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Periodic Monitoring Report for Vapor-Sampling Activities at Material Disposal Area V, Consolidated Unit 21-018(a)-99, at Technical Area 21, June to October 2009

Los Alamos
NATIONAL LABORATORY
EST. 1943

Prepared by the Environmental Programs Directorate

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EXECUTIVE SUMMARY

This periodic monitoring report summarizes the drilling and first quarter sampling results of the vapor-monitoring activities conducted June to October 2009 at Material Disposal Area (MDA) V, Consolidated Unit 21-018(a)-99, within Technical Area 21 at Los Alamos National Laboratory. The objective of vapor monitoring at MDA V is to characterize the extent of subsurface tritium. This report presents the results obtained during the monitoring well installation, sampling activities, and a separate borehole abandonment activity during this field effort.

MDA V has been sampled previously for tritium in subsurface pore gas in 2005 and 2006. During these sampling events, location 21-24524 reported a maximum-detected tritium activity of 271,192 pCi/L at total depth (TD) of 380 ft below the location of the former absorption beds. In June 2006, this borehole was plugged and abandoned in accordance with the approved MDA V investigation work plan. The open borehole, location 21-02523, was abandoned as part of first quarter monitoring activities.

To define the vertical extent of tritium and to measure tritium activities over time, two new vapor-monitoring wells (wells 21-24524W and 21-24524S) fitted with a total of nine vapor-monitoring ports were installed within 10 ft of borehole location 21-24524. During drilling of these boreholes, rock-core samples were collected and analyzed for inorganic chemicals, geotechnical properties, and tritium activity. Single-packer and monitoring-port vapor samples were collected and analyzed for tritium activity. Geotechnical parameters were analyzed to obtain subsurface characteristics of DP Mesa.

Monitoring data are presented and discussed in this report, and summarized as follows:

- Rock-core analyses indicated that tritium activity decreased to nondetect at TD (714 to 715 ft below ground surface [bgs]).
- Single-packer sample analyses indicated that tritium activity decreased to nondetect at TD (717 to 721) ft bgs.
- Vapor-port sample analyses indicated that tritium activity decreased to 1713 pCi/L at TD (712.5 to 717.5 ft bgs).
- Rock-core analyses indicated that chloride, fluoride, and perchlorate were detected at low concentrations.

Quarterly sampling of vapor-monitoring wells 21-24524W and 21-24524S will continue for a minimum of three additional quarters.

CONTENTS

Appendixes

1.0 INTRODUCTION

This periodic monitoring report presents the results of the drilling and first quarter vapor monitoring conducted from June to October 2009 at Material Disposal Area (MDA) V, Consolidated Unit 21-018(a)-99, located on Delta Prime (DP) Mesa in Technical Area 21 (TA-21) at Los Alamos National Laboratory (LANL or the Laboratory) (Figure 1.0-1). It also addresses sampling and analysis conducted during installation of the two new vapor-monitoring wells and the abandonment of one older steel-cased open borehole. These activities were conducted per the requirements outlined in the New Mexico Environment Department (NMED) approved MDA V vapor-monitoring well installation work plan (LANL 2009, 106760; LANL 2009, 105645; NMED 2009, 105691; NMED 2009, 106455). Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with U.S. Department of Energy (DOE) policy.

The objective of MDA V drilling and vapor-monitoring activities is to characterize the extent of subsurface tritium contamination beneath the three former absorption beds. From 1945 to 1961, these absorption beds received wastewater from the DP site laundry facility and wastewater research laboratory, which discharged about 6,000,000 gal. per yr. The absorption beds and laundry facility have been removed. Periodic vapor monitoring will provide data to characterize the extent of subsurface tritium contamination. This data will also contribute to a better understanding of the geohydrology of the vadose zone below TA-21 and will assist in characterizing the extent of subsurface tritium (LANL 2009, 106760).

MDA V was sampled previously for subsurface tritium as part of the 2005 site investigation (LANL 2007, 098942). The maximum tritium activity (45,334 pCi/L) was detected in borehole location 21-24524, between absorption beds 1 and 2, at a depth of 14 to 15 ft below ground surface (bgs). Figure 1.0-2 shows the location of vapor-monitoring wells 21-24524, 21-24524W and 21-24524S at MDA V. In 2006, the maximum tritium activity (271,192 pCi/L) was detected in borehole location 21-24524 at total depth (TD), which was 380 ft below the former absorption beds. In June 2006, borehole 21-24524 was plugged and abandoned in accordance with the approved MDA V investigation work plan (LANL 2004, 087358). Since the highest tritium activity was detected at TD, the vertical extent of tritium beneath the former absorption beds was not defined.

To define the vertical extent of tritium and to measure tritium activity over time, new vapor-monitoring wells were installed in 2009 within 10 ft of the location of 21-24524. Figure 1.0-3 shows a schematic design of the vapor-monitoring wells. These wells retained the location identification number of 21-24524, but with an additional designation of west (21-24524W) and south (21-24524S) to indicate their locations relative to former location 21-24524 (Figure 1.0-2). Borehole 21-24524W was drilled to 400 ft bgs and 21-24524S was drilled to 721 ft bgs. Borehole location 21-24524W has seven ports and borehole location 21-24524S has two ports.

A secondary objective of the sampling and analysis of rock-core samples collected during the drilling of the vapor-monitoring well was to obtain properties of chemical and geotechnical materials which may be used for assessing the vadose zone characteristics of DP Mesa.

Sampling activities are presented in section 2, including deviations from the NMED-approved vapor-monitoring plan (LANL 2009, 106760; NMED 2009, 107304). Sample collection and analyses for tritium activity included rock-core samples, single-packer samples, and monitoring well vapor-port samples. Rock-core chemical and geotechnical analyses included saturated and unsaturated hydraulic conductivity tests, soil density, gravimetric and volumetric moisture content, anions, and perchlorate. section 3 discusses the regulatory criteria. The field-screening results are presented in section 4.

Analytical results of samplings are presented and evaluated in section 5, followed by a summary in section 6. Appendices include Appendix A, Acronyms, Abbreviations, Metric Conversion Table, and Data Qualifier Definitions; Appendix B, Field Methods; Appendix C, Quality Assurance (QA)/Quality Control (QC) Program; Appendix D, Investigation-Derived Waste; and Appendix E, Analytical Suites and Results, Analytical Reports, Sample Collection Logs, and Chain of Custody Forms (on CD).

1.1 Site Location and Description

MDA V (Consolidated Unit 21-018(a)-99) is located within TA-21 on DP Mesa. This MDA included three cobble- and gravel-filled absorption beds measuring 25 ft × 220 ft × 5 to 6 ft (Figure 1.0-1) that were removed in 2005 and replaced by soil covered with aggregate-based graveled pavement and native grasses. The entire MDA V site measures approximately 0.88 acres in size. The recently constructed haul road for MDA B runs along the northwest perimeter.

The edge of BV Canyon, which is a tributary to Los Alamos Canyon, is approximately 75 ft from the location of the former absorption beds. The entire site was regraded following sampling and removal activities in 2005 and has best management practices installed, including straw waddles and revegetation with native grass seed. The top of the regional aquifer is approximately 1300 ft bgs at MDA V, based on proximal water-level information from regional wells R-7, Otowi-4, and R-8 (LANL 2004, 087358; Kleinfelder 2005, 091693).

The MDA V investigation report (LANL 2007, 098942) presents further details regarding historical operations and past investigation activities.

2.0 SCOPE OF ACTIVITIES

As directed by the NMED-approved MDA V vapor-monitoring well installation work plan (LANL 2009, 106760; NMED 2009, 107304), drilling and monitoring well installation, sampling activities, and separate borehole abandonment activities have been completed. Rock-core samples were collected during drilling of the monitoring wells and analyzed for tritium, perchlorate, bromide, chloride, fluoride, phosphorus, nitrate, sulfate, total porosity, soil density, moisture content (gravimetric and volumetric), and hydraulic conductivity (saturated and unsaturated). The first quarter tritium sampling was completed between June and October 2009, at vapor-monitoring wells 21-24524W and 21-24524S. Additionally, as previously approved by NMED, the open borehole, location 21-02523, was abandoned (LANL 2009, 106760; NMED 2009, 107304). Appendix B contains additional details of the field methods during this field effort.

During installation of the vapor-monitoring wells, a total of 22 rock-core samples, 8 single-packer samples, and 9 vapor-port samples were collected from wells 21-24524W and 21-24524S and subsequently analyzed for tritium. Vadose zone rock-core samples were collected using a split-spoon sampler at 20-ft intervals down to 200 ft bgs and at 50-ft intervals deeper than 200 ft bgs to a depth of 400 ft bgs. The deepest single-packer sampling depth was 717 to 721 ft bgs, approximately 10 ft into the Puye Formation where the deepest tritium-monitoring port was installed. According to the approved work plan (LANL 2009, 106760; NMED 2009, 107304), well depths were determined once tritium activity was detected at less than 20,000 pCi/L. The rock-core samples collected and analyses requested are presented in Table 2.0-1.

In monitoring well 21-24524W, single-packer samples were collected each time the borehole had been advanced to the depth of vapor-port installation. In monitoring well 21-24524S, due to the potential for injection of air into the formations once air-rotary drilling had commenced, a single-packer vapor sample was collected at 717 to 721 ft.

According to the approved vapor-monitoring well installation plan (LANL 2009, 106760; NMED 2009, 107304), 11 vapor-sampling ports were to be installed at wells 21-24524W and 21-24524S (both within 10 ft of the original borehole 21-24524 location), within the nine geologic units expected to be encountered based on the borehole log of 21-24524. These nine geologic units include the Tshirege Member, Bandelier Tuff (Qbt 3, Qbt 2, Qbt 1v, and Qbt 1g [sampling ports 1 to 4]), the Tsankawi Pumice Bed (sampling port 5), the Cerro Toledo interval (Qct [sampling port 6]), the Otowi Ash Flows (Qbof [sampling ports 7 to 9]), the Guaje Pumice Bed (Qbog [sampling port 10]), and at TD in the Puye Formation (Tpf [sampling port 11]) (LANL 2009, 106760, Figure 2). However, ports 8 and 9 (the two lowest of the three total-planned ports within the Otowi Ash Flows) were not installed due to difficulties encountered with the port installation process (Roberts 2009, 107558) as discussed in section 2.1. A total of 9 vapor-port samples were collected. Table 2.0-2 summarizes the single-packer and vapor-port samples collected. Drilling details are provided in Appendix B.

Installation of vapor-monitoring well 21-24524W used 8-inch-diameter hollow-stem augers to simulate the drilling of the original 21-24524 and to allow collection of single-packer tests over the borehole interval. Past experience at TA-21 has shown this drilling method is limited to a maximum depth of approximately 400 ft. Upon completion of the drilling and sampling of this borehole, seven vapor-monitoring ports were installed. Vapor ports consist of a 5-ft sand pack with a 6-in. stainless-steel well screen as described in the work plan. The entire sand pack interval is the sampling port interval.

A second borehole (21-24524S) was installed due to concern for the difficulty of installing 11 vapor ports in a single borehole, and experience gained from past difficulties at TA-21 relative to installing vapor ports at depths greater than 400 ft. The first 400 ft were augured without sampling. Air-rotary drilling was then used to advance the borehole to depth 635 ft where the casing could no longer be advanced. Continuous rock core was obtained from 400 to 721 ft, the last 65 ft of which was extended below the stuck casing. Samples were collected at 50-ft intervals from the rock core and at intervals where vapor-monitoring ports were installed. An additional two vapor ports were installed in this second borehole (see deviations described in section 2.1).

Investigation-derived waste (IDW) generated during the vapor-monitoring well installation and construction was managed in accordance with S0P-5238, Characterization and Management of Environmental Program Waste. Details of the IDW management are provided in Appendix D.

2.1 Deviations

Port 9 was installed at a depth of 577.5- to 582.5-ft-bgs, but became entangled on the shoe of the 115-mm inside-diameter (I.D.) ODEX and when the shoe was withdrawn, port 9 was lost. The 477.5- to 482.5-ft-bgs port (port 8) located in the Qbof formation was not installed because of difficulties experienced in the borehole (see tremie pipe discussion below) and packer results indicating non-detect at 712.5- to 717.5-ft-bgs in vapor port 11. Redrilling could not be completed because the two deeper ports (port 10 and port 11 at 677.5 to 682.5 ft bgs and 712.5- to 717.5-ft-bgs, respectively) and stainless-steel tubing were already in place. Additionally, one port (port 7 at 377.5 to 382.5 ft bgs) had already been installed in the Qbof geologic unit. NMED approved the decision to not install ports 8 and 9 in an e-mail to LANL (Roberts 2009, 107558). The decision will be reviewed by NMED following review of the first and second-quarter sampling data.

Screens were not available in 12-in.-long stainless steel. Additionally, 24-in. screens were found to be structurally inadequate. Therefore, 6-in. screens were used for the port installations, consistent with other TA-21 sites such as MDA T.

Analysis was conducted for a full-anion suite rather than a limited suite as outlined in the work plan.

During the casing advancement into well 21-24524S at 595 ft bgs, 40 ft of the 115-mm ID ODEX casing (total of eight, 5-ft-lengths of casing) became unthreaded, leaving casing from 595 to 635 ft bgs. Because rethreading the casing was not possible, the casing was abandoned in place from 595 ft bgs to 635 ft bgs. The abandonment of the 115-mm ODEX at this interval did not interfere with vapor well construction and installation of underlying ports 10 and 11. It also did not interfere with the filter packs, shallow port installation, or overlying bentonite intervals.

During construction of vapor-monitoring well 21-24524S, 20-ft-lengths of 1-in.-diameter schedule 40 polyvinyl chloride (PVC) tremie grout pipe were threaded together to form a conduit for installation of cement grout in an attempt to secure the 577.5- to 582.5-ft port (port 9). The threaded tremie grout pipe was suspended in the open borehole across the top of the 115-mm ID ODEX casing by a jaw-type clamp. While retrieving 520 linear ft of the tremie grout pipe after tagging borehole location 21-24524S at 514 ft bgs, 400 linear ft of tremie grout pipe suspended in the open borehole broke off below the clamp at the well's surface and fell into the open borehole. One hundred and twenty linear ft of the total tremie grout pipe were retrieved. Four hundred linear ft of the 1-in.-diameter schedule 40 PVC tremie grout pipe were abandoned above 520 ft bgs, which did not interfere with vapor well construction and installation of underlying port 10 and port 11 at 677.5 to 682.5 ft bgs and 712.5 to 717.5 ft bgs, respectively. It also did not interfere with their filter packs or overlying bentonite intervals.

3.0 REGULATORY CRITERIA

There are no applicable standards for tritium extracted from pore vapor.

4.0 FIELD-SCREENING RESULTS

Field screening was performed before each vapor sampling event to ensure percent carbon dioxide (%CO_2) and oxygen (%O_2) levels had stabilized at levels representative of subsurface pore-gas conditions. Corresponding field-screening results are provided in Table 4.0-1 by sampling date and sampling port.

Additional field-screening included radiological and volatile organic compound (VOC) health and safety monitoring of the immediate work area, and recovered materials, radiation screening of samples for gross radiation levels for shipping requirements, and headspace vapor screening.

Meteorological data was obtained from http://www.wunderground.com/history/airport/KLAM on each day of sampling using the closest LANL weather station to MDA V (KLAM Weather Station, Los Alamos Airport, latitude 35.83°, longitude 106.22°), which provided all meteorological data required. Table 4.0-2 summarizes the barometric pressure, temperature, and relative humidity on each corresponding sampling date. These data are provided for consideration of conditions that could affect the data results.

5.0 ANALYTICAL DATA RESULTS

Tritium, perchlorate, bromide, chloride, fluoride, phosphorus, nitrate, sulfate, total porosity, soil density, moisture content (gravimetric and volumetric), and hydraulic conductivity (saturated and unsaturated) results were obtained by laboratory analyses of rock-core samples. The methods used for the inorganic chemical and geotechnical parameter analyses are presented in Appendix C. Tritium vapor samples were collected in silica gel columns and analyzed using Environmental Protection Agency (EPA) Method 906. All analytical data were subject to extensive QA/QC and data-validation reviews in accordance with Laboratory guidance and procedures. The QA/QC and data-validation review is presented in Appendix C.

All validated analytical results from the June to October 2009 sampling are presented on CD in Appendix E. The analytical sampling data are also available at the Risk Analysis, Communication, Evaluation, and Reduction (RACER) website (http://www.racernm.com/).

5.1 Inorganic Chemical and Geotechnical Results

As directed by the approved work plan (LANL 2009, 106760; NMED 2009, 107304), the rock-core samples were analyzed for chloride, fluoride, bromide, perchlorate, phosphorus, nitrate, sulfate, total porosity, soil density, moisture content (gravimetric and volumetric), and saturated and unsaturated hydraulic conductivity.

Inorganic chemical results are presented in Table 5.1-1. Chloride, fluoride, and perchlorate were detected at low levels. Bromide, phosphorus, nitrate, and sulfate were not detected or were not detected above applicable background levels.

Geotechnical results, including total porosity, soil density, moisture content (gravimetric and volumetric), and saturated and unsaturated hydraulic conductivity are presented in Tables 5.1-2 and 5.1-3. The results are summarized as follows:

- Total porosity ranged from 32.4% to 66.5%;
- Soil density ranged from 0.89 g/cm^3 to 1.79 g/cm^3;
- Moisture content (volumetric) ranged from 6.4% to 22.8%;
- Moisture content (gravimetric) ranged from 3.9% to 20.1%;
- Saturated hydraulic conductivity ranged from 0.000023 cm/sec to 0.00693 cm/sec; and
- Unsaturated hydraulic conductivity α values ranged from 0.0078 to 0.174 and N (dimensionless) values ranged from 1.23 to 2.86.

5.2 Tritium Results

Tritium results from the first quarter vapor monitoring are presented in Table 5.2-1. The corresponding vertical profile of tritium activities is illustrated in Figure 5.2-1. For comparison purposes, data collected from 2005 to 2006 from monitoring-well 21-24524 are also included in Figure 5.2-1 and Table 5.2-2. Comparisons between rock-core, single-packer, and vapor-port monitoring samples are presented below. For clarity, all data in Figure 5.2-1 are presented as undifferentiated for monitoring well 21-24524 rather than for 21-24524, 21-24524W and 21-24524S individually.

- Single-packer samples collected in 2006 indicated tritium activity of 271,192 pCi/L at 380 ft bgs. In 2009, at this same depth, lower tritium activities were detected, as follows: 8020 pCi/L in rock-core samples, 12,840 pCi/L in single-packer samples, and 9808 pCi/L in vapor-port samples.
- Single-packer samples collected between the ground surface and 381 ft bgs (at depths corresponding to ports 1–7 intervals) indicated a peak tritium activity of 74,076 pCi/L at 260 to 261 ft bgs (port 4). Tritium activity decreased to 11,735 pCi/L at 330 to 331 ft bgs at a depth corresponding to the port 6 interval.
- Vapor-port samples collected from vapor monitoring between the ground surface and 382.5 ft bgs (ports 1–7) indicated two peaks in tritium activity. The first peak of 18,980 pCi/L was detected at 42.5 to 47.5 ft bgs (port 1), and the second peak of 46,830 pCi/L was detected at 300 to

305 ft bgs (port 5). Tritium activity decreased to 8495 pCi/L at 327.5 to 332.5 ft bgs (port 6), and to a minimum of 495 pCi/L at 677.5 to 682.5 ft bgs (port 10).

- Vapor-port sampling results at 677.5 to 682.5 ft bgs and 712.5 to 717.5 ft bgs (ports 10 and 11) indicated a slight increase in tritium activity from 495 pCi/L to 1713 pCi/L, respectively.
- Single-packer tritium activity was not detected in the deepest sample collected at 717 to 721 ft bgs. Tritium activity of 1713 pCi/L was detected at the TD vapor-port (port 11) located at 712.5 to 717.5 ft bgs. Tritium activity was not detected in the deepest rock-core sample collected at 714 to 715 ft bgs, nor at 679 to 680 ft bgs.

6.0 SUMMARY

The objective of the MDA V vapor-monitoring activities is to characterize the extent of subsurface tritium contamination. First quarter sampling of newly installed monitoring wells 21-24524W and 21-24524S was conducted from June to October 2009 per the requirements outlined in the NMED-approved MDA V vapor-monitoring well installation plan (LANL 2009, 106760; NMED 2009, 107304).

There is no agreement between the single-packer data collected in 2005 and 2006, and the current set of rock-core, single-packer, or vapor-port sample data. The relationship of the 2005 and 2006 single-packer data should continue to be examined as subsequent sampling rounds are collected.

Vapor-monitoring results indicated a maximum tritium activity at a depth range from about 259 to 305 ft bgs. The highest tritium activities were 95,800 pCi/L for rock-core samples at 20 to 21 ft bgs, 74,076 pCi/L for single-packer sampling at 260 to 261 ft bgs (port 4), and 46,830 pCi/L (vapor-port sampling at 300 to 305 ft bgs (port 5). Activities decreased from the port 5 value to TD. There was a slight increase from port 10 to port 11 (495 to 1713 pCi/L, respectively).

Within approximately 260 ft of ground surface, single-packer sampling indicated an increase in tritium activity with depth, whereas the vapor-port sampling indicated a decrease in tritium activity with an increase in depth. These trends will be reviewed in subsequent sampling rounds.

Chloride, fluoride, and perchlorate were detected at low concentrations in rock-core samples. Bromide, phosphorus, nitrate, and sulfate were not detected or were not detected above applicable background levels.

Quarterly vapor-monitoring activities will continue at MDA V per the requirements outlined in the approved vapor-monitoring well installation plan (LANL 2009, 106760; LANL 2009, 105645; NMED 2009, 106455; NMED 2009, 105691). Wells 21-24524W and 21-24524S will be monitored on a quarterly basis for three additional sampling rounds. Data collected during future monitoring activities will be presented and evaluated in subsequent periodic monitoring reports. The decision of not installing ports 8 and 9 will be revisited following review of the first and second-quarter sampling data.

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.

Kleinfelder, April 2005. "Final Completion Report, Characterization Wells R-6/R-6i," report prepared for Los Alamos National Laboratory, Project No. 37151, Albuquerque, New Mexico. (Kleinfelder 2005, 091693)

LANL (Los Alamos National Laboratory), June 2004. "Investigation Work Plan for Consolidated Unit 21-018(a)-99, Material Disposal Area V, at Technical Area 21," Los Alamos National Laboratory document LA-UR-04-3699, Los Alamos, New Mexico. (LANL 2004, 087358)

LANL (Los Alamos National Laboratory), July 2007. "Investigation Report for Consolidated Unit 21-018(a)-99, Material Disposal Area V, at Technical Area 21, Revision 1," Los Alamos National Laboratory document LA-UR-07-4390, Los Alamos, New Mexico. (LANL 2007, 098942)

LANL (Los Alamos National Laboratory), April 2009. "Phase III Investigation Work Plan for Material Disposal Area T, Consolidated Unit 21-016(a)-99," Los Alamos National Laboratory document LA-UR-09-2140, Los Alamos, New Mexico. (LANL 2009, 105645)

LANL (Los Alamos National Laboratory), August 2009. "Vadose Zone Subsurface Characterization and Vapor-Monitoring Well Installation Work Plan for Material Disposal Area V, Consolidated Unit 21-018(a)-99, Revision 1," Los Alamos National Laboratory document LA-UR-09-5021, Los Alamos, New Mexico. (LANL 2009, 106760)

LANL (Los Alamos National Laboratory), November 13, 2009. "Corrections to Tritium Pore-Vapor Concentration Data," Los Alamos National Laboratory letter (EP2009-0560) to J.P. Bearzi (NMED-HWB) from M.J. Graham (LANL) and D.R. Gregory (DOE-LASO), Los Alamos, New Mexico. (LANL 2009, 107534)

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

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

NMED (New Mexico Environment Department), September 3, 2009. "Approval with Modifications, Vadose Zone Subsurface Characterization and Vapor-Monitoring Well Installation Work Plan for Material Disposal Area V, Consolidated Unit 21-018(a)-99," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2009, 107304)

Roberts, K., October 15, 2009. RE: MDA V. E-mail message to B. Wedgeworth (LANL) from K. Roberts (NMED), Santa Fe, New Mexico. (Roberts 2009, 107558)

7.2 Map Data Sources

Data sources of existing figures used in this report are identified below:

Drainage; County of Los Alamos, Information Services; as published 16 May 2006.

Former Structures of the Los Alamos Site; Los Alamos National Laboratory, Waste and Environmental Services Division, EP2008-0441; 1:2,500 Scale Data; 08 August 2008.

Material Disposal Areas; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; ER2004-0221; 1:2,500 Scale Data; 23 April 2004.

Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 January 2009.

Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, Waste and Environmental Services Division, EP2008-0592; 04 November 2008.

Potential Release Sites; Los Alamos National Laboratory, Waste and Environmental Services Division, Environmental Data and Analysis Group, EP2008-0623; 1:2,500 Scale Data; 10 December 2008.

Security and Industrial Fences and Gates; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 January 2009.

Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 January 2009.

Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; September 2007; as published 04 December 2008.

Waste Storage Features; Los Alamos National Laboratory, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007.

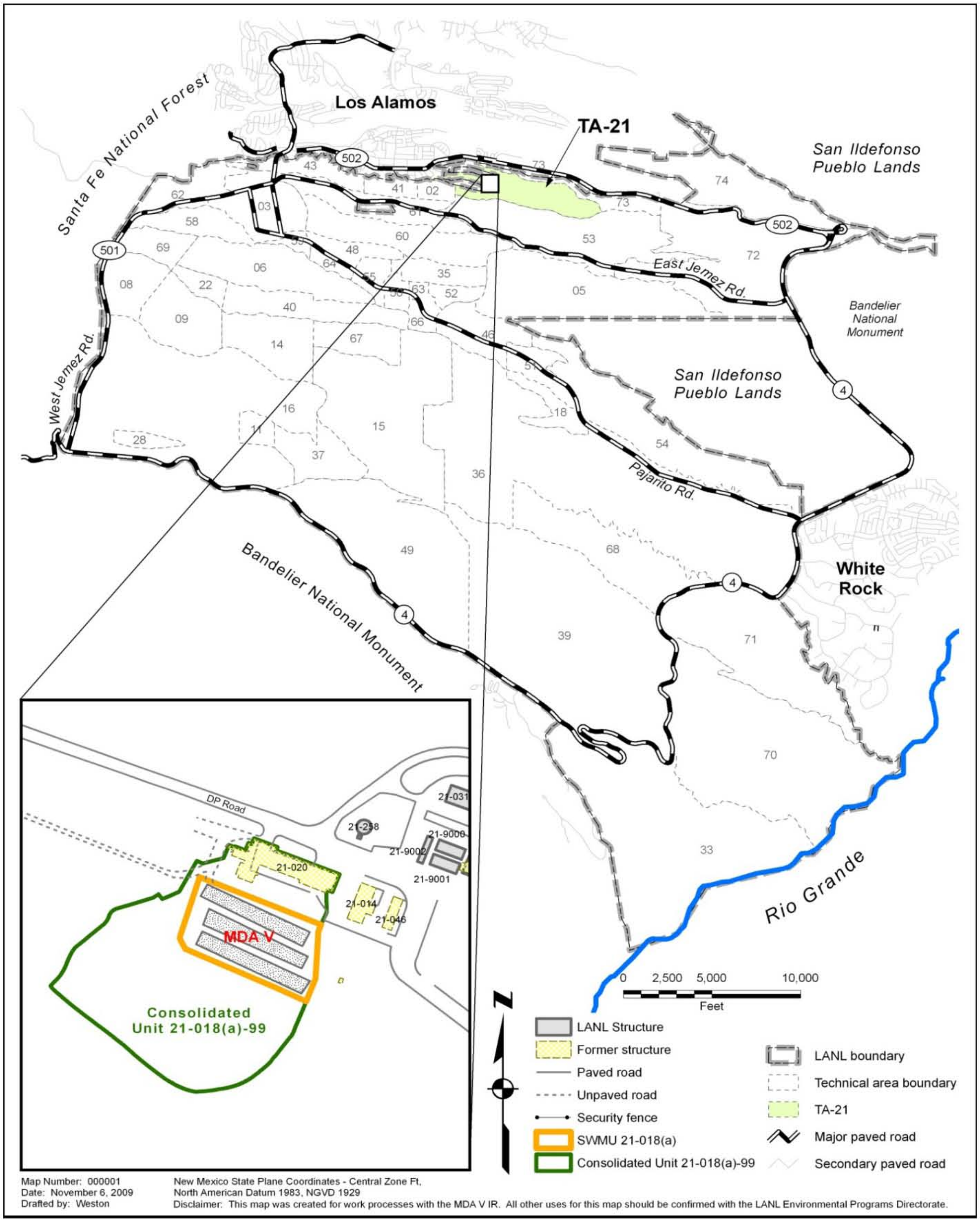

Figure 1.0-1 Location of MDA V at TA-21

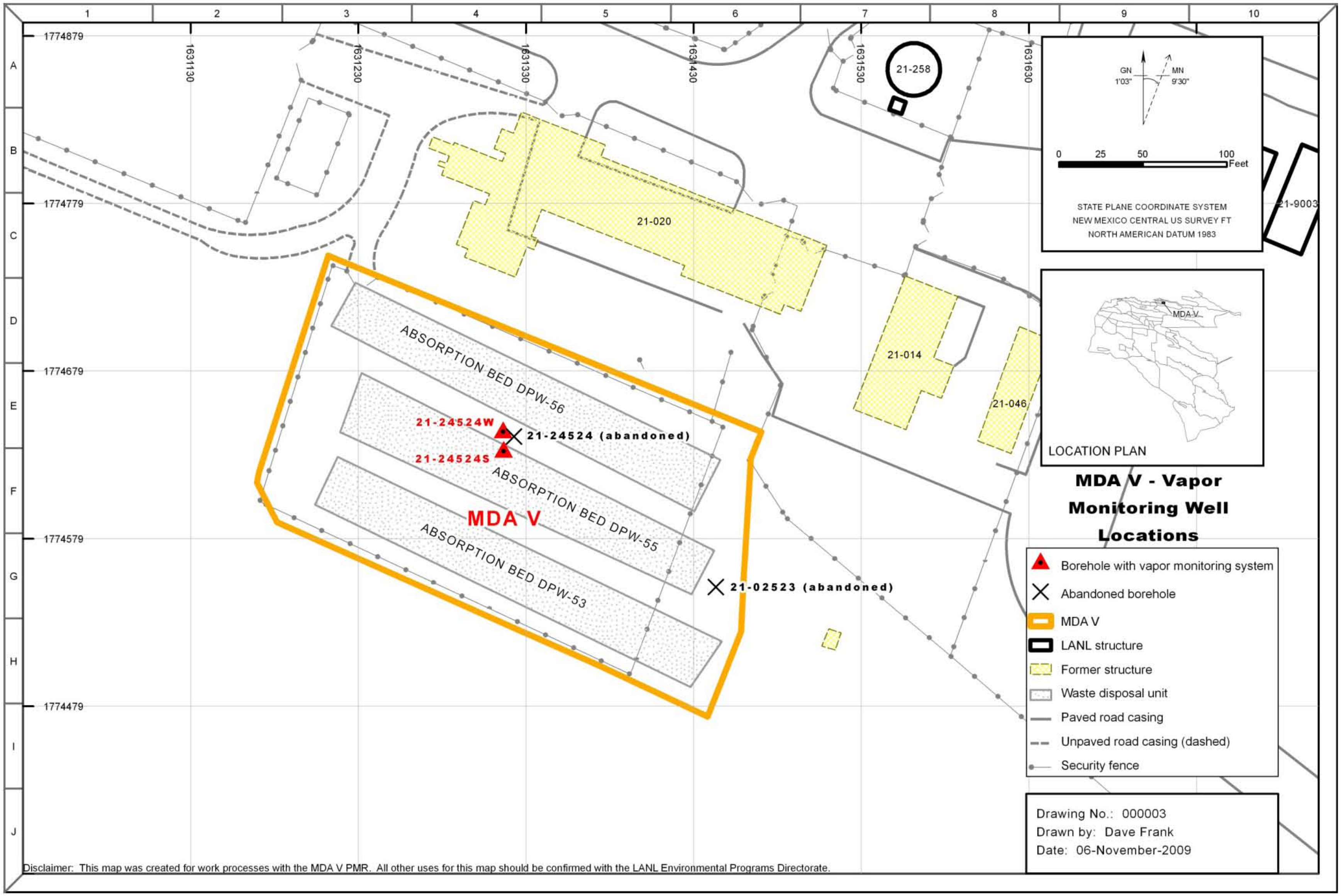

Figure 1.0-2 Location of vapor-monitoring wells 21-24524, 21-24524W, 21-24524S, and 21-02523 at MDA V

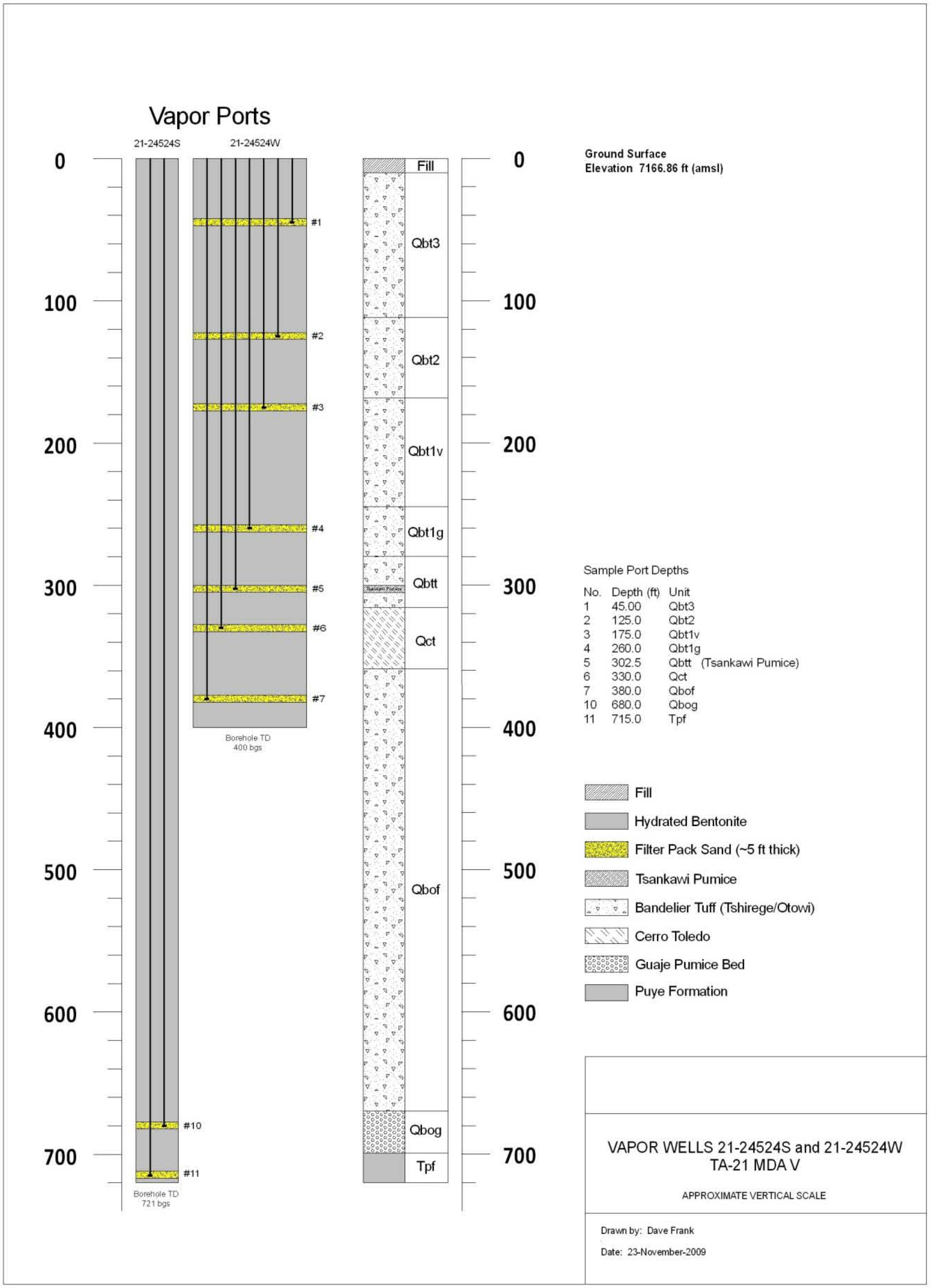

Figure 1.0-3 Schematic of vapor-monitoring wells 21-24524W/21-24524S installation at MDA V

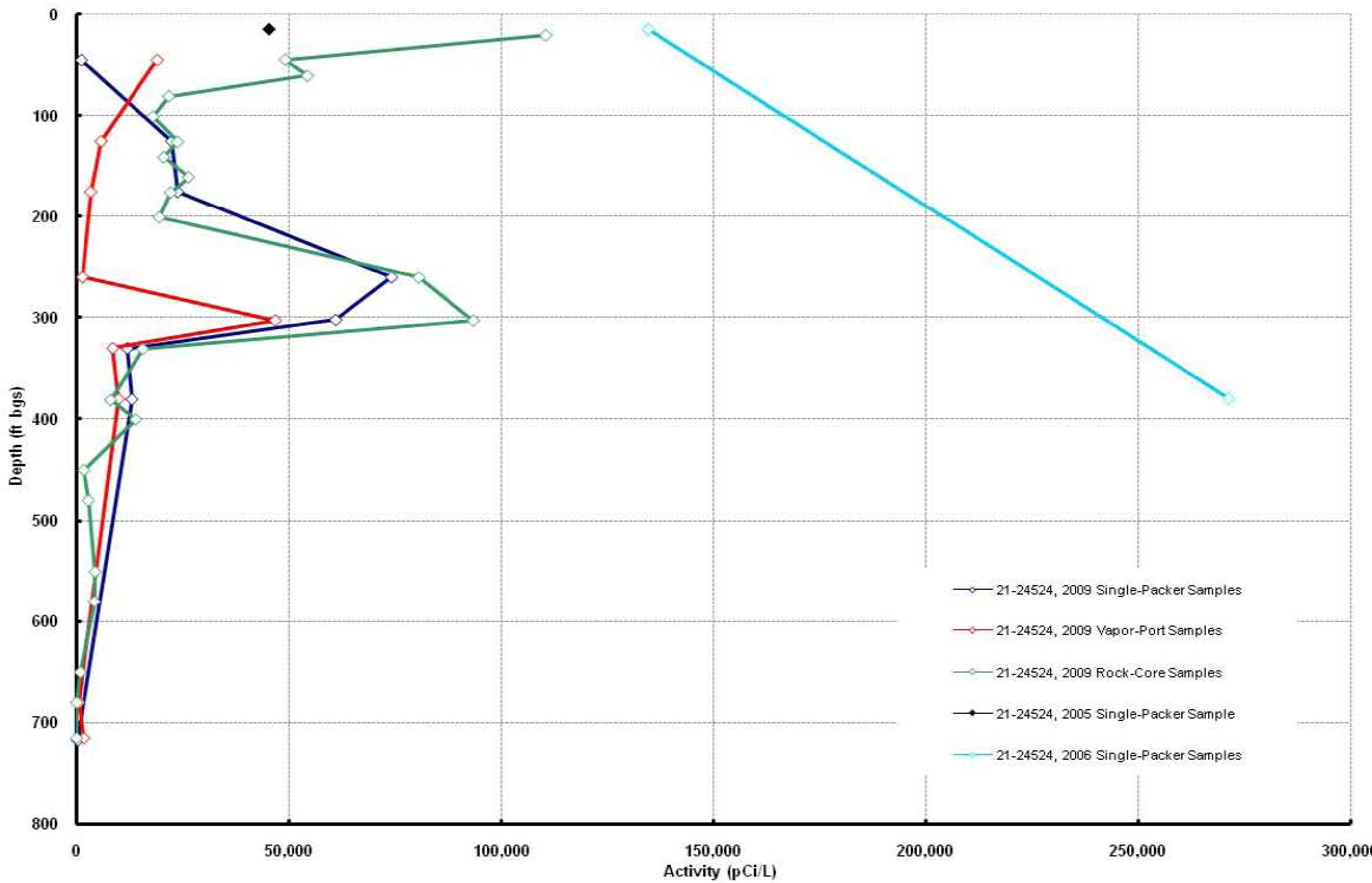

Figure 5.2-1 Vertical profile of tritium in rock-core, single-packer, and vapor-port samples from borehole location 21-24524 in 2005 and 2006, and from vapor-monitoring wells 21-24524W and 21-24524S from June to October 2009

Table 2.0-1
Summary of Rock-Core Samples Collected and Analyses Requested at MDA V

Sample ID	Well ID	Depth (ft bgs)	Collection Date	Media	Field QC	Anion	Geo-Tech	Tritium	Perchlorate
MD21-09-7268	21-24524W	20–21	6/3/2009	QBT3	n/a[a]	09-2185[b]	09-2186	09-2185	09-2185
MD21-09-7269	21-24524W	44–45	6/3/2009	QBT3	n/a	09-2185	09-2186	09-2185	09-2185
MD21-09-7270	21-24524W	60–61	6/11/2009	QBT3	n/a	09-2319	09-2318	09-2319	09-2319
MD21-09-7271	21-24524W	80–81	6/12/2009	QBT3	n/a	09-2319	09-2318	09-2319	09-2319
MD21-09-7272	21-24524W	100–101	6/12/2009	QBT2	n/a	09-2319	09-2318	09-2319	09-2319
MD21-09-7303	21-24524W	100–101	6/12/2009	QBT2	FD[c]	09-2319	—[d]	09-2319	09-2319
MD21-09-7273	21-24524W	125–126	6/12/2009	QBT2	n/a	09-2319	09-2318	09-2319	09-2319
MD21-09-7274	21-24524W	140–141	6/15/2009	QBT2	n/a	09-2339	09-2338	09-2339	09-2339
MD21-09-7275	21-24524W	160–161	6/15/2009	QBT1V	n/a	09-2339	09-2338	09-2339	09-2339
MD21-09-7276	21-24524W	175–176	6/15/2009	QBT1V	n/a	09-2339	09-2338	09-2339	09-2339
MD21-09-7277	21-24524W	200–201	6/16/2009	QBT1V	n/a	09-2345	09-2344	09-2345	09-2345
MD21-09-7304	21-24524W	200–201	6/16/2009	QBT1V	FD	09-2345	—	09-2345	09-2345
MD21-09-7278	21-24524W	259.5–260.5	6/16/2009	QBT1G	n/a	09-2345	09-2344	09-2345	09-2345
MD21-09-7279	21-24524W	302–303	6/18/2009	QBTT	n/a	09-2413	09-2416	09-2413	09-2413
MD21-09-7308	21-24524W	303–304	6/18/2009	QBTT	n/a	—	09-2416	—	—
MD21-09-7280	21-24524W	330–331	6/18/2009	QCT	n/a	09-2413	09-2416	09-2413	09-2413
MD21-09-7281	21-24524W	380–381	6/22/2009	QBO	n/a	09-2443	09-2442	09-2443	09-2443
MD21-09-7309	21-24524W	381–382	6/22/2009	QBO	n/a	—	09-2442	—	—
MD21-09-7282	21-24524W	399–400	6/22/2009	QBO	n/a	09-2443	09-2442	09-2443	09-2443
MD21-09-7283	21-24524S	449–450	8/28/2009	QBO	n/a	09-3036	09-3035	09-3036	09-3036
MD21-09-7305	21-24524S	449–450	8/28/2009	QBO	FD	09-3036	—	09-3036	09-3036
MD21-09-7284	21-24524S	479–480	8/28/2009	QBO	n/a	09-3036	09-3035	09-3036	09-3036
MD21-09-7285	21-24524S	549–550	8/28/2009	QBO	n/a	09-3036	09-3035	09-3036	09-3036
MD21-09-7286	21-24524S	579–580	8/31/2009	QBO	n/a	09-3062	09-3061	09-3062	09-3062
MD21-09-7287	21-24524S	649–650	8/31/2009	QBO	n/a	09-3062	09-3061	09-3062	09-3062
MD21-09-7310	21-24524S	669–670	9/1/2009	QBOG	n/a	—	09-3069	—	—

Table 2.0-1 (continued)

Sample ID	Well ID	Depth (ft bgs)	Collection Date	Media	Field QC	Anion	Geo-Tech	Tritium	Perchlorate
MD21-09-7288	21-24524S	679–680	9/1/2009	QBOG	n/a	09-3070	09-3069	09-3070	09-3070
MD21-09-7289	21-24524S	714–715	9/15/2009	TPF	n/a	09-3242	09-3241	09-3242	09-3242
MD21-09-7311	21-24524S	715–716	9/15/2009	TPF	n/a	—	09-3241	—	—

[a] n/a= Not applicable.

[b] Laboratory request number.

[c] FD = Field duplicate.

[d] — = Analysis not requested.

Table 2.0-2
Summary of Tritium Vapor Samples Collected at MDA V, June to October 2009

Sample ID	Vapor-Monitoring Well ID	Sampling Port	Depth (ft bgs)	Collection Date	Field QC Type	Request Number
MD21-09-7313[a]	21-24524W	1	45–46	6/11/2009	n/a[b]	09-2322
MD21-09-7314[a]	21-24524W	2	125–126	6/12/2009	n/a	09-2337
MD21-09-7315[a]	21-24524W	3	175–176	6/15/2009	n/a	09-2337
MD21-09-7316[a]	21-24524W	4	260–261	6/17/2009	n/a	09-2376
MD21-09-7317[a]	21-24524W	5	302–303	6/18/2009	n/a	09-2428
MD21-09-7318[a]	21-24524W	6	330–331	6/19/2009	n/a	09-2428
MD21-09-7319[a]	21-24524W	7	380–381	6/22/2009	n/a	09-2444
MD21-09-7320[a]	21-24524S	11	717–721	9/17/2009	n/a	09-3273
MD21-09-12336[c]	21-24524W	1	42.5–47.5	8/20/2009	n/a	09-2976
MD21-09-12337[c]	21-24524W	2	122.5–127.5	8/20/2009	n/a	09-2976
MD21-09-12338[c]	21-24524W	3	172.5–177.5	8/20/2009	n/a	09-2976
MD21-09-12339[c]	21-24524W	4	257.5–262.5	8/20/2009	n/a	09-2976
MD21-09-12340[c]	21-24524W	5	300–305	8/20/2009	n/a	09-2976
MD21-09-12334[c]	21-24524W	5	300–305	8/20/2009	FD[d]	09-2976
MD21-09-12341[c]	21-24524W	6	327.5–332.5	8/20/2009	n/a	09-2976
MD21-09-12342[c]	21-24524W	7	377.5–382.5	8/20/2009	n/a	09-2976
MD21-09-12343[c]	21-24524S	10	677.5–682.5	10/14/2009	n/a	10-125
MD21-09-12344[c]	21-24524S	11	712.5–717.5	10/14/2009	n/a	10-125
MD21-09-12335[c]	21-24524S	11	712.5–717.5	10/14/2009	FD	10-125

[a] Single-packer sample.

[b] n/a = Not applicable.

[c] Vapor-port sample.

[d] FD = Field duplicate.

Table 4.0-1
Summary of Field-Screening Results, June to October 2009

Event ID	Collection Date	Location ID	Sampling Port Number	Top Depth (ft bgs)	Bottom Depth (ft bgs)	$\%CO_2$	$\%O_2$
756	6/11/2009	21-24524W	1	45	46	2.2	18.9
756	6/12/2009	21-24524W	2	125	126	0.2	20.8
756	6/15/2009	21-24524W	3	175	176	0.2	19.4
756	6/17/2009	21-24524W	4	260	261	0.2	19.0
756	6/18/2009	21-24524W	5	302	303	0.2	18.9
756	6/19/2009	21-24524W	6	330	331	0.2	18.8
756	6/22/2009	21-24524W	7	380	381	0.2	20.7
2215	8/20/2009	21-24524W	1	42.5	47.5	2.3	17.4
2215	8/20/2009	21-24524W	2	122.5	127.5	0.3	19.6
2215	8/20/2009	21-24524W	3	172.5	177.5	0.3	20.0
2215	8/20/2009	21-24524W	4	257.5	262.5	0.3	20.0
2215	8/20/2009	21-24524W	5	300	305	0.2	20.0
2215	8/20/2009	21-24524W	6	327.5	332.5	0.2	20.1
2215	8/20/2009	21-24524W	7	377.5	382.5	0.2	20.1
2215	9/17/2009	21-24524S	11	717	721	0.0	20.8
2215	10/14/2009	21-24524S	10	677.5	682.5	0.0	20.4
2215	10/14/2009	21-24524S	11	712.5	717.5	0.5	19.0

Note: Event IDs refer to the sample collection log and chain-of-custody packages provided in Appendix E.

Table 4.0-2
Barometric Pressure, Relative Humidity, and Temperature at KLAM Weather Station during Sample Collection, June to October 2009

Date of Measurement	Average Barometric Pressure (in Hg)*	Average Relative Humidity (%)*	Average Temperature (°F)*
6/11/2009	30.12	40	58
6/12/2009	30.13	14	65
6/15/2009	30.14	24	68
6/16/2009	30.12	16	68
6/17/2009	30.15	15	68
6/18/2009	30.1	24	68
6/19/2009	30.06	19	70
6/22/2009	30.11	30	73
8/20/2009	30.16	18	72
9/17/2009	30.39	96	52
10/14/2009	30.19	38	60

*Data obtained from http://www.wunderground.com/history/airport/KLAM.

Table 5.1-1
Inorganic Chemicals Detected, or Detected above Background Values, in Rock-Core Samples, June to October 2009

Sample ID	Vapor-Monitoring Well ID	Depth (ft bgs)	Media	Chloride (mg/kg)	Fluoride (mg/kg)	Perchlorate (mg/kg)
QBT1G Background Value				474	na[a]	na
QBT1V Background Value				446	na	na
QBT 2,3,4 Background Value				94.6	na	na
QBTT Background Value				na	na	na
QCT Background Value				na	na	na
TPT Background Value				na	na	na
MD21-09-7268	21-24524W	20–21	QBT3	—[b]	3.1 (J-)	—
MD21-09-7269	21-24524W	44–45	QBT3	—	6.5 (J-)	0.00039 (J)
MD21-09-7270	21-24524W	60–61	QBT3	—	6.9 (J-)	0.00014 (J)
MD21-09-7271	21-24524W	80–81	QBT3	—	3.5 (J-)	—
MD21-09-7272	21-24524W	100–101	QBT2	—	13 (J-)	0.00012 (J)
MD21-09-7273	21-24524W	125–126	QBT2	—	4.2 (J-)	0.00021 (J)
MD21-09-7274	21-24524W	140–141	QBT2	—	7.8 (J-)	0.00022 (J)
MD21-09-7275	21-24524W	160–161	QBT1V	—	5.1 (J-)	0.00013 (J)
MD21-09-7276	21-24524W	175–176	QBT1V	—	6.2 (J-)	—
MD21-09-7277	21-24524W	200–201	QBT1V	—	4.8 (J-)	—
MD21-09-7278	21-24524W	259.5–260.5	QBT1G	—	9.5 (J-)	Rejected[c]
MD21-09-7279	21-24524W	302–303	QBTT	—	6.9 (J-)	Rejected
MD21-09-7280	21-24524W	330–331	QCT	—	15 (J-)	—
MD21-09-7289	21-24524S	714–715	TPT	1.5 (J)	—	—

Note: Data qualifiers are defined in Appendix A.

[a] na = Not available.

[b] — = Not detected or not detected above background.

[c] Rejected data; see Appendix C for further details.

Table 5.1-2
Geotechnical Results for Rock-Core Sampling, June to October 2009

Sample ID	Request Number	Vapor-Monitoring Well ID	Depth (ft bgs)	Collection Date	Parameter	Result
MD21-09-7268	09-2186	21-24524W	20–21	6/3/2009	Moisture content- volumetric	11%
MD21-09-7268	09-2186	21-24524W	20–21	6/3/2009	Moisture content- gravimetric	7.7%
MD21-09-7268	09-2186	21-24524W	20–21	6/3/2009	Saturated Hydraulic Conductivity	0.00026 cm/sec
MD21-09-7268	09-2186	21-24524W	20–21	6/3/2009	Density	1.43 g/cm^3
MD21-09-7268	09-2186	21-24524W	20–21	6/3/2009	Calculated total porosity	46%
MD21-09-7269	09-2186	21-24524W	44–45	6/3/2009	Moisture content- volumetric	8.6%
MD21-09-7269	09-2186	21-24524W	44–45	6/3/2009	Moisture content- gravimetric	6.2%
MD21-09-7269	09-2186	21-24524W	44–45	6/3/2009	Saturated Hydraulic Conductivity	0.0015 cm/sec
MD21-09-7269	09-2186	21-24524W	44–45	6/3/2009	Density	1.38 g/cm^3
MD21-09-7269	09-2186	21-24524W	44–45	6/3/2009	Calculated total porosity	47.8%
MD21-09-7270	09-2318	21-24524W	60–61	6/11/2009	Moisture content- volumetric	7.1%
MD21-09-7270	09-2318	21-24524W	60–61	6/11/2009	Moisture content- gravimetric	5.7%
MD21-09-7270	09-2318	21-24524W	60–61	6/11/2009	Saturated Hydraulic Conductivity	0.00014 cm/sec
MD21-09-7270	09-2318	21-24524W	60–61	6/11/2009	Density	1.24 g/cm^3
MD21-09-7270	09-2318	21-24524W	60–61	6/11/2009	Calculated total porosity	53.3%
MD21-09-7271	09-2318	21-24524W	80–81	6/12/2009	Moisture content- volumetric	6.7%
MD21-09-7271	09-2318	21-24524W	80–81	6/12/2009	Moisture content- gravimetric	5.2%
MD21-09-7271	09-2318	21-24524W	80–81	6/12/2009	Saturated Hydraulic Conductivity	0.0005 cm/sec
MD21-09-7271	09-2318	21-24524W	80–81	6/12/2009	Density	1.29 g/cm^3
MD21-09-7271	09-2318	21-24524W	80–81	6/12/2009	Calculated total porosity	51.3%
MD21-09-7272	09-2318	21-24524W	100–101	6/12/2009	Moisture content- volumetric	6.4%
MD21-09-7272	09-2318	21-24524W	100–101	6/12/2009	Moisture content- gravimetric	4.9%
MD21-09-7272	09-2318	21-24524W	100–101	6/12/2009	Saturated Hydraulic Conductivity	0.000092 cm/sec
MD21-09-7272	09-2318	21-24524W	100–101	6/12/2009	Density	1.3 g/cm^3
MD21-09-7272	09-2318	21-24524W	100–101	6/12/2009	Calculated total porosity	50.9%
MD21-09-7273	09-2318	21-24524W	125–126	6/12/2009	Moisture content- volumetric	6.5%
MD21-09-7273	09-2318	21-24524W	125–126	6/12/2009	Moisture content- gravimetric	3.9%
MD21-09-7273	09-2318	21-24524W	125–126	6/12/2009	Saturated Hydraulic Conductivity	0.00017 cm/sec

Table 5.1-2 (continued)

Sample ID	Request Number	Vapor-Monitoring Well ID	Depth (ft bgs)	Collection Date	Parameter	Result
MD21-09-7273	09-2318	21-24524W	125–126	6/12/2009	Density	1.69 g/cm^3
MD21-09-7273	09-2318	21-24524W	125–126	6/12/2009	Calculated total porosity	36.2%
MD21-09-7274	09-2338	21-24524W	140–141	6/15/2009	Saturated Hydraulic Conductivity	0.000084 cm/sec
MD21-09-7274	09-2338	21-24524W	140–141	6/15/2009	Density	1.68 g/cm^3
MD21-09-7274	09-2338	21-24524W	140–141	6/15/2009	Calculated total porosity	36.6%
MD21-09-7274	09-2338	21-24524W	160–161	6/15/2009	Moisture content- volumetric	10.4%
MD21-09-7274	09-2338	21-24524W	160–161	6/15/2009	Moisture content-gravimetric	6.2%
MD21-09-7275	09-2338	21-24524W	160–161	6/15/2009	Moisture content	8.1%
MD21-09-7275	09-2338	21-24524W	160–161	6/15/2009	Moisture content-gravimetric	5.4%
MD21-09-7275	09-2338	21-24524W	160–161	6/15/2009	Saturated Hydraulic Conductivity	0.00082 cm/sec
MD21-09-7275	09-2338	21-24524W	160–161	6/15/2009	Density	1.51 g/cm^3
MD21-09-7275	09-2338	21-24524W	160–161	6/15/2009	Calculated total porosity	42.9%
MD21-09-7276	09-2338	21-24524W	175–176	6/15/2009	Moisture content- volumetric	6.6%
MD21-09-7276	09-2338	21-24524W	175–176	6/15/2009	Moisture content-gravimetric	5.5%
MD21-09-7276	09-2338	21-24524W	175–176	6/15/2009	Saturated Hydraulic Conductivity	0.00066 cm/sec
MD21-09-7276	09-2338	21-24524W	175–176	6/15/2009	Density	1.2 g/cm^3
MD21-09-7276	09-2338	21-24524W	175–176	6/15/2009	Calculated total porosity	54.7%
MD21-09-7277	09-2344	21-24524W	200–201	6/16/2009	Moisture content- volumetric	8.1%
MD21-09-7277	09-2344	21-24524W	200–201	6/16/2009	Moisture content-gravimetric	7.4%
MD21-09-7277	09-2344	21-24524W	200–201	6/16/2009	Saturated Hydraulic Conductivity	0.0012 cm/sec
MD21-09-7277	09-2344	21-24524W	200–201	6/16/2009	Density	1.1 g/cm^3
MD21-09-7277	09-2344	21-24524W	200–201	6/16/2009	Calculated total porosity	58.4%
MD21-09-7278	09-2344	21-24524W	259.5–260.5	6/16/2009	Moisture content- volumetric	16.2%
MD21-09-7278	09-2344	21-24524W	259.5–260.5	6/16/2009	Moisture content-gravimetric	15.7%
MD21-09-7278	09-2344	21-24524W	259.5–260.5	6/16/2009	Saturated Hydraulic Conductivity	0.00078 cm/sec
MD21-09-7278	09-2344	21-24524W	259.5–260.5	6/16/2009	Density	1.03 g/cm^3
MD21-09-7278	09-2344	21-24524W	259.5–260.5	6/16/2009	Calculated total porosity	61%
MD21-09-7279	09-2416	21-24524W	302–303	6/18/2009	Moisture content- volumetric	20.4%
MD21-09-7279	09-2416	21-24524W	302–303	6/18/2009	Moisture content-gravimetric	20.1%

Table 5.1-2 (continued)

Sample ID	Request Number	Vapor-Monitoring Well ID	Depth (ft bgs)	Collection Date	Parameter	Result
MD21-09-7279	09-2416	21-24524W	302–303	6/18/2009	Saturated Hydraulic Conductivity	0.0023 cm/sec
MD21-09-7279	09-2416	21-24524W	302–303	6/18/2009	Density	1.01 g/cm^3
MD21-09-7279	09-2416	21-24524W	302–303	6/18/2009	Calculated total porosity	61.7%
MD21-09-7280	09-2416	21-24524W	330–331	6/18/2009	Moisture content- volumetric	22.8%
MD21-09-7280	09-2416	21-24524W	330–331	6/18/2009	Moisture content-gravimetric	12.7%
MD21-09-7280	09-2416	21-24524W	330–331	6/18/2009	Saturated Hydraulic Conductivity	0.000077 cm/sec
MD21-09-7280	09-2416	21-24524W	330–331	6/18/2009	Density	1.79 g/cm^3
MD21-09-7280	09-2416	21-24524W	330–331	6/18/2009	Calculated total porosity	32.4%
MD21-09-7308	09-2416	21-24524W	303–304	6/18/2009	Moisture content- volumetric	22.1%
MD21-09-7308	09-2416	21-24524W	303–304	6/18/2009	Moisture content-gravimetric	19.2%
MD21-09-7308	09-2416	21-24524W	303–304	6/18/2009	Saturated Hydraulic Conductivity	0.002 cm/sec
MD21-09-7308	09-2416	21-24524W	303–304	6/18/2009	Density	1.15 g/cm^3
MD21-09-7308	09-2416	21-24524W	303–304	6/18/2009	Calculated total porosity	56.7%
MD21-09-7281	09-2442	21-24524W	380–381	6/22/2009	Moisture content- volumetric	11.5%
MD21-09-7281	09-2442	21-24524W	380–381	6/22/2009	Moisture content-gravimetric	13%
MD21-09-7281	09-2442	21-24524W	380–381	6/22/2009	Saturated Hydraulic Conductivity	0.0007 cm/sec
MD21-09-7281	09-2442	21-24524W	380–381	6/22/2009	Density	0.89 g/cm^3
MD21-09-7281	09-2442	21-24524W	380–381	6/22/2009	Calculated total porosity	66.5%
MD21-09-7282	09-2442	21-24524W	399–400	6/22/2009	Moisture content- volumetric	15%
MD21-09-7282	09-2442	21-24524W	399–400	6/22/2009	Moisture content-gravimetric	12.5%
MD21-09-7282	09-2442	21-24524W	399–400	6/22/2009	Saturated Hydraulic Conductivity	0.00036 cm/sec
MD21-09-7282	09-2442	21-24524W	399–400	6/22/2009	Density	1.2 g/cm^3
MD21-09-7282	09-2442	21-24524W	399–400	6/22/2009	Calculated total porosity	54.7%
MD21-09-7309	09-2442	21-24524W	381–382	6/22/2009	Moisture content- volumetric	11.6%
MD21-09-7309	09-2442	21-24524W	381–382	6/22/2009	Moisture content-gravimetric	12.2%
MD21-09-7309	09-2442	21-24524W	381–382	6/22/2009	Saturated Hydraulic Conductivity	0.0018 cm/sec
MD21-09-7309	09-2442	21-24524W	381–382	6/22/2009	Density	0.95 g/cm^3
MD21-09-7309	09-2442	21-24524W	381–382	6/22/2009	Calculated total porosity	64.2%
MD21-09-7283	09-3035	21-24524S	449–450	8/28/2009	Moisture content- volumetric	12.7%

Table 5.1-2 (continued)

Sample ID	Request Number	Vapor-Monitoring Well ID	Depth (ft bgs)	Collection Date	Parameter	Result
MD21-09-7283	09-3035	21-24524S	449–450	8/28/2009	Moisture content-gravimetric	12.5%
MD21-09-7283	09-3035	21-24524S	449–450	8/28/2009	Saturated Hydraulic Conductivity	0.00014 cm/sec
MD21-09-7283	09-3035	21-24524S	449–450	8/28/2009	Density	1.02 g/cm^3
MD21-09-7283	09-3035	21-24524S	449–450	8/28/2009	Calculated total porosity	61.6%
MD21-09-7284	09-3035	21-24524S	479–480	8/28/2009	Moisture content- volumetric	15.7%
MD21-09-7284	09-3035	21-24524S	479–480	8/28/2009	Moisture content-gravimetric	14.8%
MD21-09-7284	09-3035	21-24524S	479–480	8/28/2009	Saturated Hydraulic Conductivity	0.00077 cm/sec
MD21-09-7284	09-3035	21-24524S	479–480	8/28/2009	Density	1.06 g/cm^3
MD21-09-7284	09-3035	21-24524S	479–480	8/28/2009	Calculated total porosity	59.9%
MD21-09-7285	09-3035	21-24524S	549–550	8/28/2009	Moisture content- volumetric	18.4%
MD21-09-7285	09-3035	21-24524S	549–550	8/28/2009	Moisture content-gravimetric	18.1%
MD21-09-7285	09-3035	21-24524S	549–550	8/28/2009	Saturated Hydraulic Conductivity	0.000023 cm/sec
MD21-09-7285	09-3035	21-24524S	549–550	8/28/2009	Density	1.01 g/cm^3
MD21-09-7285	09-3035	21-24524S	549–550	8/28/2009	Calculated total porosity	61.7%
MD21-09-7286	09-3061	21-24524S	579–580	8/31/2009	Moisture content- volumetric	14.9%
MD21-09-7286	09-3061	21-24524S	579–580	8/31/2009	Moisture content-gravimetric	14.9%
MD21-09-7286	09-3061	21-24524S	579–580	8/31/2009	Saturated Hydraulic Conductivity	0.00693 cm/sec
MD21-09-7286	09-3061	21-24524S	579–580	8/31/2009	Density	1.01 g/cm^3
MD21-09-7286	09-3061	21-24524S	579–580	8/31/2009	Calculated total porosity	62%
MD21-09-7287	09-3061	21-24524S	649–650	8/31/2009	Moisture content- volumetric	16.3%
MD21-09-7287	09-3061	21-24524S	649–650	8/31/2009	Moisture content-gravimetric	16.4%
MD21-09-7287	09-3061	21-24524S	649–650	8/31/2009	Saturated Hydraulic Conductivity	0.00016 cm/sec
MD21-09-7287	09-3061	21-24524S	649–650	8/31/2009	Density	0.99 g/cm^3
MD21-09-7287	09-3061	21-24524S	649–650	8/31/2009	Calculated total porosity	62.5%
MD21-09-7288	09-3069	21-24524S	679–680	9/1/2009	Moisture content- volumetric	17%
MD21-09-7288	09-3069	21-24524S	679–680	9/1/2009	Moisture content-gravimetric	17.6%
MD21-09-7288	09-3069	21-24524S	679–680	9/1/2009	Saturated Hydraulic Conductivity	0.001 cm/sec
MD21-09-7288	09-3069	21-24524S	679–680	9/1/2009	Density	0.96 g/cm^3
MD21-09-7288	09-3069	21-24524S	679–680	9/1/2009	Calculated total porosity	63.6%

Table 5.1-2 (continued)

Sample ID	Request Number	Vapor-Monitoring Well ID	Depth (ft bgs)	Collection Date	Parameter	Result
MD21-09-7310	09-3069	21-24524S	669–670	9/1/2009	Moisture content- volumetric	17.6%
MD21-09-7310	09-3069	21-24524S	669–670	9/1/2009	Moisture content-gravimetric	17.3%
MD21-09-7310	09-3069	21-24524S	669–670	9/1/2009	Saturated Hydraulic Conductivity	0.000055 cm/sec
MD21-09-7310	09-3069	21-24524S	669–670	9/1/2009	Density	1.02 g/cm^3
MD21-09-7310	09-3069	21-24524S	669–670	9/1/2009	Calculated total porosity	61.7%
MD21-09-7289	09-3241	21-24524S	714–715	9/15/2009	Moisture content-volumetric	14.2%
MD21-09-7289	09-3241	21-24524S	714–715	9/15/2009	Moisture content-gravimetric	9.4%
MD21-09-7289	09-3241	21-24524S	714–715	9/15/2009	Saturated Hydraulic Conductivity	0.0045 cm/sec
MD21-09-7289	09-3241	21-24524S	714–715	9/15/2009	Density	1.51 g/cm^3
MD21-09-7289	09-3241	21-24524S	714–715	9/15/2009	Calculated total porosity	43.1%
MD21-09-7311	09-3241	21-24524S	715–716	9/15/2009	Moisture content- volumetric	18.9%
MD21-09-7311	09-3241	21-24524S	715–716	9/15/2009	Moisture content-gravimetric	12.5
MD21-09-7311	09-3241	21-24524S	715–716	9/15/2009	Saturated Hydraulic Conductivity	0.003 cm/sec
MD21-09-7311	09-3241	21-24524S	715–716	9/15/2009	Density	1.51 g/cm^3
MD21-09-7311	09-3241	21-24524S	715–716	9/15/2009	Calculated total porosity	42.9%

Table 5.1-3
Unsaturated Hydraulic Conductivity Results

Sample ID	A (cm-1)	N (dimensionless)	Top Depth (ft bgs)	Bottom Depth (ft bgs)
MD21-09-7268	0.0078	1.6637	20	21
MD21-09-7269	0.0089	1.9402	44	45
MD21-09-7270	0.0061	1.6033	60	61
MD21-09-7271	0.0059	2.5596	80	81
MD21-09-7272	0.0075	1.8454	100	101
MD21-09-7273	0.0023	1.7811	125	126
MD21-09-7274	0.0033	2.8615	140	141
MD21-09-7275	0.0018	1.8868	160	161
MD21-09-7276	0.0205	1.4916	175	176
MD21-09-7277	0.0142	1.5618	200	201
MD21-09-7278	0.0048	1.8815	259.5	260.5
MD21-09-7279	0.0038	1.8432	302	303
MD21-09-7280	0.0068	1.3121	330	331
MD21-09-7281	0.0039	1.7198	380	381
MD21-09-7282	0.0037	1.6927	399	400
MD21-09-7283	0.0053	1.5864	449	450
MD21-09-7284	0.0103	1.4362	479	480
MD21-09-7285	0.0062	1.6196	549	550
MD21-09-7286	0.0063	1.657	579	580
MD21-09-7287	0.0062	1.5961	649	650
MD21-09-7288	0.0058	1.6373	679	680
MD21-09-7289	0.1738	1.23	714	715
MD21-09-7308	0.0049	2.0129	303	304
MD21-09-7309	0.003	1.7144	381	382
MD21-09-7310	0.0047	1.7328	669	670
MD21-09-7311	0.0085	1.4542	715	716

Table 5.2-1
Summary of Tritium Results in Rock-Core, Single-Packer, and Vapor-Port Samples collected at 21-24524, June to October 2009

Sample ID	Vapor-Monitoring Well ID	Collection Date	Depth (ft bgs)	Tritium Result (pCi/L)
Core Samples				
MD21-09-7268	21-24524W	6/3/2009	20–21	95800
MD21-09-7269	21-24524W	6/3/2009	44–45	49100
MD21-09-7270	21-24524W	6/11/2009	60–61	54300
MD21-09-7271	21-24524W	6/12/2009	80–81	21700
MD21-09-7272	21-24524W	6/12/2009	100–101	18000
MD21-09-7273	21-24524W	6/12/2009	125–126	23700
MD21-09-7274	21-24524W	6/15/2009	140–141	20500
MD21-09-7275	21-24524W	6/15/2009	160–161	26300
MD21-09-7276	21-24524W	6/15/2009	175–176	22100
MD21-09-7277	21-24524W	6/16/2009	200–201	19500
MD21-09-7278	21-24524W	6/16/2009	259.5–260.5	80500
MD21-09-7279	21-24524W	6/18/2009	302–303	93300 (J-)
MD21-09-7280	21-24524W	6/18/2009	330–331	15600 (J-)
MD21-09-7281	21-24524W	6/22/2009	380–381	8020 (J-)
MD21-09-7282	21-24524W	6/22/2009	399–400	13900 (J-)
MD21-09-7283	21-24524S	8/28/2009	449–500	1740
MD21-09-7284	21-24524S	8/28/2009	479–480	2790
MD21-09-7285	21-24524S	8/28/2009	549–550	4420
MD21-09-7286	21-24524S	8/31/2009	579–580	4240
MD21-09-7287	21-24524S	8/31/2009	649–650	920
MD21-09-7288	21-24524S	9/1/2009	679–680	—*
MD21-09-7289	21-24524S	9/15/2009	714–715	—
Single Packer Samples				
MD21-09-7313	21-24524W	6/11/2009	45–46	919
MD21-09-7314	21-24524W	6/12/2009	125–126	22229
MD21-09-7315	21-24524W	6/15/2009	175–176	23609
MD21-09-7316	21-24524W	6/17/2009	260–261	74076
MD21-09-7317	21-24524W	6/18/2009	302–303	60923
MD21-09-7318	21-24524W	6/19/2009	330–331	11735
MD21-09-7319	21-24524W	6/22/2009	380–381	12840
MD21-09-7320	21-24524S	9/17/2009	717–721	—

Table 5.2-1 (continued)

Sample ID	Vapor-Monitoring Well ID	Collection Date	Depth (ft bgs)	Tritium Result (pCi/L)
Vapor-Port Samples				
MD21-09-12336	21-24524W	8/20/2009	42.5–47.5	18980
MD21-09-12337	21-24524W	8/20/2009	122.5–127.5	5791
MD21-09-12338	21-24524W	8/20/2009	172.5–177.5	3268
MD21-09-12339	21-24524W	8/20/2009	257.5–262.5	1324
MD21-09-12340	21-24524W	8/20/2009	300–305	46830
MD21-09-12341	21-24524W	8/20/2009	327.5–332.5	8495
MD21-09-12342	21-24524W	8/20/2009	377.5–382.5	9808
MD21-09-12343	21-24524S	10/14/2009	677.5–682.5	495
MD21-09-12344	21-24524S	10/14/2009	712.5–717.5	1713

Note: Data qualifiers are defined in Appendix A.

* — = Not detected.

Table 5.2-2
Summary of Tritium Results in
Single-Packer Samples Collected at 21-24524, 2005–2006

Sample ID	Collection Date	Depth (ft bgs)	Tritium (pCi/L)
MD21-05-61752	07-08-05	14–15	45334
MD21-06-71202	05-06-06	14–15	134634
MD21-06-71201	05-06-06	379–380	271192

Appendix A

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

A-1.0 ACRONYMS AND ABBREVIATIONS

%Rs	percent recoveries
AK	acceptable knowledge
bgs	below ground surface
CCV	continuing calibration verification
CME	Construction Mine Equipment
COC	chain of custody
Consent Order	Compliance Order on Consent
DER	duplicate error ratio
DOE	Department of Energy (U.S.)
DOT	Department of Transportation (U.S.)
DP	Delta Prime
EPA	Environmental Protection Agency (U.S.)
ER	environmental restoration
FD	field duplicate
HSA	hollow-stem auger
ICS	interference check samples
ICV	initial calibration verification
I.D.	inside diameter
IDW	investigation derived waste
LAL	lower acceptance limit
LANL	Los Alamos National Laboratory
LCS	laboratory control sample
LLW	low-level waste
MCL	maximum contaminant level
MDA	material disposal area
MDC	minimum detectable concentration
MS	matrix spike
MSW	municipal solid waste
NMED	New Mexico Environment Department
NOI	notice of intent
PB	performance blank
PID	photoionization detector

PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RACER	Risk Analysis, Communication, Evaluation, and Reduction
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician
RFI	RCRA facility investigation
RPD	relative percent difference
RPF	records processing facility
SCL	sample collection log
SMO	sample management office
SOP	standard operating procedures
SOW	statement of work
SS	stainless steel
TA	technical area
TD	total depth
VOC	volatile organic compound
WCSF	waste characterization strategy form

A-2.0 METRIC CONVERSION TABLE

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

A-3.0 DATA QUALIFIER DEFINITIONS

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

Appendix B

Field Methods

B-1.0 INTRODUCTION

This appendix summarizes the field methods used during the June to October 2009 borehole drilling, sampling, monitoring well installation, and separate borehole-abandonment activities at Material Disposal Area (MDA) V, Consolidated Unit 21-018(a)-99, at Technical Area 21 at Los Alamos National Laboratory (LANL or the Laboratory). All activities were conducted in accordance with the applicable standard operating procedures (SOPs), quality procedures, Laboratory implementation requirements, and Laboratory procedural requirements. Table B-1.0-1 provides a summary of the field methods used, and Table B-1.0-2 lists the applicable procedures. The LANL website http://www.lanl.gov/environment/all/qa/adep.shtml contains the plans and procedures used during these field activities.

B-2.0 FIELD METHODS

All work was conducted per a site-specific health and safety plan and an integrated work document. Field activities conducted according to SOPs (Table B-1.0-2) are discussed below.

B-2.1 Borehole Drilling and Logging

Drilling operations to install the two vapor-monitoring wells at MDA V began on June 2, 2009, and concluded on September 15, 2009. Two boreholes were drilled with a combination of hollow-stem auger (HSA) and air-rotary techniques. Because two types of drilling technology were used, the well was completed in two separate boreholes: one well was constructed using HSA and one well was constructed using air-rotary techniques. HSA was used to drill to a total depth (TD) of 380 ft bgs at borehole location 21-24524W to simulate the initial drilling of borehole location 21-24524 (now abandoned), and air-rotary techniques were used to drill to a TD of 721 ft bgs at borehole location 21-24524S. This was to allow an easier completion of the vapor wells within the small-diameter boreholes by limiting the number of ports contained in each hole and to avoid some of the difficulties encountered by the installation of a vapor-monitoring well of the same design at MDA T.

A Construction Mine Equipment 85 (CME 85) HSA drill rig was utilized to advance borehole location 21-24524W using 4.25-in. inner-diameter and nominal 8.625-in. outer-diameter, 5-ft-long auger flights. A hex-rod core retrieval system and a 4-in. outer-diameter steel split tube core barrel were used for sampling. A nominal 9-in.-diameter drill bit was used during HSA boring operations. To maintain an open borehole and overall borehole integrity, 5-ft-long auger flights were connected to one another during borehole advancement until TD (380 ft) was reached.

After augering to 400 ft bgs using the above-described technique, a Delta Base 540 (DB540) air-rotary drill rig was utilized to further advance borehole location 21-24524S from 385 ft below ground surface (bgs) to TD of 721 ft bgs. ODEX casing of 140 mm inner-diameter was advanced through the pilot borehole to 450 ft bgs and 115-mm ODEX casing was telescoped inside the 140-mm ODEX casing and advanced from 450 ft bgs to TD of 721 ft bgs. High-pressure air (180 psi), supplied by an Ingersoll Rand 750 air compressor, was circulated through the ODEX casing to recover drill cuttings. The drill cuttings were collected with a Torit Donaldson TD650 dust collection and cyclone system powered by an Onan generator.

Lithologic core logs were recorded in accordance with SOP-12.01, Field Logging, Handling and Documentation of Borehole Materials. Boreholes were logged in accordance with Section IX.B.2.c of the Compliance Order on Consent (the Consent Order), by a qualified engineer or geologist in accordance with the required soil (American Society for Testing and Materials method D2488) and rock (American Geological Institute) classification methods. The logs contain lithological descriptions, field-screening results, sample ID numbers, and significant events encountered during the drilling process. Borehole logs are presented in Attachment B-1 (on CD included with this document). Rock-core samples were collected near the location where each monitoring port was installed. Figure 1.0-3 in the main text presents a schematic of the vapor-monitoring wells.

Drilling equipment was decontaminated after each borehole using dry methods per EP-ERSS-SOP-5061, Field Decontamination of Equipment.

B-2.2 Field Screening of Samples

Field screening conducted during the 2009 vapor-monitoring well installations at MDA V included (1) health and safety monitoring of the immediate work area and recovered materials for exposure to gross radiation and/or organic vapors, (2) screening of collected samples for gross radiation levels to ensure compliance with U.S. Department of Transportation (DOT) shipping requirements, and (3) headspace vapor screening and screening for gross radioactivity on all intervals of core recovered during collection of sample material and during sample collection.

Screening for gross alpha and beta/gamma radiation was performed by a Radiological Control Technician (RCT) using an Eberline E-600/SHP380AB Portable Radiation Monitor. All samples collected for off-site analysis were screened for gross radioactivity by a LANL Health Physics Operations (RP-1) RCT prior to removal from the site to ensure compliance with DOT shipping requirements. Gross radiation monitoring was conducted by a certified LANL RCT in accordance with SOP-10.14, Performing and Documenting Gross Gamma Radiation Scoping Surveys.

Organic vapor monitoring and headspace screening was performed using a MiniRAE 2000, Model PGM-7600 Photoionization Detector (PID) with an 11.7-eV bulb. Organic vapor monitoring was conducted by field personnel in accordance with SOP-06.33, Headspace Vapor Screening with a Photoionization Detector.

Upon recovery of a drilling core, materials were immediately screened for gross gamma radiation and volatile organic compounds (VOCs). After screening measurements indicated drilling core was below background levels, core material was sampled and logged. Gross alpha and beta/gamma radiation levels were collected for one minute at the area of the core exhibiting the highest reading. Radiological field-screening results were recorded on the corresponding sample collection logs (SCLs) (Appendix E), the borehole logs presented at the end of this appendix, and the RCT's Survey Form.

Headspace vapor screening for VOCs was performed with a PID. After completion of radiological surveys, portions of core material were removed and placed in quart-sized sealable plastic bags. Bags were sealed and samples were allowed to equilibrate for five minutes after which the sample was screened for VOCs by inserting the PID probe into each bag. Field-screening results were recorded on the corresponding SCL (Appendix E) and borehole logs presented at the end of this appendix.

B-2.3 Subsurface Borehole Sampling

Rock-core samples were collected from each of the boreholes for laboratory analyses based on the approved vapor-monitoring well installation work plan (LANL 2009, 106760; NMED 2009, 107304). Rock-core samples were collected at 20-ft intervals to a depth of 200 ft and 50-ft intervals below the 200-ft depth to the borehole total depth (TD). Sampling depths were adjusted to include the depths required for tritium monitoring to avoid unnecessary duplication of samples; therefore, the monitoring-port depth requirements superseded the vadose zone sampling depth requirements. The deepest sampling depth was 715 ft bgs, approximately 10 ft into the Puye Formation where the deepest tritium monitoring port (port 11) was installed.

Core material was collected in Lexan plastic coring tubes. Bulk-density core samples and unsaturated hydraulic conductivity samples were undisturbed as each Lexan plastic core tube was cut and prepared for laboratory analysis. The remaining core material was placed in the appropriate sampling containers, labeled, documented, and preserved (as applicable for laboratory analysis). The Lexan plastic core tube samples and additional sample containers were transported to the Sample Management Office (SMO). Samples were submitted for laboratory analysis including volumetric and gravimetric moisture content, soil bulk density, total porosity, chloride, fluoride, bromide, perchlorate, phosphorus, nitrate, sulfate, tritium, and saturated and unsaturated hydraulic conductivity testing. Field duplicate samples were submitted and analyzed in accordance with EP-ERSS-SOP-5059, Field Quality Control Samples. All SCLs and chain-of-custody (COC) forms collected during drilling operations are provided in Appendix E. Table 2.0-1 summarizes the samples collected. All samples were submitted to the SMO for processing and transport to off-site contract analytical laboratories.

B-2.4 Single-Packer Tritium Vapor Sampling

Single-packer subsurface vapor sampling was conducted and results were used to determine the vertical extent of tritium contamination before vapor-monitoring ports were installed. Subsurface vapor samples were collected in accordance with EP-ERSS-SOP-5074, Sampling for Sub-Atmospheric Air, to ensure subsurface vapor conditions were stabilized and representative of formation conditions prior to collection of sub-atmospheric (formation vapor) samples. Tritium vapor samples were collected in LabClear cartridges containing dehydrated silica gel desiccant.

Seven single-packer tritium vapor samples were collected from borehole location 21-24524W during HSA drilling. During borehole advancement, single-packer tritium vapor samples were collected at each vapor port installation depth. HSA flights were lifted 1 ft to expose the formation where the vapor port would be installed. Once the HSA flights had been lifted, the single packer was placed inside the HSA, lowered into the borehole, and inflated in the bottom HSA flight, thereby isolating the exposed formation interval in the borehole. A purge pump was used prior to sampling to withdraw borehole and formation vapors. Concentrations of purge indicator CO_2 and O_2 (parameter stabilization gases) were monitored continuously using a LandTec GEM 500 landfill gas monitor. Vapor sampling proceeded once indicator gas concentrations were stable and proper purge of the sampling system was verified.

Because of the potential injection of air into the formations when air-rotary drilling is used, no packer tests were performed in the air-rotary borehole, except at TD (717 to 721 ft bgs) in borehole 21-24524S. Once TD was reached, the subsurface pore gas was allowed to re-equilibrate for 48 h before the first vapor sample was collected. A single-packer tritium sample was collected at the TD of borehole 21-24524S where the deepest vapor-monitoring port was installed. To expose the formation where the vapor port was installed, the core-barrel sampler device used during air rotary drilling was removed from the borehole by a wire line on the drill rig. The single packer was then inflated in the bottom of the drill string thereby isolating the exposed formation interval in the borehole. Prior to sampling, a purge pump was used to withdraw borehole and formation vapors and concentrations of purge indicator CO_2 and O_2 (parameter stabilization gases) were monitored continuously using a LandTec GEM 500 landfill gas monitor. Once indicator gas concentrations were stable and proper purge of the sampling system was verified, vapor sampling proceeded.

All samples were submitted to the SMO for processing and transport to off-site contract analytical laboratories. The SCLs and COCs for the single packer sampling at borehole locations 21-24524W and 21-24524S are provided in Appendix E. Table 2.0-2 summarizes tritium samples collected.

B-2.5 Tritium Monitoring Well Construction and Installation

Vapor-monitoring well 21-24524W was constructed with seven vapor-sampling ports, and vapor-monitoring well 21-24524S was constructed with two vapor-sampling ports. Each of the nine vapor ports was built with a Geoprobe Systems AT86SW25 Soil Gas Implant consisting of a 0.0057-in. pore size, nominal 0.5-in.-diameter, 6-in. effective stainless-steel (SS) screen length, 0.25-in. Swagelok connection, and drive point connected to SS Swagelok sample tubing extending to the ground surface. The SS Swagelok sample tubing was 20 ft in length and 0.25-in. in diameter with 0.035-in.-thick walls and SS connections using 0.25-in. Swagelok union fittings. Inserted through the top of each of the sample tube connections below each of the unions was an inverted, conical Teflon nut manufactured by Hand Precision Machining. The Teflon nut base dimension was 0.6-in., with a 0.0248-in.-diameter reamed opening. The reamed opening allowed for the Teflon nut to be slid onto the SS sample tubing beneath and adjacent to the 0.56-in. squared edge of the union’s fastening nut. The placement of the Teflon nut ensured that the trailing lip of the shoe on the first piece of ODEX casing would not catch on the square edge of the union’s fastening nut, thereby not pulling the previously set port out of its filter pack during the ODEX casing removal from the borehole. Figure 1.0-3 in the main text shows the vapor-monitoring well construction.

During construction of both vapor-monitoring wells, all nine vapor ports were set at the mid-portion (approximately 2.5 ft) of their respective 5-ft-thick filter packs at the appropriate depths. The filter packs were constructed of 10/20 Carmeuse Colorado Silica Sand using 50-lb bags. One 50-lb bag of silica sand equals approximately 2.5 linear ft in a 6.0-in.-diameter borehole and approximately 1.0 linear ft in a 9.0-in.-diameter borehole. Each vapor port and the respective lengths of SS sample tubing, was constructed so that none of the Swagelok union fittings would be placed in an overlying vapor-sampling port filter pack.

Bentonite chips were tremied into the borehole and hydrated to isolate the filter pack sampling intervals. Intervals between each of the filter packs were constructed with 3/8-in. HolePlug Bentonite chips using 50-lb bags. One 50-lb bag of 3/8-in. bentonite chips equals approximately 3.5 linear ft in a 6.0-in.-diameter borehole, and approximately 1.67 linear ft in a 9.0-in.-diameter borehole. The bentonite chips were hydrated with approximately 3 gal. of potable water per 50-lb bag of chips.

The process for building each of the vapor-monitoring ports in their respective wells includes the following steps:

1. The TD of the borehole was measured and recorded.
2. Bentonite chips were added and hydrated to build a bentonite interval to the bottom of each respective filter pack depth. Depth measurements were constantly taken and recorded to ensure that building of the intervals was accurate.
3. A total of 2.5 ft of 10/20 silica sand was added to support the Geoprobe Systems AT86SW25 Soil Gas Implant. Depth was measured and recorded.
4. The vapor-sampling ports were assembled at the surface in 20-ft-long sections (to their appropriate length dependent on specified port depth) and lowered into the borehole to rest on the previously placed 2.5 ft of 10/20 silica sand. Depth was measured and recorded.

5. Once the SS vapor-sampling port had been assembled and the top of the port protruded above the ground surface, the top of each port was labeled to identify the port and depth of screen.
6. A SS cap was placed on top of the vapor-sampling port to contain the open end of the SS tubing. The cap was labeled to identify the port.
7. Another 2.5 ft of 10/20 silica sand was added to cover the vapor-sampling port and complete the filter pack silica sand design interval of 5.0 ft total depth. Depth was measured and recorded.
8. Bentonite chips were added and hydrated during placement to build a bentonite interval to the bottom of the next overlying vapor port filter pack depth. Depth measurements were constantly taken and recorded to ensure that building of the intervals was accurate.
9. Steps 3 through 7 were repeated for each successive vapor-sampling port assembly until all ports had been installed and the final bentonite interval had been placed to 2.0 ft bgs. Depth measurements were constantly taken and recorded to ensure that building of the intervals was accurate.
10. The 10/20 silica sand was added from 2.0 ft bgs to ground surface.
11. Flush mount surface completions were constructed once all of the vapor ports had been installed in each of their respective monitoring wells.

Surface completions of the flush mounted well pads were constructed to well R-18 axle load specifications for both vapor-monitoring wells. Construction of both well pads included pouring concrete into 3-ft-long × 3-ft-wide × 1-ft-deep forms surrounding the flush mount well plates, vaults, and rebar reinforcement lattice structures.

B-2.6 First-Quarter Tritium Vapor Sampling

Subsurface tritium vapor sampling was conducted with LANL's manifold and solar charging subsurface tritium vapor sampling system. The sampling event was conducted in accordance with EP-ERSS-SOP-5074, Sampling for Sub-Atmospheric Air, to ensure that subsurface vapor conditions were stabilized and representative of formation conditions before the collection of sub-atmospheric (formation vapor) samples. Tritium vapor samples were collected in LabClear cartridges containing dehydrated silica gel desiccant following the above referenced procedure.

B-2.7 Borehole Abandonment

The task of abandoning the borehole at location 21-02523 was included in the NMED-approved MDA V vapor-monitoring well installation and sampling work plan (LANL 2009, 106760; NMED 2009, 107304). Procedure ERSS-SOP-5034, Monitoring Well and Borehole Abandonment, was followed during borehole abandonment. Borehole 21-02523 had a TD of 305 ft bgs prior to the work, and contained a 10-in.-diameter steel surface casing, which extended to 20 ft bgs. To abandon the borehole, approximately 6 yd^3 of tremie grout was pumped down the well. The standard mixture for the tremie grout consisted of ten 50-lb bags of QUICKRETE Type I/II Portland cement, one 50-lb bag of QUICK-GEL high yield bentonite, and 200 gal. of water per batch. A total of 18 batches were used to fill borehole 21-02523 to a depth of 5 ft bgs.

After allowing the grout to set for just over a month, the ground around borehole 21-02523 was excavated to expose the top 5 ft of the steel well casing. Due to difficulties with a handheld grinder to cut the well casing, an acetylene torch was used. The excavation at borehole 21-02523 was then backfilled.

B-2.8 Site Restoration

Site restoration activities were performed as drill cuttings from the four 20 yd^3 roll-off bins were land applied per S0P-5238, Characterization and Management of Environmental Program Waste. The pulverized drill cuttings were placed at the site. Best management practices were then applied, including reseeding with native grasses and spreading wood straw to provide erosion control, followed by straw wattles to provide sediment control.

B-3.0 REFERENCES

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

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LANL (Los Alamos National Laboratory), August 2009. "Vadose Zone Subsurface Characterization and Vapor-Monitoring Well Installation Work Plan for Material Disposal Area V, Consolidated Unit 21-018(a)-99, Revision 1," Los Alamos National Laboratory document LA-UR-09-5021, Los Alamos, New Mexico. (LANL 2009, 106760)

NMED (New Mexico Environment Department), September 3, 2009. "Approval with Modifications, Vadose Zone Subsurface Characterization and Vapor-Monitoring Well Installation Work Plan for Material Disposal Area V, Consolidated Unit 21-018(a)-99," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2009, 107304)

Table B-1.0-1
Summary of Field Methods

Method	Summary
General Instructions for Field Investigations	This procedure provides an overview of instructions regarding activities to be performed before, during, and after field investigations. It is assumed field investigations involve standard sampling equipment, personal protective equipment, waste management, and site-control equipment/materials. The procedure covers premobilization activities, mobilization to the site, documentation and sample collection activities, sample media evaluation, surveillance, and completion of lessons learned.
Sample Containers and Preservation	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on the U.S. Environmental Protection Agency guidance for environmental sampling, preservation, and quality assurance. Specific requirements are met for each sample and are printed in the sample collection logs provided by the Laboratory's SMO (size and type of container, preservatives, etc.). Samples are preserved by placing them in insulated containers with ice to maintain a temperature of approximately 4°C.
Handling, Packaging, and Transporting Field Samples	Field team members seal and label samples before packing to ensure sample and transport containers are free of external contamination. Environmental samples are collected, preserved, packaged, and transported to the SMO under COC. The SMO arranges for shipping of samples to analytical laboratories. Any levels of radioactivity (i.e., action-level or limited-quantity ranges) are documented in SCLs submitted to the SMO.
Sample Control and Field Documentation	Collection, screening, and transport of samples are documented in standard forms generated by the SMO. These forms include SCLs, COC forms, sample container labels, and custody seals. Collection logs are completed at the time of sampling and are signed by the sampler and a reviewer who verifies the logs for completeness and accuracy. Corresponding labels are initialed and applied to each sample container, and custody seals are placed around container lids or openings. COC forms are completed and signed to verify that the samples are not left unattended.
Field Quality Control (QC) Samples	Field QC samples are collected as follows: Field duplicates (FDs) are collected at a frequency of 10% at the same time as a regular sample and submitted for the same analyses.
Sampling of Sub-Atmospheric Air	Vapor sampling was performed on the two newly-installed monitoring wells in accordance with the current version of EP-ERSS-SOP-5074 and analyzed for tritium. This SOP describes the process of sampling subatmospheric air from vapor ports in monitoring wells and boreholes.

Table B-1.0-2
List of Applicable General Procedures for
MDA V Well Installation and Pore-Gas Monitoring Activities

Document Number	LANL Procedure Title
EP-ERSS-SOP-5034	Monitor Well and Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) Borehole Abandonment
EP-ERSS-SOP-5055	General Instructions for Field Investigations
EP-ERSS-SOP-5056	Sample Containers and Preservation
EP-ERSS-SOP-5057	Handling, Packaging, and Transporting Field Samples
EP-ERSS-SOP-5058	Sample Control and Field Documentation
EP-ERSS-SOP-5059	Field Quality Control Samples
EP-ERSS-SOP-5061	Field Decontamination of Equipment
EP-ERSS-SOP-5074	Sampling for Sub-Atmospheric Air
EP-ERSS-SOP-5077	Field Sampling of Core and Cuttings for Geological Analysis
EP-ERSS-WSP-1001	Quality Assurance Project Plan for the Drilling Operations Project
P 101-6	Personal Protective Equipment
SOP-01.12	Field Site Closeout Checklist
SOP-01.13	Initiating and Managing Data Set Requests
SOP-06.24	Sample Collection from Split-Spoon Samplers and Shelby Tube Samplers
SOP-06.26	Core Barrel Sampling for Subsurface Earth Materials
SOP-06.33	Headspace Vapor Screening with a Photoionization Detector
SOP-10.14	Performing and Documenting Gross Gamma Radiation Scoping Surveys
SOP-12.01	Field Logging, Handling & Documentation of Borehole Materials
SOP-5181	Notebook Documentation for Environmental Restoration Technical Activities
SOP-5228	ADEP Reporting Requirements for Abnormal Events
SOP-5238	Characterization and Management of Environmental Program Waste

Attachment B-1

Borehole Logs
(on CD included with this document)

Appendix C

Quality Assurance/Quality Control Program

C-1.0 INTRODUCTION

This appendix presents the analytical methods and summarizes the data quality review for samples collected from June to October 2009 at Material Disposal Area (MDA) V, Consolidated Unit 21-018(a)-99, at Technical Area 21 at Los Alamos National Laboratory (LANL or the Laboratory).

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

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

C-2.0 ANALYTICAL DATA ORGANIZATION AND VINTAGE

The June to October 2009 vapor-monitoring tritium data are obtained from 19 samples (17 characterization and 2 field duplicate samples) collected during the first quarter sampling event from vapor-monitoring well locations 21-24524W and 21-24524S. The anion, perchlorate, and tritium rock-core data are obtained from 25 rock-core samples collected (22 characterization samples and 3 field duplicate samples). The geo-technical data (saturated hydraulic conductivity, total porosity, soil bulk density, and moisture content) were obtained from 26 characterization samples. Complete data packages and sample documentation for the 2009 samples are provided in Appendix E (on CD).

C-3.0 RADIONUCLIDE ANALYSIS METHODS

The vapor and rock-core samples collected from June to October 2009 were analyzed by U.S. Environmental Protection Agency (EPA) Method 906 for tritium (Table C-3.0-1). Table 2.0-2 from the main text summarizes all samples collected and the requested analyses. All tritium results are provided on CD in Appendix E.

C-3.1 Radionuclide Quality Assurance/Quality Control Samples

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

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

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

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

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

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

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

The data quality of the June to October 2009 MDA V tritium data is summarized below.

C-4.1.1 Tritium Qualified Data

During the June to October 2009 monitoring period, 19 pore-gas samples and 25 rock-core samples were collected and submitted for tritium analysis.

No tritium data were rejected and no data quality issues were identified.

Four tritium results were qualified as estimated and biased low (J-) because the associated matrix spike recovery was less than 10%.

One tritium result was qualified as estimated not detected (UJ) because the associated matrix spike recovery was less than 10%.

All validated tritium data collected in June to October 2009 from MDA V pore gas were used to evaluate tritium.

C-5.0 INORGANIC CHEMICAL ANALYSIS METHODS

Table C-5.0-1 lists the analytical methods used for anions, perchlorate, and geotechnical analyses.

C-5.1 Inorganic Chemical Quality Assurance/Quality Control Samples

LCSs, method blanks, MS samples, laboratory duplicate samples, interference check samples (ICSs), and serial dilution samples were analyzed to assess accuracy and precision of inorganic chemical analyses. The analytical services SOW defines each of these QA/QC sample types (LANL 2000, 071233). The following sections briefly describe the sample types.

The LCS serves as a monitor of the overall performance of each step during the analysis, including sample digestion. The analytical results for the samples were qualified according to National Functional Guidelines (EPA 1994, 048639) if the individual LCS recoveries were not within method-specific acceptable criteria. LCS recoveries should fall into the control limits of 75% to 125% (LANL 2000, 071233).

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 serve as a measurement of bias and potential cross-contamination. All target analytes should be below the contract-required detection limit (LANL 2000, 071233).

MS samples are used to assess the accuracy of inorganic chemical analyses. An MS sample provides information about the effect of each sample matrix on the sample preparation procedures and analytical technique. The spike sample recoveries should be within the acceptance range of 75% to 125% (LANL 2000, 071233).

Laboratory duplicate samples assess the precision of inorganic chemical analyses. All relative percent differences (RPDs) between the sample and laboratory duplicate should be ±35% in soil (LANL 2000, 071233).

ICSs verify interelement and background correction factors at the beginning and end of each analysis run.

Serial dilution samples are used to determine the concentration of an analyte when serial dilution is employed. The purpose of such dilution is to bring the concentration of an analyte in the sample within the range of the analysis or to increase the precision of the detected result.

The validation of inorganic chemical data can result in the assignment of various qualifiers to individual sample results or the rejection of the data. The inorganic chemical data were qualified using the appropriate SOPs, and the qualifiers do not affect the usability of the sampling results (except for R-qualified results). The qualified data (except R-qualified data) were used as reported.

C-5.2 Anion Qualified Data

Two perchlorate results were rejected because ion abundance rations did not meet specifications. The rejected data were not used to characterize the wells and do not affect the overall findings. There are 20 other samples analyzed for perchlorate. Therefore, no additional sampling for perchlorate is necessary.

One anion result was qualified as estimated (J) because the sample result was reported as detected between the instrument detection limit and the estimated detection limit.

Five anion results were qualified as estimated (J) because the analyte was identified in the method blank but was greater than 5 times.

Thirteen anion results were qualified as estimated and biased low (J-) because the associated matrix spike recovery was less than the lower acceptance limit (LAL) but greater than 10%.

Six anion results were qualified as estimated not detected (UJ) because the associated matrix spike recovery was less than the LAL but greater than 10%.

Eleven anion results were qualified as estimated not detected (UJ) because the ICV and/or CCV were recovered outside the method-specific limits.

C-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.

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

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)

Table C-1.0-1
Data Validation Procedures

Procedure	Title	Effective Date
SOP-5165, Rev. 0	Routine Validation of Metals Analytical Data	6/17/2008
SOP-5166, Rev. 0	Routine Validation of Gamma Spectroscopy, Chemical Separation Alpha Spectrometry, Gas Proportional Counting, and Liquid Scintillation Analytical Data	6/30/2008
SOP-5167, Rev. 0	Routine Validation of General Chemistry Analytical Data	6/30/2008
SOP-5191, Rev. 0	Routine Validation of LC/MS/MS Perchlorate Analytical Data	6/30/2008

Table C-3.0-1
Analytical Methods for Tritium Samples

Analytical Method	Analytical Description	Analytical Suite
EPA Method 906	Liquid Scintillation	Tritium

Table C-5.0-1
Analytical Methods for Geotechnical Parameter, Anion, and Perchlorate Samples

Analytical Method	Analytical Description	Analytical Suite
EPA Method 300	Ion chromatography	Bromide, chloride, fluoride, phosphorus, nitrate, sulfate
ASTM:D2434	Constant head method	Saturated hydraulic conductivity
ASTM:D6836	Calculated	Unsaturated hydraulic conductivity
ASTM:D2937	Drive-cylinder method	Bulk density
ASTM:D2216V	Drying sample and determining mass	Moisture (gravimetric and volumetric)
MOSA:18-1986	Calculated	Total porosity
EPA Method SW-846:6850	High-performance liquid chromatography/electrospray ionization/mass spectroscopy	Perchlorate

Appendix D

Investigation-Derived Waste Storage and Disposal

D-1.0 INTRODUCTION

This appendix contains the waste management records for the investigation-derived waste (IDW) generated while implementing the approved vapor-monitoring well installation work plan for Material Disposal Area (MDA) V (LANL 2009, 106760; NMED 2009, 107304) at Technical Area 21 (TA-21) of Los Alamos National Laboratory (LANL or the Laboratory).

All IDW generated during the vapor-monitoring well construction at MDA V was managed in accordance with Standard Operating Procedure (SOP) SOP-5238, Characterization and Management of Environmental Program Waste. This SOP incorporates the requirements of all applicable U.S. Environmental Protection Agency (EPA) and New Mexico Environment Department (NMED) regulations, U.S. Department of Energy (DOE) orders, and LANL requirements.

Consistent with Laboratory procedures, a waste characterization strategy form (WCSF) was prepared to address characterization approaches, on-site management, and final disposition options for wastes. Analytical data and information concerning wastes generated during well installation from previous investigations and/or acceptable knowledge (AK) were used to complete the WCSF. The WCSF is provided in this appendix as Attachment D-1 (on CD included with this document).

The selection of waste containers was based on appropriate U.S. Department of Transportation (DOT) requirements, waste types, and estimated volumes of IDW generated. Immediately following containerization, each waste container was individually labeled with a unique identification number and with information regarding waste classification, contents, and date generated. Wastes were staged in clearly marked and appropriately constructed waste accumulation areas. Waste accumulation area posting, regulated storage duration, and inspection requirements were based on the type of IDW and its classification. Container and storage requirements were detailed in the WCSF and approved before waste was generated.

Investigation activities were conducted in a manner that minimizes the generation of waste. Waste minimization was accomplished by implementing the most recent version of the “Los Alamos National Laboratory Hazardous Waste Minimization Report.”

D-2.0 WASTE STREAMS

The IDW streams generated and managed during the MDA V vapor-monitoring well installation are described below and summarized in Table D-2.0-1.

- Contact waste: This waste stream includes spent personal protective equipment, material used in dry decontamination of sampling equipment (e.g., paper towels) and plastic bags. These wastes were containerized in gallon-sized Ziploc plastic bags labeled accordingly and stored in a plastic-lined 30-gal. drum in a clam-shell at the Technical Area 21 (TA-21) Contractor Site Field Office. Characterization of this waste is conducted using AK and is pending final disposal at an authorized facility appropriate for the waste regulatory classification. The AK used was the data obtained from sampling the drill cuttings. The waste is characterized as low-level waste (LLW) and will be disposed at an authorized on-site or off-site facility.
- Drill Cuttings: This waste stream includes soil and tuff cuttings from boreholes. The drill cuttings were managed in accordance with the NMED-approved Notice of Intent (NOI) Decision Tree for Land Application of IDW Solids from Construction of Wells and Boreholes (November 2007). Drill cuttings were containerized in 20 yd^3 roll-off containers and characterized by direct sampling in

accordance with WCSF. Drill cuttings were generated both using a hollow-stem auger to obtain a continuous core and an air rotary drill. The drill cuttings were containerized at the point of generation and directly sampled. The cuttings were classified as non-hazardous waste to be land applied.

- Municipal Solid Waste (MSW): MSW consists of noncontact trash and debris and empty sample-preservation containers. The MSW was determined to be nonhazardous, nonradioactive municipal solid waste. It was stored in plastic-lined trash cans and disposed of at the Los Alamos County landfill.

D-3.0 REFERENCES

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NMED (New Mexico Environment Department), September 3, 2009. "Approval with Modifications, Vadose Zone Subsurface Characterization and Vapor-Monitoring Well Installation Work Plan for Material Disposal Area V, Consolidated Unit 21-018(a)-99," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2009, 107304)

Table D-2.0-1
Summary of IDW Generation and Management

Waste Stream	Waste Type	Volume	Characterization Method	On-Site Management	Disposition
Contact Waste	LLW	30 gal.	AK based on sampling and drill cutting analytical results	Plastic bags, 30-gal. drum	Disposed of at an authorized on-site or off-site facility
Drill Cuttings	Not applicable	25 yd^3	Direct sampling	Roll-off container, 55-gal. drums	Land application
Municipal Solid Waste	MSW	2 yd^3	AK	Plastic bags	Authorized off-site disposal facility

Attachment D-1

Waste Characterization Strategy Form
(on CD included with this document)

Appendix E

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