	10	10-12	H <sub>2</sub> O (µg/m <sup>3</sup> )	12/5/08	6,110,000	4/2/09	54,400	4/29/09	59.8 <sup>a</sup>	8/6/09	15,600,000
			PCE (µg/m <sup>3</sup> )	12/5/08	5560	4/2/09	-3500	4/29/09	227	8/6/09	233
			Pressure differential (kPa)	12/5/08	0	4/2/09	0.15	4/29/09	0	8/6/09	0
			TCA (µg/m <sup>3</sup> )	12/5/08	-2680	4/2/09	-4400	4/29/09	-13,000	8/6/09	-5100
			TCE (µg/m <sup>3</sup> )	12/5/08	4380	4/2/09	10,500	4/29/09	-1200	8/6/09	428
	60	60-62	CO <sub>2</sub> (µg/m <sup>3</sup> )	NS <sup>b</sup>	NS	4/2/09	5,070,000	4/29/09	9,750,000	8/6/09	4,970,000
			Freon-11 (µg/m <sup>3</sup> )	NS	NS	4/2/09	-1200	4/29/09	-2400	8/6/09	-72
			H <sub>2</sub> O (µg/m <sup>3</sup> )	NS	NS	4/2/09	58,400	4/29/09	60.6 <sup>a</sup>	8/6/09	21,300,000
			PCE (µg/m <sup>3</sup> )	NS	NS	4/2/09	7870	4/29/09	1990	8/6/09	3340
			Pressure differential (kPa)	12/5/08	0.21	4/2/09	0	4/29/09	0.06	8/6/09	0
			TCE (µg/m <sup>3</sup> )	NS	NS	4/2/09	1000	4/29/09	2030	8/6/09	-699
	100	100-102	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/5/08	2,210,000	4/2/09	5,420,000	4/29/09	9,230,000	8/6/09	6,320,000
			Freon-11 (µg/m <sup>3</sup> )	12/5/08	-492	4/2/09	-2700	4/29/09	-1200	8/6/09	1250
			H <sub>2</sub> O (µg/m <sup>3</sup> )	12/5/08	4,170,000	4/2/09	53,100	4/29/09	60.7 <sup>a</sup>	8/6/09	29,500,000
			PCE (µg/m <sup>3</sup> )	12/5/08	1910	4/2/09	-1700	4/29/09	-1800	8/6/09	581
			Pressure differential (kPa)	12/5/08	0.21	4/2/09	0	4/29/09	0.02	8/6/09	0
			TCA (µg/m <sup>3</sup> )	12/5/08	-7980	4/2/09	-19,000	4/29/09	-13,000	8/6/09	-3700
			TCE (µg/m <sup>3</sup> )	12/5/08	3860	4/2/09	7080	4/29/09	1780	8/6/09	-2000
	54-15462	150	150-152	CO <sub>2</sub> (µg/m <sup>3</sup> )	12/5/08	1,930,000	4/2/09	3,450,000	4/29/09	5,990,000	8/6/09
Freon-11 (µg/m <sup>3</sup> )				12/5/08	-326	4/2/09	-589	4/29/09	-1500	8/6/09	55
H <sub>2</sub> O (µg/m <sup>3</sup> )				12/5/08	4,810,000	4/2/09	48,600	4/29/09	60.2 <sup>a</sup>	8/6/09	22,900,000
PCE (µg/m <sup>3</sup> )				12/5/08	744	4/2/09	2440	4/29/09	-941	8/6/09	519

Table 4.0-2 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte (Unit)	1st Quarter FY09		2nd Quarter FY09		3rd Quarter FY09		4th Quarter FY09	
				Date	Result	Date	Result	Date	Result	Date	Result
54-15462	150	150–152	Pressure differential (kPa)	12/5/08	-0.09	4/2/09	-0.11	4/29/09	0.04	8/6/09	0
			TCA ( $\mu\text{g}/\text{m}^3$ )	12/5/08	-6380	4/2/09	-7200	4/29/09	-14,000	8/6/09	-3900
			TCE ( $\mu\text{g}/\text{m}^3$ )	12/5/08	2390	4/2/09	2950	4/29/09	2640	8/6/09	799
	200	200–202	CO <sub>2</sub> ( $\mu\text{g}/\text{m}^3$ )	12/5/08	2,500,000	4/2/09	4,230,000	4/29/09	5,960,000	8/6/09	3,990,000
			Freon-11 ( $\mu\text{g}/\text{m}^3$ )	12/5/08	-281	4/2/09	-13,000	4/29/09	-1400	8/6/09	-1200
			H <sub>2</sub> O ( $\mu\text{g}/\text{m}^3$ )	12/5/08	5,730,000	4/2/09	50,300	4/29/09	59.7 <sup>a</sup>	8/6/09	21,200,000
			PCE ( $\mu\text{g}/\text{m}^3$ )	12/5/08	665	4/2/09	-4100	4/29/09	-2200	8/6/09	-391
			Pressure differential (kPa)	12/5/08	0	4/2/09	-0.11	4/29/09	0	8/6/09	-0.03
			TCA ( $\mu\text{g}/\text{m}^3$ )	12/5/08	-10,600	4/2/09	-17,000	4/29/09	-7100	8/6/09	-5100
			TCE ( $\mu\text{g}/\text{m}^3$ )	12/5/08	2810	4/2/09	55,900	4/29/09	4070	8/6/09	4210
	254	254–256	CO <sub>2</sub> ( $\mu\text{g}/\text{m}^3$ )	12/5/08	704,000	4/2/09	2,700,000	4/29/09	4,980,000	8/6/09	3,330,000
			Freon-11 ( $\mu\text{g}/\text{m}^3$ )	12/5/08	137	4/2/09	-11,000	4/29/09	-1600	8/6/09	-45.6
			H <sub>2</sub> O ( $\mu\text{g}/\text{m}^3$ )	12/5/08	5,710,000	4/2/09	42,400	4/29/09	59.1 <sup>a</sup>	8/6/09	20,600,000
			PCE ( $\mu\text{g}/\text{m}^3$ )	12/5/08	4710	4/2/09	2060	4/29/09	-510	8/6/09	-291
			Pressure differential (kPa)	12/5/08	-0.25	4/2/09	-0.03	4/29/09	0	8/6/09	-0.05
			TCA ( $\mu\text{g}/\text{m}^3$ )	12/5/08	-5320	4/2/09	-5400	4/29/09	7700	8/6/09	-133
			TCE ( $\mu\text{g}/\text{m}^3$ )	12/5/08	-772	4/2/09	46,600	4/29/09	3930	8/6/09	512

Notes: All results for first quarter FY2009 reported in  $\mu\text{g}/\text{m}^3$  were converted from ppm assuming 1 atmosphere and 25°C ( $\mu\text{g}/\text{m}^3 = [\text{ppm} * (\text{g}/\text{mol}) / 25] * 1000$ ). All results for second, third, and fourth quarters FY2009 reported in  $\mu\text{g}/\text{m}^3$  were converted from  $\text{mg}/\text{m}^3$ . The B&K detection threshold is gas dependent; reliable values are typically above 1 ppm (1000 to 7000  $\mu\text{g}/\text{m}^3$  depending on the analyte). Grey shading indicates data were rejected by NMED (2009, 105599).

<sup>a</sup> Results presented in Tdew (dew point).

<sup>b</sup> NS = Not sampled.

**Table 5.0-1**  
**Pore-Gas VOCs Detected at MDA H, Fourth Quarter FY2009 and Three Previous Quarters**

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte	1st Quarter FY09			2nd Quarter FY09			3rd Quarter FY09			4th Quarter FY09		
				Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )
54-01023	10	10-12	Acetone	12/3/08	ND <sup>a</sup>	ND	3/11/09	5	12	4/30/09	ND	ND	8/5/09	ND	ND
			Butanone[2-]	12/3/08	ND	ND	3/11/09	ND	ND	4/30/09	4.1	12	8/5/09	ND	ND
			Carbon Disulfide	12/3/08	1.2	3.7	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	ND	ND
			Dichlorodifluoromethane	12/3/08	3.1	16	3/11/09	3.1	15	4/30/09	1.7	8.3	8/5/09	3.8	19
			Tetrachloroethene	12/3/08	ND	ND	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	1.1	7.2
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	12/3/08	0.76	5.8	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	1.4	11
			Trichloroethane[1,1,1-]	12/3/08	0.74	4	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	3.7	20
			Trichloroethene	12/3/08	ND	ND	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	1.2	6.3
			Trichlorofluoromethane	12/3/08	7.5	42	3/11/09	7.1	40	4/30/09	2.9	16	8/5/09	10	58
	60	60-62	Acetone	12/3/08	6	14	3/11/09	5.5	13	4/30/09	ND	ND	8/5/09	ND	ND
			Butanol[1-]	12/3/08	30	92	3/11/09	11 (J)	32 (J)	4/30/09	4.9 (J)	15 (J)	8/5/09	ND	ND
			Butanone[2-]	12/3/08	1.3	3.8	3/11/09	ND	ND	4/30/09	3.4	10	8/5/09	ND	ND
			Carbon Disulfide	12/3/08	21	64	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	ND	ND
			Chlorobenzene	12/3/08	2.4	11	3/11/09	ND	ND	4/30/09	1.1	5	8/5/09	1.2	5.8
			Dichlorodifluoromethane	12/3/08	4.5	22	3/11/09	5	25	4/30/09	2.1	10	8/5/09	4.8	24
			Tetrachloroethene	12/3/08	0.83	5.6	3/11/09	1	6.9	4/30/09	ND	ND	8/5/09	1.3	9
			Toluene	12/3/08	0.87	3.3	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	ND	ND
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	12/3/08	1.4	11	3/11/09	1.2	9.3	4/30/09	ND	ND	8/5/09	1.7	13
			Trichloroethane[1,1,1-]	12/3/08	3.1	17	3/11/09	2.7	15	4/30/09	ND	ND	8/5/09	4.5	25
Trichloroethene	12/3/08	1.2	6.3	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	1.9	10			
Trichlorofluoromethane	12/3/08	9.3	52	3/11/09	11	61	4/30/09	3.9	22	8/5/09	13	75			

Table 5.0-1 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte	1st Quarter FY09			2nd Quarter FY09			3rd Quarter FY09			4th Quarter FY09		
				Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )
54-01023	100	100–102	Acetone	12/3/08	5.2	12	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	16	37
			Butanol[1-]	12/3/08	18	56	3/11/09	6.4	20	4/30/09	9.2 (J)	28 (J)	8/5/09	5.2 (J)	16 (J)
			Butanone[2-]	12/3/08	ND	ND	3/11/09	ND	ND	4/30/09	2.8	8.3	8/5/09	2.7	7.8
			Chlorobenzene	12/3/08	3.6	16	3/11/09	0.93	4.3	4/30/09	2	9.2	8/5/09	2	9.1
			Dichlorodifluoromethane	12/3/08	4.3	21	3/11/09	5.4	27	4/30/09	1.2	6.2	8/5/09	3.9	19
			Dichloroethene[1,1-]	12/3/08	ND	ND	3/11/09	1.3	5	4/30/09	ND	ND	8/5/09	ND	ND
			Tetrachloroethene	12/3/08	ND	ND	3/11/09	0.9	6.1	4/30/09	ND	ND	8/5/09	ND	ND
			Tetrahydrofuran	12/3/08	ND	ND	3/11/09	ND	ND	4/30/09	5.9	17	8/5/09	ND	ND
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	12/3/08	1.4	11	3/11/09	1.7	13	4/30/09	ND	ND	8/5/09	1.4	10
			Trichloroethane[1,1,1-]	12/3/08	3.4	18	3/11/09	2.5	14	4/30/09	ND	ND	8/5/09	3.5	19
			Trichloroethene	12/3/08	0.94	5	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	1.2	6.3
			Trichlorofluoromethane	12/3/08	8.4	47	3/11/09	11	64	4/30/09	1.8	10	8/5/09	10	56
	150	150–152	Acetone	12/3/08	ND	ND	3/11/09	4.6	11	4/30/09	ND	ND	8/5/09	ND	ND
			Butanol[1-]	12/3/08	32	97	3/11/09	15	45	4/30/09	19 (J)	57 (J)	8/5/09	9.3 (J)	28 (J)
			Butanone[2-]	12/3/08	ND	ND	3/11/09	1.1	3.2	4/30/09	ND	ND	8/5/09	ND	ND
			Chlorobenzene	12/3/08	2.6	12	3/11/09	1.3	5.9	4/30/09	2.5	11	8/5/09	1.5	7.1
			Dichlorodifluoromethane	12/3/08	3.7	18	3/11/09	4.8	24	4/30/09	1.3	6.4	8/5/09	3.7	18
			Dichloroethene[1,1-]	12/3/08	ND	ND	3/11/09	1.4	5.4	4/30/09	ND	ND	8/5/09	ND	ND
			Toluene	12/3/08	ND	ND	3/11/09	1.5	5.6	4/30/09	ND	ND	8/5/09	ND	ND
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	12/3/08	1.3	9.7	3/11/09	1.6	12	4/30/09	ND	ND	8/5/09	1.3	9.7
			Trichloroethane[1,1,1-]	12/3/08	3.6	19	3/11/09	2.5	14	4/30/09	ND	ND	8/5/09	4	22
			Trichloroethene	12/3/08	ND	ND	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	1	5.6
Trichlorofluoromethane	12/3/08	5.8	33	3/11/09	9.2	52	4/30/09	1.6	9	8/5/09	7	39			

Table 5.0-1 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte	1st Quarter FY09			2nd Quarter FY09			3rd Quarter FY09			4th Quarter FY09		
				Date	Result (ppbv)	Result (µg/m³)	Date	Result (ppbv)	Result (µg/m³)	Date	Result (ppbv)	Result (µg/m³)	Date	Result (ppbv)	Result (µg/m³)
54-01023	200	200–202	Acetone	12/3/08	ND	ND	3/11/09	5	12	4/30/09	ND	ND	8/5/09	5	12
			Butanone[2-]	12/3/08	ND	ND	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	0.95	2.8
			Carbon Disulfide	12/3/08	ND	ND	3/11/09	ND	ND	4/30/09	2.8	8.6	8/5/09	2.2	7
			Carbon Tetrachloride	12/3/08	1.2	7.6	3/11/09	1.1	7	4/30/09	ND	ND	8/5/09	1	6.6
			Dichlorodifluoromethane	12/3/08	4.2	21	3/11/09	5.8	29	4/30/09	1.8	8.8	8/5/09	4.2	21
			Dichloroethene[1,1-]	12/3/08	ND	ND	3/11/09	2.1	8.4	4/30/09	ND	ND	8/5/09	ND	ND
			Dichloropropane[1,2-]	12/3/08	ND	ND	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	0.93 (J)	4.3 (J)
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	12/3/08	1.7	13	3/11/09	2.4	19	4/30/09	ND	ND	8/5/09	2	15
			Trichloroethane[1,1,1-]	12/3/08	3.7	20	3/11/09	3.7	20	4/30/09	ND	ND	8/5/09	5.2	28
			Trichloroethene	12/3/08	ND	ND	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	0.97	5.2
	Trichlorofluoromethane	12/3/08	4.8	27	3/11/09	6.7	38	4/30/09	1.9	11	8/5/09	5.5	31		
	247	247–249	Butanol[1-]	12/3/08	70	210	3/11/09	32	98	4/30/09	37 (J)	110 (J)	8/5/09	19 (J)	59 (J)
			Carbon Tetrachloride	12/3/08	1.2	7.8	3/11/09	1.1	7	4/30/09	ND	ND	8/5/09	1.3	8.2
			Chlorobenzene	12/3/08	9.6	44	3/11/09	4.8	22	4/30/09	7	32	8/5/09	8.4	39
			Dichlorodifluoromethane	12/3/08	3.4	17	3/11/09	4.3	21	4/30/09	1.6	7.8	8/5/09	3.5	17
			Methylene Chloride	12/3/08	ND	ND	3/11/09	ND	ND	4/30/09	1.8	6.1	8/5/09	ND	ND
			Tetrachloroethene	12/3/08	2.1	14	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	ND	ND
			Toluene	12/3/08	1.2	4.6	3/11/09	0.98	3.7	4/30/09	ND	ND	8/5/09	3	11
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	12/3/08	1.3	10	3/11/09	1.6	12	4/30/09	ND	ND	8/5/09	1.5	12
			Trichloroethane[1,1,1-]	12/3/08	1.9	10	3/11/09	1.3	7	4/30/09	ND	ND	8/5/09	2.3	12
Trichloroethene			12/3/08	0.89 (J)	4.8 (J)	3/11/09	ND	ND	4/30/09	ND	ND	8/5/09	ND	ND	
Trichlorofluoromethane	12/3/08	4.4	25	3/11/09	4.6	26	4/30/09	1.7	9.8	8/5/09	4.1	23			

Table 5.0-1 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte	1st Quarter FY09			2nd Quarter FY09			3rd Quarter FY09			4th Quarter FY09		
				Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )
54-15461	10	10-12	Acetone	12/3/08	3.8	9.2	3/9/09	ND	ND	4/29/09	ND	ND	8/6/09	ND	ND
			Carbon Disulfide	12/3/08	ND	ND	3/9/09	2.2	6.7	4/29/09	ND	ND	8/6/09	ND	ND
			Dichlorodifluoromethane	12/3/08	ND	ND	3/9/09	2.6	13	4/29/09	1.2	5.8	8/6/09	1.5	7.3
			Toluene	12/3/08	ND	ND	3/9/09	ND	ND	4/29/09	2.1	8	8/6/09	ND	ND
			Trichloroethane[1,1,1-]	12/3/08	ND	ND	3/9/09	1.3	7.3	4/29/09	ND	ND	8/6/09	1.1	5.9
			Trichlorofluoromethane	12/3/08	ND	ND	3/9/09	1.6	9	4/29/09	ND	ND	8/6/09	1.1	6
	60	60-62	Carbon Disulfide	12/3/08	ND	ND	3/9/09	1.4	4.3	4/29/09	2	6.2	8/6/09	ND	ND
			Dichlorodifluoromethane	12/3/08	3.2	16	3/9/09	3.2	16	4/29/09	3.3	16	8/6/09	1.8	9.1
			Trichloroethane[1,1,1-]	12/3/08	1.8	9.9	3/9/09	1.8	9.7	4/29/09	1.4	7.7	8/6/09	1.1	6.1
			Trichlorofluoromethane	12/3/08	2.3	13	3/9/09	2.3	13	4/29/09	2.6	14	8/6/09	1.2	7
	95	95-97	Acetone	12/3/08	ND	ND	3/9/09	11	27	4/29/09	ND	ND	8/6/09	ND	ND
			Butanone[2-]	12/3/08	ND	ND	3/9/09	1.8	5.3	4/29/09	ND	ND	8/6/09	ND	ND
			Carbon Disulfide	12/3/08	ND	ND	3/9/09	ND	ND	4/29/09	ND	ND	8/6/09	2.9	9
Dichlorodifluoromethane			12/3/08	3.4	17	3/9/09	3.5	17	4/29/09	3.4	16	8/6/09	1.9	9.3	
Trichloroethane[1,1,1-]			12/3/08	1.8	10	3/9/09	2	11	4/29/09	1.4	7.4	8/6/09	1.1	5.9	
Trichlorofluoromethane			12/3/08	2.6	14	3/9/09	2.9	16	4/29/09	2.7	15	8/6/09	1.6	8.8	
54-15462	10	10-12	Acetone	12/5/08	ND	ND	4/2/09	10	25	4/29/09	ND	ND	8/6/09	ND	ND
			Benzene	12/5/08	50	160	4/2/09	4.9	16	4/29/09	ND	ND	8/6/09	ND	ND
			Butadiene[1,3-]	12/5/08	10	23	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	ND	ND
			Butanone[2-]	12/5/08	ND	ND	4/2/09	2.8	8.4	4/29/09	ND	ND	8/6/09	ND	ND
			Cyclohexane	12/5/08	ND	ND	4/2/09	2.7	9.4	4/29/09	ND	ND	8/6/09	ND	ND
			Dichlorodifluoromethane	12/5/08	ND	ND	4/2/09	1.7	8.6	4/29/09	3.4	17	8/6/09	1	4.9
			Dichloroethene[1,1-]	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	1.6	6.6	8/6/09	ND	ND
			Ethylbenzene	12/5/08	ND	ND	4/2/09	1.3	5.8	4/29/09	ND	ND	8/6/09	ND	ND



Table 5.0-1 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte	1st Quarter FY09			2nd Quarter FY09			3rd Quarter FY09			4th Quarter FY09		
				Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )
54-15462	10	10-12	Hexane	12/5/08	11	38	4/2/09	2.5	8.8	4/29/09	ND	ND	8/6/09	ND	ND
			n-Heptane	12/5/08	ND	ND	4/2/09	1.4	6	4/29/09	ND	ND	8/6/09	ND	ND
			Propanol[2-]	12/5/08	ND	ND	4/2/09	96	240	4/29/09	ND	ND	8/6/09	ND	ND
			Propylene	12/5/08	38	66	4/2/09	10	18	4/29/09	ND	ND	8/6/09	ND	ND
			Tetrahydrofuran	12/5/08	ND	ND	4/2/09	1.6	4.6	4/29/09	ND	ND	8/6/09	1.1	3.4
			Toluene	12/5/08	45	170	4/2/09	280	1000	4/29/09	5.4	20	8/6/09	ND	ND
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	1.4	11	8/6/09	ND	ND
			Trichloroethane[1,1,1-]	12/5/08	ND	ND	4/2/09	1.7	9.5	4/29/09	4.6	25	8/6/09	2.3	12
			Trichlorofluoromethane	12/5/08	ND	ND	4/2/09	1.1	6.1	4/29/09	3	17	8/6/09	ND	ND
			Xylene[1,2-]	12/5/08	ND	ND	4/2/09	1.8	7.6	4/29/09	ND	ND	8/6/09	ND	ND
			Xylene[1,3-]+Xylene[1,4-]	12/5/08	14	60	4/2/09	3.5	15	4/29/09	ND	ND	8/6/09	ND	ND
	60	60-62	Acetone	NS <sup>b</sup>	NS	NS	4/2/09	35	84	4/29/09	ND	ND	8/6/09	ND	ND
			Butanol[1-]	NS	NS	NS	4/2/09	12	37	4/29/09	7 (J)	21 (J)	8/6/09	4.9 (J)	15 (J)
			Butanone[2-]	NS	NS	NS	4/2/09	4.8	14	4/29/09	ND	ND	8/6/09	ND	ND
			Carbon Disulfide	NS	NS	NS	4/2/09	6.5	20	4/29/09	ND	ND	8/6/09	ND	ND
			Chlorobenzene	NS	NS	NS	4/2/09	1.3	5.9	4/29/09	1.8	8.4	8/6/09	2.2	10
			Dichlorodifluoromethane	NS	NS	NS	4/2/09	4.1	20	4/29/09	6.6	32	8/6/09	2.8	14
			Dichloroethene[1,1-]	NS	NS	NS	4/2/09	ND	ND	4/29/09	3.9	15	8/6/09	ND	ND
			Methanol	NS	NS	NS	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	190 (J)	250 (J)
			Propanol[2-]	NS	NS	NS	4/2/09	92	230	4/29/09	ND	ND	8/6/09	ND	ND
			Tetrahydrofuran	NS	NS	NS	4/2/09	2.5	7.3	4/29/09	ND	ND	8/6/09	ND	ND
			Toluene	NS	NS	NS	4/2/09	45	170	4/29/09	1.4	5.3	8/6/09	1	3.9
Trichloro-1,2,2-trifluoroethane[1,1,2-]	NS	NS	NS	4/2/09	1.5	11	4/29/09	2.8	22	8/6/09	1.1	8.7			

Table 5.0-1 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte	1st Quarter FY09			2nd Quarter FY09			3rd Quarter FY09			4th Quarter FY09		
				Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )
54-15462	60	60-62	Trichloroethane[1,1,1-]	NS	NS	NS	4/2/09	5.3	29	4/29/09	10	56	8/6/09	5.5	30
			Trichlorofluoromethane	NS	NS	NS	4/2/09	2.8	16	4/29/09	5.7	32	8/6/09	2.4	13
			Xylene[1,3-]+Xylene[1,4-]	NS	NS	NS	4/2/09	0.89	3.9	4/29/09	ND	ND	8/6/09	ND	ND
	100	100-102	Acetone	12/5/08	ND	ND	4/2/09	30	70	4/29/09	10	24	8/6/09	ND	ND
			Benzene	12/5/08	17	54	4/2/09	0.85 (J)	2.7 (J)	4/29/09	ND	ND	8/6/09	ND	ND
			Butadiene[1,3-]	12/5/08	3.2	7	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	ND	ND
			Butanol[1-]	12/5/08	ND	ND	4/2/09	18	53	4/29/09	14 (J)	41 (J)	8/6/09	47 (J)	140 (J)
			Butanone[2-]	12/5/08	ND	ND	4/2/09	4.2	12	4/29/09	1.7	5.1	8/6/09	ND	ND
			Chlorobenzene	12/5/08	ND	ND	4/2/09	2.3	10	4/29/09	2.8	13	8/6/09	4.4	20
			Dichlorodifluoromethane	12/5/08	1.5	7.5	4/2/09	3.9	19	4/29/09	7	35	8/6/09	3.6	18
			Dichloroethene[1,1-]	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	4.1	16	8/6/09	ND	ND
			Ethylbenzene	12/5/08	1.4	6.3	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	ND	ND
			Hexane	12/5/08	8.7	31	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	ND	ND
			n-Heptane	12/5/08	3.8	16	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	ND	ND
			Propanol[2-]	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	20	50	8/6/09	26	63
			Propylene	12/5/08	16	27	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	ND	ND
			Tetrahydrofuran	12/5/08	ND	ND	4/2/09	2.9	8.4	4/29/09	ND	ND	8/6/09	ND	ND
			Toluene	12/5/08	19	70	4/2/09	22	84	4/29/09	1.7	6.5	8/6/09	2.2	8.4
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	12/5/08	ND	ND	4/2/09	1.4	11	4/29/09	3.1	24	8/6/09	1.6	12
			Trichloroethane[1,1,1-]	12/5/08	ND	ND	4/2/09	6	33	4/29/09	14	74	8/6/09	7.8	43
			Trichloroethene	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	1	5.4	8/6/09	ND	ND
Trichlorofluoromethane	12/5/08	1.1	6.1	4/2/09	2.8	16	4/29/09	6.4	36	8/6/09	3.4	19			
Xylene[1,2-]	12/5/08	0.93	4	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	ND	ND			
Xylene[1,3-]+Xylene[1,4-]	12/5/08	3.5	15	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	ND	ND			

Table 5.0-1 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte	1st Quarter FY09			2nd Quarter FY09			3rd Quarter FY09			4th Quarter FY09		
				Date	Result (ppbv)	Result (µg/m³)	Date	Result (ppbv)	Result (µg/m³)	Date	Result (ppbv)	Result (µg/m³)	Date	Result (ppbv)	Result (µg/m³)
54-15462	150	150–152	Acetone	12/5/08	ND	ND	4/2/09	49	120	4/29/09	11	27	8/6/09	ND	ND
			Benzene	12/5/08	0.89	2.8	4/2/09	1.2	3.7	4/29/09	ND	ND	8/6/09	ND	ND
			Butanol[1-]	12/5/08	ND	ND	4/2/09	29	89	4/29/09	29 (J)	88 (J)	8/6/09	67 (J)	200 (J)
			Butanone[2-]	12/5/08	ND	ND	4/2/09	0.89	2.6	4/29/09	2	5.9	8/6/09	ND	ND
			Carbon Disulfide	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	8.8	28
			Chlorobenzene	12/5/08	ND	ND	4/2/09	5.2	24	4/29/09	6.6	30	8/6/09	6.8	31
			Dichlorodifluoromethane	12/5/08	1.4	7	4/2/09	3.1	15	4/29/09	7.4	37	8/6/09	2.8	14
			Dichloroethene[1,1-]	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	3.5	14	8/6/09	ND	ND
			Propanol[2-]	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	4	10
			Toluene	12/5/08	ND	ND	4/2/09	31	120	4/29/09	3.1	12	8/6/09	2.6	9.7
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	12/5/08	ND	ND	4/2/09	1.1	8.4	4/29/09	3.3	25	8/6/09	1.1	8.7
			Trichloroethane[1,1,1-]	12/5/08	ND	ND	4/2/09	3.3	18	4/29/09	9.8	54	8/6/09	5.3	29
			Trichloroethene	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	0.89 (J)	4.8 (J)	8/6/09	ND	ND
	Trichlorofluoromethane	12/5/08	1	5.8	4/2/09	1.9	11	4/29/09	5.8	32	8/6/09	2.4	13		
	200	200–202	Acetone	12/5/08	6	14	4/2/09	33	78	4/29/09	9	21	8/6/09	ND	ND
			Benzene	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	1.3	4.3	8/6/09	1.3	4.2
			Butanol[1-]	12/5/08	ND	ND	4/2/09	42	130	4/29/09	53 (J)	160 (J)	8/6/09	120 (J)	370 (J)
			Butanone[2-]	12/5/08	1	3	4/2/09	5.7	17	4/29/09	ND	ND	8/6/09	ND	ND
			Carbon Disulfide	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	2.7	8.4
			Chlorobenzene	12/5/08	ND	ND	4/2/09	6.2	29	4/29/09	13	60	8/6/09	14	66
			Dichlorodifluoromethane	12/5/08	2	9.7	4/2/09	4.5	22	4/29/09	7.1	35	8/6/09	2.4	12
			Dichloroethene[1,1-]	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	2.8	11	8/6/09	ND	ND
			Ethanol	12/5/08	ND	ND	4/2/09	32	60	4/29/09	ND	ND	8/6/09	ND	ND

Table 5.0-1 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte	1st Quarter FY09			2nd Quarter FY09			3rd Quarter FY09			4th Quarter FY09		
				Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )	Date	Result (ppbv)	Result ( $\mu\text{g}/\text{m}^3$ )
54-15462	200	200–202	Propanol[2-]	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	110	280	8/6/09	78	190
			Tetrahydrofuran	12/5/08	ND	ND	4/2/09	2.9	8.4	4/29/09	ND	ND	8/6/09	ND	ND
			Toluene	12/5/08	ND	ND	4/2/09	53	200	4/29/09	5.6	21	8/6/09	6.2	23
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	3.1	24	8/6/09	0.95	7.2
			Trichloroethane[1,1,1-]	12/5/08	ND	ND	4/2/09	5	27	4/29/09	9.7	53	8/6/09	3.7	20
			Trichloroethene	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	0.96	5.1	8/6/09	ND	ND
			Trichlorofluoromethane	12/5/08	1.5	8.3	4/2/09	2.8	15	4/29/09	5.3	30	8/6/09	1.9	11
	254	254–256	Acetone	12/5/08	4.3	10	4/2/09	300	720	4/29/09	ND	ND	8/6/09	ND	ND
			Benzene	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	1.9	6.2	8/6/09	3.5	11
			Butanol[1-]	12/5/08	ND	ND	4/2/09	50	150	4/29/09	67 (J)	200 (J)	8/6/09	200 (J)	600 (J)
			Butanone[2-]	12/5/08	ND	ND	4/2/09	8.4	25	4/29/09	3.9	11	8/6/09	ND	ND
			Carbon Disulfide	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	1	3.1
			Carbon Tetrachloride	12/5/08	6.4	40	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	ND	ND
			Chlorobenzene	12/5/08	ND	ND	4/2/09	11	49	4/29/09	17	79	8/6/09	25	110
Chloroform	12/5/08		1.8	8.6	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	ND	ND		
Dichlorobenzene[1,4-]	12/5/08		ND	ND	4/2/09	ND	ND	4/29/09	0.95	5.7	8/6/09	1.1	6.9		
Dichlorodifluoromethane	12/5/08		4.5	22	4/2/09	ND	ND	4/29/09	6.6	33	8/6/09	1.8	9		
Ethanol	12/5/08		ND	ND	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	3.8 (J)	7.1 (J)		
Propanol[2-]	12/5/08		ND	ND	4/2/09	ND	ND	4/29/09	ND	ND	8/6/09	170	410		
Propylene	12/5/08		ND	ND	4/2/09	ND	ND	4/29/09	6.1	10	8/6/09	ND	ND		
Toluene	12/5/08		2.2	8.3	4/2/09	200	750	4/29/09	210	800	8/6/09	28	110		

Table 5.0-1 (continued)

Borehole ID	Port Depth (ft bgs)	Sampling-Port Depth or Interval (ft bgs)	Analyte	1st Quarter FY09			2nd Quarter FY09			3rd Quarter FY09			4th Quarter FY09		
				Date	Result (ppbv)	Result (µg/m <sup>3</sup> )	Date	Result (ppbv)	Result (µg/m <sup>3</sup> )	Date	Result (ppbv)	Result (µg/m <sup>3</sup> )	Date	Result (ppbv)	Result (µg/m <sup>3</sup> )
54-15462	254	254–256	Trichloro-1,2,2-trifluoroethane[1,1,2-]	12/5/08	2	15	4/2/09	ND	ND	4/29/09	2.7	21	8/6/09	ND	ND
			Trichloroethane[1,1,1-]	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	6.9	38	8/6/09	2.8	15
			Trichlorofluoromethane	12/5/08	3.3	19	4/2/09	ND	ND	4/29/09	4.4	25	8/6/09	1.5	8.2
			Xylene[1,2-]	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	2.3	10	8/6/09	1.9	8.4
			Xylene[1,3-]+Xylene[1,4-]	12/5/08	ND	ND	4/2/09	ND	ND	4/29/09	1.3	5.7	8/6/09	ND	ND

Note: See Appendix A for data qualifier definitions. Grey shading indicates data were rejected by NMED (2009, 105599).

<sup>a</sup> ND = Not detected.

<sup>b</sup> NS = Not sampled.

**Table 5.0-2  
Tritium Pore-Vapor Results at MDA H**

Borehole ID	Port Depth (ft bgs)	Sampling Port Depth or Interval (ft bgs)	1st Quarter FY09		2nd Quarter FY09		3rd Quarter FY09		4th Quarter FY09	
			Date	Result (pCi/L)	Date	Result (pCi/L)	Date	Result (pCi/L)	Date	Result (pCi/L)
54-01023	10	10–12	12/12/08	4,977,760	3/10/09	4,635,190	5/4/09	16,424,700	8/6/09	6,836,460
	60	60–62	12/12/08	5,020,150	3/10/09	3,998,480	5/4/09	9,284,720	8/6/09	2,963,040
	100	100–102	12/12/08	1,017,050	3/10/09	2,337,200	5/4/09	5,507,850	8/6/09	2,057,790
	150	150–152	12/12/08	1,024,600	3/10/09	1,155,930	5/4/09	2,382,130	8/6/09	1,320,480
	200	200–202	12/12/08	1,080,790	3/10/09	1,244,830	5/4/09	2,149,850	8/6/09	699,163
	247	247–249	12/12/08	944,477	3/10/09	746,273	5/11/09	ND <sup>a</sup>	8/6/09	860,847
54-15461	10	10–12	12/11/08	2563.72	3/11/09	2369.83	4/30/09	4937.48	8/7/09	3112.83
	60	60–62	12/11/08	619.131	3/11/09	8706.76	4/30/09	937.567	8/10/09	1183.58
	95	95–97	12/11/08	712.751	3/11/09	21,854.8	4/30/09	621.228	8/7/09	1558.41
54-15462	10	10–12	12/11/08	671.623	4/6/09	ND	5/1/09	1161.33	8/7/09	864.929
	60	60–62	NS <sup>b</sup>	NS	4/6/09	ND	5/1/09	1130.24	8/7/09	1068.52
	100	100–102	12/11/08	361.468	4/6/09	ND	5/1/09	904.313	8/10/09	668.452
	150	150–152	12/11/08	6223.58	4/3/09	ND	5/4/09	701.119	8/7/09	475.882
	200	200–202	12/11/08	333.554	4/3/09	369.9	5/4/09	797.65	8/7/09	566.728
	254	254–256	12/11/08	1119.1	4/3/09	ND	5/1/09	1026.2	8/10/09	1492.27

<sup>a</sup> ND = Not detected.

<sup>b</sup> NS = Not sampled.

# **Appendix A**

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





## A-1.0 ACRONYMS AND ABBREVIATIONS

B&K	Brüel and Kjær
bgs	below ground surface
CAS	Chemical Abstract Service
DCE	1,1-dichloroethylene
DER	duplicate error ratio
EPA	Environmental Protection Agency (U.S.)
eV	electron volt
FLUTe	Flexible Liner Underground Technology
FY	fiscal year
kPa	kilopascal
LANL	Los Alamos National Laboratory
LCS	laboratory control sample
MCL	maximum contaminant level
MDA	material disposal area
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
PCE	tetrachloroethene
PID	photoionization detector
QA	quality assurance
QC	quality control
RPD	relative percent difference
RPF	Records Processing Facility
SL	screening level
SV	screening value
SOP	standard operating procedure
SOW	statement of work
TA	technical area
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TPU	total propagated uncertainty
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 ( $\mu\text{m}$ )	0.000394	inches (in.)
square kilometers ( $\text{km}^2$ )	0.3861	square miles ( $\text{mi}^2$ )
hectares (ha)	2.5	acres
square meters ( $\text{m}^2$ )	10.764	square feet ( $\text{ft}^2$ )
cubic meters ( $\text{m}^3$ )	35.31	cubic feet ( $\text{ft}^3$ )
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter ( $\text{g}/\text{cm}^3$ )	62.422	pounds per cubic foot ( $\text{lb}/\text{ft}^3$ )
milligrams per kilogram (mg/kg)	1	parts per million (ppm)
micrograms per gram ( $\mu\text{g}/\text{g}$ )	1	parts per million (ppm)
liters (L)	0.26	gallons (gal.)
milligrams per liter (mg/L)	1	parts per million (ppm)
degrees Celsius ( $^{\circ}\text{C}$ )	$9/5 + 32$	degrees Fahrenheit ( $^{\circ}\text{F}$ )

**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**

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*Quality Assurance/Quality Control Program*



## **B-1.0 INTRODUCTION**

This appendix discusses analytical methods and data quality review and summarizes the effects of data quality exceptions on the acceptability of the analytical laboratory data collected at Material Disposal Area H during the fourth quarter of fiscal year (FY) 2009.

Quality assurance (QA), quality control (QC), and data validation procedures were implemented in accordance with the Los Alamos National Laboratory (LANL or the Laboratory) "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, blank spikes, matrix spikes, laboratory control samples (LCS), internal standards, initial and continuing calibrations, and surrogates, were used to assess laboratory accuracy and bias.

The type and frequency of QC analyses are described in the analytical services contract. Other QC factors, such as sample preservation and holding times, were also assessed. The requirements for sample preservation and holding times are given in standard operating procedure (SOP) ER-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 procedures used for data validation are listed in Table B-1.0-1. Copies of the raw analytical data, laboratory logbooks, and instrument printouts are provided in data packages as part of Appendix C (on CD included with this document).

Analytical data were reviewed and evaluated based on U.S. Environmental Protection Agency (EPA) National Functional Guidelines, where applicable (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 some of the analytical records.

### **B-1.1 Maintenance of Chain of Custody**

To maintain chain of custody is to document or demonstrate the possession of an item by only authorized individuals. The chain-of-custody process, described in EP-ERSS-SOP-5058, Chain of Custody for Analytical Data Record Packages, provides confidence in and documentation of analytical data integrity by establishing the traceability of the sample from the time of collection through processing to final maintenance as a record. The chain-of-custody forms are provided in Appendix C (on CD).

### **B-1.2 Sample Documentation**

Establishing sample documentation acceptability, described in EP-ERSS-SOP-5058, is the first step toward verifying an analytical system has produced data of known quality. Documentation depends on the accessibility of review items that accurately and completely describe the work performed. In the absence of adequate sample documentation, data quality cannot be independently verified.

### **B-1.3 Sample Preservation**

Sample preservation is the use of specific types of sample containers and preservation techniques, as described in EP-ERSS-SOP-5056, Sample Containers and Preservation. Sample preservation is

mandatory for hazardous site investigations because the integrity of any sample decreases over time. Physical factors (light, pressure, temperature, etc.), chemical factors (changes in pH, volatilization, etc.), and biological factors may alter the original quality of a sample. Because the various target parameters are uniquely altered at varying rates, distinct sample containers, preservation techniques, and holding times have been established to maintain sample integrity for a reasonable and acceptable period of time.

#### **B-1.4 Holding Time**

Holding time, the maximum amount of time a sample can be stored without unacceptable changes in analyte concentrations, is described in EP-ERSS-SOP-5056. Extraction holding time refers to the time that elapses between sample collection and sample preparation; analytical holding time refers to the time that elapses between sample preparation and analysis.

#### **B-1.5 Initial and Continuing Calibration Verification (Including Interference-Check Standards)**

Calibration verification establishes a quantitative relationship between the response of the analytical procedure and the concentration of the target analyte. There are two aspects of calibration verification: initial and continuing. The initial calibration verifies the accuracy of the calibration curve and the individual calibration standards being used to perform the calibration. The continuing calibration ensures that the initial calibration is still holding and correct as the instrument is used to process samples. Interference-check samples are used to determine if a high concentration of a single analyte in a sample interferes with the accurate quantitation of other analytes.

#### **B-1.6 Analyte Identification (Including Spectra Review and Thermal Ionization Cavity Review)**

Analyte identification is the process of associating an instrument signal with a compound or analyte of interest. Evaluation of signal retention times, spectral overlap, multiplex pattern matching, and mass spectral library searches are tools for making analyte identification determinations.

#### **B-1.7 Analyte Quantitation**

Analyte quantitation is the association of an instrument signal with a concentration and the determination that a recorded signal is detected or not detected. Detection limits, instrument calibration linear ranges, and internal standards are tools for making analyte quantitation evaluations.

Organic chemical results are not detected if reported results are less than or equal to the method detection limit adjusted by sample-specific dilution or concentration factors.

Radionuclide results reported at less than the minimum detectable activity are not detected (U). Each radiochemical result is also compared to the corresponding 1-sigma total propagated uncertainty (TPU). If the result is less than 3 times the TPU, it is also qualified as U.

#### **B-1.8 Method Blank**

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as those used in the environmental sample processing and which 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. All target analytes should be below the contract-required detection limit in the method blank (LANL 2000, 071233).

### **B-1.9 Matrix Spike Recoveries**

A matrix spike is an aliquot of sample spiked with a known concentration of the target analyte(s). Matrix spike samples are used to measure the ability to recover prescribed analytes from a native sample matrix. Spiking typically occurs before sample preparation and analysis. Acceptable percentage recoveries for matrix spikes vary by method but should generally be greater than 10% for an analytical result to be usable (LANL 2000, 071233).

### **B-1.10 Surrogate Recoveries**

A surrogate (an organic chemical compound) is similar in composition and behavior to target analytes but is not typically found in environmental samples. Surrogates are added to every blank, sample, and spike to evaluate the efficiency with which target analytes are recovered during extraction and analysis. The recovery percentages of the surrogates vary by method but should generally be greater than 10% for an analytical result to be usable (LANL 2000, 071233).

### **B-1.11 Internal Standard Responses**

Internal standards are chemical compounds that are added to blank, sample, and standard extracts at known concentrations. They are used to compensate for (1) analyte concentration changes that might occur during storage of the extract, and (2) quantitation variations that can occur during analysis. Internal standard responses are used to adjust the reported concentrations for the quantitation of target analytes. The response factors for internal standards vary by method but should generally be within the range of  $\geq 50\%$  to  $\leq 200\%$  (LANL 2000, 071233).

### **B-1.12 LCS Recoveries**

An LCS is a known matrix that has been spiked with compound(s) that are representative of the target analytes. The LCS is used to document laboratory performance. The acceptance criteria for LCSs are method-specific, but should generally be greater than 10% for an analytical result to be usable (LANL 2000, 071233).

### **B-1.13 Laboratory and Field Duplicates (Including Serial Dilutions)**

Laboratory duplicates are two portions of a sample taken from the same sample container (prepared for analysis and analyzed independently but under identical conditions) used to assess or demonstrate acceptable laboratory-method precision at the time of analysis. Each duplicate sample is equally representative of the original material. Duplicate analyses are also performed to generate data and to determine the long-term precision of an analytical method on various matrices. All relative percent differences (RPDs) between samples and field duplicates should be  $\pm 35\%$  (LANL 2000, 071233). The RPD is defined by the equation  $RPD = [(D1 - D2) / (D1 + D2)] \times 100\%$ , where D1 and D2 represent the analytical measurements on duplicate samples.

For radionuclides, the duplicate error ratio (DER) may also be used to quantify precision. The DER is defined by the equation  $DER = |S - D| / \sqrt{(2\sigma_S^2 + 2\sigma_D^2)}$ , where S represents the original sample value, D represents the duplicate value, and  $2\sigma_S$  and  $2\sigma_D$  represent the 2-sigma uncertainties surrounding the original and duplicate samples, respectively. A DER below 3 indicates sample-to-field-duplicate precision that is in control.

Field duplicates are independent samples collected as closely as possible at the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently.

Serial dilution checks are performed for certain inorganic analyses to determine if dilutions have been prepared correctly, and to identify any effects that may arise from characteristics of the sample matrix.

#### **B-1.14 Field Blanks**

A field blank is a sample of analyte-free medium taken to the sampling site and exposed to the atmosphere during sample-collection activities. Field blanks are used to measure contamination introduced during sample collection.

### **B-2.0 LABORATORY ANALYSIS SUMMARY**

During the fourth quarter FY2009, 15 pore gas volatile organic compound (VOC) samples, 2 VOC field duplicates, 2 VOC field blanks, 3 VOC equipment blanks, 15 tritium samples, 2 tritium field duplicates, and 2 tritium field blanks were collected at Solid Waste Management Unit 54-004, also known as Material Disposal Area (MDA) H. Analyses for VOCs were performed using EPA Method TO-15 and for tritium using EPA Method 906.0. All QC procedures were followed as required by the analytical services SOW (LANL 2000, 071233). Table B-2.0-1 lists the analytical methods used for VOC and tritium analyses.

Sampling locations, sampling ports, and validated analytical results are presented in Tables 5.0-1 and 5.0-2 of the periodic monitoring report. The data, including the qualified data, are usable for evaluation purposes.

The tritium and VOCs analyses are summarized in the following sections. The required minimum detectable activity or estimated quantitation limit is prescribed in the analytical services SOW (LANL 2000, 071233).

### **B-3.0 ORGANIC CHEMICAL ANALYSES**

All VOC data were accepted. No VOC data were rejected.

#### **B-3.1 Maintenance of Chain of Custody**

Chain of custody was properly maintained for all samples.

#### **B-3.2 Sample Documentation**

All samples were properly documented in the field.

#### **B-3.3 Sample Preservation**

No sample preservation is required for VOCs.

#### **B-3.4 Holding Time**

The holding times were met for all samples.



### **B-3.5 Initial and Continuing Calibration Verification**

Initial calibration criteria were not met for 20 VOC results. Affected analytes were analyzed with an initial calibration curve that exceeded the %RSD criteria and/or the associated multipoint calibration correlation coefficient was <0.995. Six affected results were qualified as estimated (J) and 14 were qualified as estimated not detected (UJ)

Initial or continuing calibration verification was recovered outside the method-specific limits for 25 VOC results. Twenty-one affected results were qualified as estimated not detected (UJ) and four were qualified as estimated.

### **B-3.6 Analyte Identification (Including Internal Standards and Spectra Review)**

Analyte identification criteria were met for all sample analyses.

### **B-3.7 Method Blank**

Method blank results for VOC analyses were within acceptable limits for all results.

### **B-3.8 Surrogate Recoveries**

All surrogate recoveries for VOC analyses were within acceptable limits.

### **B-3.9 Internal Standard Responses**

All internal standard responses for VOC analyses were within acceptable limits.

### **B-3.10 LCS Recoveries**

LCS recoveries were within acceptable limits for all VOC results.

### **B-3.11 Laboratory and Field Duplicates**

One field duplicate collected at borehole location 54-15461 at 95 ft bgs had an RPD greater than 35% for carbon disulfide. One field duplicate collected at borehole location 54-15462 at 60 ft bgs had an RPD greater than 35% for butanol [1-]. Table B-3.11-1 presents the RPD for these two samples and their field duplicates for the analytes greater than 35%.

### **B-3.12 Field Blanks and Equipment Blanks**

Two field blanks collected on August 6, 2009, from borehole locations 54-15461 and 54-15462 contained detectable traces of acetone and butanone(2-). Sixteen sampling results, nine for acetone and seven for butanone(2-), were detected but at concentrations less than or equal to 5 times the concentration for the related analyte in the trip blank and were qualified as not detected (U).

## **B-4.0 RADIOCHEMICAL ANALYSES**

All tritium data were accepted. No tritium data were rejected.

#### **B-4.1 Maintenance of Chain of Custody**

Chain of custody was properly maintained for all samples.

#### **B-4.2 Sample Documentation**

Samples were properly documented in the field.

#### **B-4.3 Sample Preservation**

No sample preservation is required for tritium.

#### **B-4.4 Holding Times**

The holding times were met for all tritium analyses.

#### **B-4.5 Method Blanks**

Method blank results were within acceptable limits for all tritium analyses.

#### **B-4.6 LCS Recoveries**

The LCS recoveries were within acceptable limits for all tritium analyses.

#### **B-4.7 Field Duplicates**

Laboratory duplicate analyses indicate acceptable precision for all tritium analyses. The two field duplicates collected during the fourth quarter of FY2009 had DERs less than 3.

#### **B-4.8 Field Blanks and Equipment Blanks**

Field blanks did not contain detectable levels of tritium.

### **B-5.0 FIELD-MONITORING SUMMARY**

#### **B-5.1 Volatile Organic Compounds**

Field-monitoring data are less costly to generate than analytical laboratory data and are immediately available to guide field decisions. Field-monitoring results are generated by rapid methods of analysis that provide less precision than laboratory analyses. Field-monitoring data provide analyte (or at least chemical class) identification and quantification, although the quantification may be relatively imprecise.

Field monitoring of subsurface vapor monitoring at MDA H is conducted using guidance provided in ER-ERSS-SOP-5074, Sampling of Sub-Atmospheric Air. This procedure covers the use of the Brüel and Kjær (B&K) Type 1302 multigas analyzer and the Landtec GEM 500 photoionization detector (PID).

The B&K is maintained through calibration and changing or cleaning of filters as needed. The B&K is calibrated before use each quarter by a certified calibration laboratory. The B&K is adjusted before each day's use to compensate for ambient pressure and temperature. A daily operational check is conducted through the analysis of ambient air readings and triplicate readings of known quantities of organic

analytes in nitrogen. These verification check analyses confirm analytical stability, the instrument zero point for each analyte is correctly set, and the stored calibration curve remains applicable to current instrument response to the presence of organic chemicals. Concentrations of gas standards analyzed before each day's use are expected to be within  $\pm 20\%$  of their known values. Additionally, during each sample analysis, a low-sample flow condition will trigger an alarm on the B&K and the VOC measurement is not completed.

The presence of nontarget VOCs bias B&K target analytes may skew results if they have an acoustic response to infrared light similar to the target analyte. Trichlorofluoromethane (Freon-11) generates a measurable acoustic signal in response to light with a wavelength of 11.6  $\mu\text{m}$  proportional to its concentration. Other VOCs generating an acoustic signal to light at this wavelength include (Freon-114) (Chemical Abstract Service [CAS] 76-14-2; 1,2-dichloro-1,1,2,2-tetrafluoroethane) and Freon-21 (CAS 75-43-4, dichlorofluoromethane), neither of which is reported by EPA Method TO-15. Tetrachloroethene (PCE) generates an acoustic signal in response to light with a wavelength of 11.1  $\mu\text{m}$ . Other VOCs responding to light at this wavelength include styrene (CAS 100-42-5) and (Freon-113) (CAS 76-13-1, 1,1,2-trichloro-1,2,2-trifluoroethane), neither of which is reported by EPA Method TO-15; Freon-12 (CAS 75-71-8, dichlorodifluoromethane); ethanol (CAS 64-17-5); and 1,1-dichloroethylene (DCE) (CAS 75-35-4). Results indicate that DCE and Freon-113 are detected in most samples at MDA H at concentrations that generate a measurable acoustic signal in response to light with a wavelength included in the acoustic signal interpreted as PCE, which may make the PCE readings appear higher on the B&K. Table B-5.1-1 presents VOCs that interfere with each of the four B&K target analytes.

Data generated using the B&K Type 1302 are supported by calibration records that bracket the periods of analyses. Calibration information is reported below for the B&K Type 1302 photoacoustic analyzer used to generate results presented in this periodic monitoring report.

- On June 15, 2009, the B&K with serial number 1732805 was calibrated before the fourth quarter monitoring event. The zero points were set for 1,1,1-trichloroethane (TCA), trichloroethene (TCE), Freon-11, PCE, carbon dioxide ( $\text{CO}_2$ ), and water vapor. Span concentrations of TCA at 10.4 ppm, TCE at 19.46 ppm, Freon-11 at 3.8 ppm, PCE at 21.4 ppm, and  $\text{CO}_2$  at 2.5 ppm were used to generate calibration response curves.
- After the fourth quarter monitoring event, the B&K with serial number 1732805 was calibrated.

The Landtec GEM 500 PID is calibrated by a certified calibration laboratory. During calibration, methane ( $\text{CH}_4$ ), oxygen ( $\text{O}_2$ ), and  $\text{CO}_2$  zero points are set, and each analyte's calibration response curves is developed. The  $\text{CH}_4$  reading is filtered to an infrared absorption frequency of 3.41  $\mu\text{m}$  (nominal), the frequency specific to hydrocarbon bonds. Landtec instruments are calibrated using certified  $\text{CH}_4$  mixtures and will give correct readings, provided no other hydrocarbon gases present are present within the sample (e.g., ethane, propane, butane). If other hydrocarbons are present, the  $\text{CH}_4$  reading will be higher (never lower) than the actual  $\text{CH}_4$  concentration being monitored. The extent to which the  $\text{CH}_4$  reading is affected depends upon the concentration of the  $\text{CH}_4$  in the sample and the concentration of the other hydrocarbons. The effect of other hydrocarbons is nonlinear and difficult to predict. The  $\text{CO}_2$  reading is filtered to an infrared absorption frequency of 4.29  $\mu\text{m}$  (nominal), the frequency specific to  $\text{CO}_2$ . Therefore, any other gases usually found on landfill sites will not affect the  $\text{CO}_2$  reading. The  $\text{O}_2$  sensor is a galvanic cell type and suffers no influence from  $\text{CO}_2$ , hydrogen sulfide, nitrate, sulfide, or hydrogen.

Calibration is confirmed before each day's use through the analysis of multiple readings of ambient air. Zero readings of  $\text{CH}_4$  and  $\text{CO}_2$  are expected.  $\text{O}_2$  is expected to read 20.9%, and readings within  $\pm 25\%$  of 20.9%  $\text{O}_2$  are considered acceptable.

Data generated using the Landtec GEM-500 PID is supported by calibration records that arrive with the rented instrument previous to the period of analyses. Calibration is performed by Geotech's Colorado Service Center in Denver, Colorado. Calibration information is reported below for the Landtec PID used to generate results presented in this periodic monitoring report.

- Unit 915 was calibrated on June 26, 2009. The zero points were set for CH<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub>. Calibration was performed so that CH<sub>4</sub> and CO<sub>2</sub> reached  $\pm 15\%$  of a known concentration, and O<sub>2</sub> was set to read ambient air at 20.9%. Pump flow was confirmed to be 500 cc/min.

## **B-5.2 Tritium**

Silica gel is the medium used at the Laboratory to collect moisture from pore-vapor samples. This moisture is analyzed for tritium using 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. This drying removes moisture from the silica gel but does not remove bound water. The amount of silica gel used in each sample is weighed before the sample is collected (typically about 135 g). The sample canister with silica gel is weighed before sampling. The sampling procedure, EP-ERSS-SOP-5074, Sampling of Sub-Atmospheric Air, requires collecting at least 5 g of moisture. After sampling, the sample canister with silica gel is weighed again to verify that 5 grams of water vapor has been collected.

The sample (canister plus silica gel) is shipped to the analytical laboratory where the canister with the 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 using the percent moisture value determined by the analytical laboratory (Marczak 2009, 106500). Tritium results presented in this report have been corrected for bound-water dilution.

## **B-6.0 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 New Mexico Environment Department 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), 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), 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 B-1.0-1  
Data Validation Procedures**

Procedure	Title	Effective Date
SOP-1561, Rev. 0	Routine Validation of Volatile Organic Compound (VOC) Analytical Data	6/10/2008
SOP-1566, Rev. 0	Routine Validation of Gamma Spectroscopy, Chemical Separation Alpha Spectrometry, Gas Proportional Counting, and Liquid Scintillation Analytical Data	6/30/2008

**Table B-2.0-1  
Analytical Methods Used for Sample Analyses**

Analytical Method	Analytical Description	Target Compound List
EPA Method TO-15	VOCs in pore gas	See analytical services SOW (LANL 2000, 071233)
EPA Method 906.0	Tritium in pore gas	Tritium

**Table B-3.11-1  
Sample Record with Field Duplicate RPD above 35%**

Borehole ID	Depth (ft)	Analyte	FD Quant Limit ( $\mu\text{g}/\text{m}^3$ )	FD Result ( $\mu\text{g}/\text{m}^3$ )	Std Quant Limit ( $\mu\text{g}/\text{m}^3$ )	Sample Result ( $\mu\text{g}/\text{m}^3$ )	RPD
54-15461	95	Carbon Disulfide	2.8	120	2.7	9	86%
54-15462	60	Butanol [1-]	11	89	11	15	71%

**Table B-5.1-1  
B&K Target Analytes  
and Potential Interfering Analytes**

<b>Target</b>	<b>Potential Interfering Analyte</b>
PCE	Styrene
PCE	Freon-113
PCE	Freon-12
PCE	DCE
PCE	Ethylene oxide
PCE	Ethanol
PCE	DipropylNitrosamine
PCE	1,1-Dimethylhydrazine
PCE	1,4-Diethylene dioxide
PCE	Cyclohexene
PCE	tert-Butyl alcohol
PCE	m-Vinyltoluene
PCE	Vinyl chloride
PCE	Tetrahydrofurane
PCE	Silicium tetrafluoride
PCE	Nitromethane
PCE	Nitrogen trifluoride
PCE	$\alpha$ -Methylstyrene
PCE	Monomethyl hydrazine
PCE	Methyl iodide
PCE	n-Hexane
PCE	Acetic anhydride
PCE	1,3-Butadiene
Freon-11	Freon-114
Freon-11	Freon-21
Freon-11	Carbonyl sulphide
Freon-11	Methyl acetate
Freon-11	Chloropicrine
Freon-11	Cyclohexane
Freon-11	Dimethylnitrosamine
Freon-11	Epichlorohydrine
Freon-11	Ethane
Freon-11	Ethylene oxide
Freon-11	Ethyl formate
Freon-11	2-Nitropropane



Table B-5.1-1 (continued)

Target	Potential Interfering Analyte
Freon-11	Phosgene
Freon-11	Vinyl acetate
TCA	Fluorobenzene
TCA	Ethyl benzene
TCA	Dimethyl formamide
TCA	Dichloromethane
TCA	1,2-Dichloroethane
TCA	o-Dichlorobenzene
TCA	Dibutyl phthalate
TCA	Chloromethane
TCA	m-Xylene
TCA	1,1,2-Trichloroethane
TCA	o-Toluidine
TCA	Toluene
TCA	Phenol
TCA	Chlorobenzene
TCA	Carbon dioxide
TCA	Boron trifluoride
TCA	Aniline
TCA	Acetophenone
TCA	Hydrogen cyanide
TCA	n-Heptane
TCE	Arsine
TCE	Butanone
TCE	1,2-Difluoroethane
TCE	Diethyl ketone
TCE	Dinitrogen difluoride
TCE	2-Pentanone
TCE	2-Propanol
TCE	Sulfur hexafluoride
TCE	Vinyl chloride



## **Appendix C**

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

