

A generalized stratigraphic cross-section is shown in Figure 4.3-1. Detailed cross-sections through MDA C, as defined by the stratigraphy encountered during drilling of the vapor-monitoring wells and regional wells R-46 and R-60, are shown in Figure 4.3-2. This figure also illustrates the vapor-monitoring ports and regional aquifer wells available for sampling during the Phase III investigation.

Known subsurface features at MDA C include disposal pits and shafts as shown in Figure 1.1-2. These features were specifically avoided during this investigation to prevent waste in the pits and shafts from being disturbed.

A buried utility corridor extends roughly east to west along the southern boundary of MDA C, between the boundary fence and Pajarito Road (Figure 4.3-3). This utility corridor contains electrical, water, industrial waste, and communications lines. The utilities were not disturbed during this investigation.

4.4 Groundwater Conditions

Groundwater occurs in three distinct modes on the Pajarito Plateau:

shallow alluvial groundwater found in canyon-bottom alluvium (LANL 1998, 059730);

- intermediate-depth saturated horizons; and
- the regional aquifer.

Regional monitoring well R-46 was installed 880 ft downgradient (east-southeast) of MDA C (Figure 4.1-1) to serve as a monitoring well for the site (LANL 2009, 105076). The upper surface of the regional aquifer is located in the Puye Formation, and the depth to water following well development at R-46 was 1327.9 ft bgs. In characterization well R-14 (Figure 4.1-1), located in Ten Site Canyon approximately 3000 ft (900 m) east of MDA C, groundwater was encountered at a depth of 1182 ft bgs (LANL 2003, 076062, p. 5).

Regional monitoring well R-60 was installed 100 ft downgradient (east) of MDA C (Figure 4.1-1) to serve as a monitoring well for the site (LANL 2009, 105076). The upper surface of the regional aquifer is located in the Puye Formation, and the depth to water following well completion at R-60 was 1319.5 ft bgs. The regional aquifer should be present at approximately this depth beneath MDA C. Figure G-1.0-1 shows the elevations of the top of the regional aquifer for an extended area of the Laboratory surrounding MDA C.

The regional aquifer is the only known aquifer in the Los Alamos area capable of producing a municipal and industrial water supply. The velocity of groundwater flow ranges from about 20 ft/yr to 250 ft/yr across the plateau (LANL 1998, 059599). Near MDA C, the groundwater velocity is approximately 450 ft/yr and the direction of groundwater flow in the regional aquifer is to the east-southeast, toward the Rio Grande (see Appendix G). More detailed information about groundwater flow directions beneath MDA C is presented in Appendix G.

No perched groundwater or intermediate-depth saturated horizons were encountered during previous investigations at MDA C (LANL 1998, 059599; LANL 2005, 091493, p. 6); in any of the boreholes drilled during this investigation; or during the drilling of regional wells R-46 or R-60. Perched groundwater was encountered in the Puye Formation and dacite lavas at wells R-17 and PCI-2, located in Pajarito Canyon, 3000 ft southeast of MDA C; however, these perched zones do not appear to extend under Mesita del Buey at MDA C, based on the results of drilling beneath the mesa. MDA C is located on a mesa top, so no shallow alluvial groundwater is present in the immediate vicinity. Alluvial groundwater is not known to be present in Ten Site Canyon to the north and northeast of MDA C.

4.5 Surface Water Conditions

No permanent surface water exists at MDA C. Occasional surface runoff occurs as a result of snowmelt or seasonal thunderstorms that can produce significant rainfall in short time periods. Surface runoff may occur as minor sheet flow that drains toward the east-northeast into the upper portion of Ten Site Canyon, which borders the northeast corner of the site. No significant drainage channels exist on the site.

4.6 Surface Air and Subsurface Vapor Conditions

Surface air conditions were monitored for health and safety purposes during the Phase III investigation using a Data Ram portable dust monitor. Surface air conditions did not exceed dust action levels for either inorganic chemicals or radionuclides and did not result in any impacts to the investigation activities. Subsurface vapor-screening results are presented in Table 3.1-1.

5.0 REGULATORY CRITERIA

Regulatory criteria are used for the purpose of screening investigation results. The Phase III investigation involved collecting subsurface dacite, groundwater, and vapor samples. The dacite samples were collected at depths of over 600 ft bgs for the purpose of evaluating ranges of inorganic chemical concentrations in dacite. These samples were not collected to screen against regulatory criteria. All groundwater samples collected by the Laboratory, including those collected from the well installed as part of the Phase III investigation, were screened in accordance with the specific criteria in Section IV.A.3.g of the Consent Order. Screening results are reported monthly to NMED (e.g., LANL 2011, 203596), and no additional groundwater screening was performed as part of the Phase III investigation. Screening of the Phase III vapor data is described below.

The Consent Order does not specifically address cleanup standards, SLs, or other regulatory criteria for vapor. Appendix F describes the methodology used to screen vapor-phase VOCs detected in the vadose zone beneath MDA C. A screening method that compares vapor-phase concentrations with screening values is presented in the periodic monitoring reports for vapor-sampling activities at the Laboratory (e.g., LANL 2010, 109955) and is discussed in Appendix F as a Tier I screening evaluation.

The Tier I screening evaluation uses Henry's law to identify the vapor-phase VOC concentration thresholds that have to be exceeded for a given VOC to potentially impact the groundwater at concentrations exceeding applicable groundwater standards. If the Tier I SL is exceeded for a given VOC, the Tier II screen is applied. The Tier II screen considers the migration of the VOCs to the water table and subsequent mixing with groundwater. This analysis includes migration of VOCs through the vadose zone in both the pore water and vapor phases. The resulting groundwater concentration following mixing immediately beneath the site is calculated and compared with applicable groundwater standards.

6.0 SITE CONTAMINATION

6.1 Subsurface Sampling of Tschicoma Formation Dacite

In 2010, four dacite samples, plus one field duplicate, were collected and analyzed for TAL metals. Two dacite samples were collected new boreholes 50-613184 and 50-613185, drilled during the Phase III investigation. Samples were collected from two depths, approximately 20 vertical ft apart, in the two boreholes. Table 3.3-5 lists the dacite samples collected and the analyses requested for each sample.

Figure 6.2-1 summarizes the horizontal and vertical distribution of the TCE vapor plume at MDA C. TCE results are presented because TCE is the most frequently detected VOC and is present at the highest concentrations. As shown in Figure 6.2-1, the highest TCE concentrations are located approximately 250 ft below the eastern end of MDA C and concentrations decrease in all directions. The shape of the plume is not affected by stratigraphic controls, such as dipping interfaces. A detailed evaluation of vapor data, including the results of Tier I and Tier II screening evaluations and calculation of subsurface contaminant mass, is presented in Appendix F.

6.2.1.2 Tritium

First Quarter FY2011

A total of 140 vapor samples, including 13 field duplicates, were collected from 127 sampling ports at the 14 monitoring wells during the first quarter of FY2011. The samples were submitted to an off-site contract analytical laboratory for analysis of tritium. Table 6.2-4 presents the activities of detected tritium in vapor samples collected from the 14 monitoring wells sampled during the first quarter of FY2011. Tritium was detected in each of the 14 monitoring wells sampled for tritium during the first quarter of FY2011. The sampling locations and detected activities are shown on Plate 7.

Second Quarter FY2011

A total of 170 vapor samples, including 16 field duplicates, were collected from 154 sampling ports at 18 monitoring wells during the second quarter of FY2011. The samples were submitted to an off-site contract analytical laboratory for analysis of tritium. Tritium was detected in vapor samples in 17 of the 18 monitoring wells sampled for tritium during the second quarter of FY2011. Table 6.2-5 presents the activities of detected tritium in vapor samples collected from the 18 boreholes sampled during second quarter of FY2011. The sampling locations and detected activities are shown on Plate 8.

Third Quarter FY2011

A total of 172 vapor samples, including 18 field duplicates, were collected from 154 sampling ports at 18 monitoring wells in the third quarter of FY2011. The samples were submitted to an off-site contract analytical laboratory for analysis of tritium. Tritium was detected in 17 of the 18 boreholes sampled for tritium during the third quarter of FY2011. Table 6.2-6 presents the activities of detected tritium in vapor samples collected from the 18 boreholes sampled during the third quarter of FY2011. The sampling locations and detected activities are shown on Plate 9.

6.3 Regional Groundwater Sampling Results

The current regional aquifer monitoring network for MDA C consists of regional wells R-46 and R-60, both of which are to the east (downgradient) of MDA C. Well R-46 was installed in 2009 to detect contaminants potentially migrating from MDA C toward water-supply well PM-5. R-60 was installed in 2010 as part of the Phase III investigation for MDA C. Well R-60 is designed for early detection of contaminant releases and is screened at the top of the regional aquifer at the eastern boundary of MDA C. As discussed in Appendix G, wells R-46 and R-60 provide a high probability of detecting releases of VOCs (99.7%) and tritium (95.9%).

Two VOCs (acetone and toluene) have been detected in R-46. Acetone was detected in five samples collected over the period May 2009 to February 2010. Concentrations decreased over time from 60.3 µg/L in the May 2009 sample to 6.24 µg/L in the February 2010 sample. Acetone was not detected in samples collected since February 2010. Toluene was detected in eight samples collected over the period

May 2009 to November 2010. Concentrations decreased over time from 10.9 µg/L in the May 2009 sample to 0.38 µg/L in the November 2010 sample. Toluene was not detected in one sample collected at R-46 since November 2010. Tritium was not detected in six samples collected at R-46 from March 2009 to February 2010. Tritium was detected at 36.7 pCi/L in the sample collected in May 2010 and 24.4 pCi/L in the sample collected in November 2010. All results from R-46 are reported in the periodic monitoring reports for Mortandad and Sandia watersheds (e.g., LANL 2011, 203407).

Groundwater samples were collected from R-60 in December 2010, after well development, and in January 2011 as part of quarterly watershed monitoring. The results from the December 2010 sampling showed six organic chemicals detected. Four polycyclic aromatic hydrocarbons ([PAHs] benzo[a]pyrene; benzo[b]fluoranthene; benzo[g,h,i]perylene; and benzo[k]fluoranthene) and one VOC (acetone) were detected. Two of these PAHs were detected above SLs: benzo[a]pyrene was detected at 0.851 µg/L, which exceeds the maximum contaminant level of 0.2 µg/L, and benzo[b]fluoranthene was detected at 0.714 µg/L, which exceeds the EPA tap water SL of 0.29 µg/L. One additional PAH (dibenz[a,h]anthracene) was detected only in a field duplicate sample at 1.35 µg/L, which exceeds the EPA tap water SL of 0.029 µg/L. Acetone was detected at 68.5 µg/L, which is less than the EPA tap water SL of 22,000 µg/L. Five inorganic chemicals (aluminum, iron, manganese, molybdenum, and zinc) were detected above background levels, but none exceeded an SL. These results were reported to NMED in the February 2011 groundwater data review (LANL 2011, 201565). Only one organic chemical, 4-nitrotoluene, was detected the sample collected in January 2011. Nitrotoluene(4-) was detected at 0.327 µg/L, which is less than the EPA tap water SL of 42 µg/L. This result was reported to NMED in the March 2011 groundwater data review (LANL 2011, 202271). No VOCs were detected in the January 2011 sample.

VOCs and semivolatile organic compounds are commonly detected in initial samples collected at newly installed monitoring wells and are associated with drilling products or installation activities. In these cases, the highest concentrations are typically observed in the first or second sampling rounds, and concentrations steadily decline thereafter from the gradual removal via groundwater flow, purging, and biodegradation. This behavior was observed for acetone and toluene at R-46 and is expected to occur at R-60.

7.0 CONCLUSIONS

The conclusions presented in the following sections are based on the results of all investigations to date, including the 2010 to 2011 Phase III investigation.

7.1 Nature and Extent of Inorganic Chemical Contamination in Surface and Near-Surface Soil

The nature and extent of inorganic chemical contamination in surface and near-surface soil were evaluated during the Phase II and earlier investigations. Based on the results of these two phases of investigation, the Phase II investigation report concluded the lateral and vertical extent of contamination are defined for all inorganic chemicals in the surface and near-surface at MDA C (LANL 2009, 107389, p. 22).

7.2 Nature and Extent of Contamination in Tuff

7.2.1 Inorganic Chemicals in Tuff

The nature and extent of inorganic chemical contamination in tuff core were evaluated during the 2004 to 2006 and Phase II investigations. Based on the results of these two phases of investigation, the Phase II investigation report concluded the lateral and vertical extent of contamination are defined for all inorganic chemicals in tuff at MDA C (LANL 2009, 107389, p. 23). This conclusion was based on decreasing