DEPARTMENT OF ENERGY
Environmental Management Los Alamos Field Office (EM-LA)
Los Alamos, New Mexico 87544

EMLA-23-BF197-2-1

April 20, 2022

Mr. Rick Shean
Acting Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6313

Subject: Submittal of the Periodic Monitoring Report for 2022 Vapor-Sampling and Soil-Vapor Extraction at Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54

Dear Mr. Shean:

Enclosed please find two hard copies with electronic files of the "Periodic Monitoring Report for 2022 Vapor-Sampling and Soil-Vapor Extraction at Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54." This periodic monitoring report summarizes vapor-monitoring activities conducted for calendar year 2022 at Material Disposal Area (MDA) L, Solid Waste Management Unit 54-006, in Technical Area 54, at Los Alamos National Laboratory. Two sampling rounds were conducted, the first in June and July 2022, and the second in October 2022.

The report is being submitted to fulfill fiscal year 2023 Milestone 14 in Appendix B of the 2016 Compliance Order on Consent. The monitoring was conducted per the recommendations included in the "Interim Measures Final Report for Soil-Vapor Extraction of Volatile Organic Compounds from Material Disposal Area L, Technical Area 54." The objectives of the current vapor monitoring at MDA L are to monitor for potential plume rebound following an interim measure conducted in 2015, and to monitor for potential new releases.

If you have any questions, please contact Kevin Reid at (505) 257-7710 (kevin.reid@em-la.doe.gov) or Cheryl Rodriguez at (505) 414-0450 (cheryl.rodriguez@em.doe.gov).

Sincerely,

ARTURO DURAN

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Arturo Q. Duran
Compliance and Permitting Manager
U.S. Department of Energy
Environmental Management
Los Alamos Field Office

Enclosure(s):

1. Two hard copies with electronic files:
   Periodic Monitoring Report for 2022 Vapor-Sampling and Soil-Vapor Extraction at Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54 (EM2023-0049)

cc (letter with CD/DVD enclosure[s]):
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May 2023
EM2023-0049

Periodic Monitoring Report for 2022 Vapor-Sampling and Soil-Vapor Extraction at Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54

EM2023-0049

Periodic Monitoring Report for 2022 Vapor-Sampling and Soil-Vapor Extraction at Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54

May 2023

Responsible program director:

Printed Name	Signature	Title	Organization	Date
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Responsible N3B representative:

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Troy Thomson		Program Manager	N3B Environmental Remediation Program	4/13/23

Responsible DOE EM-LA representative:

Printed Name	Signature	Title	Organization	Date
Arturo Q. Duran	ARTURO DURAN Digitally signed by ARTURO DURAN Date: 2023.04.18 07:14:24 -06'00'	Compliance and Permitting Manager	Office of Quality and Regulatory Compliance	

EXECUTIVE SUMMARY

This periodic monitoring report (PMR) summarizes vapor-monitoring and soil-vapor extraction (SVE) activities conducted for calendar year 2022 at Material Disposal Area (MDA) L, Solid Waste Management Unit 54-006, in Technical Area 54, at Los Alamos National Laboratory. Submittal of this PMR fulfills the New Mexico Environment Department requirement in Appendix B, Milestones and Targets, of the Compliance Order on Consent, Milestone 14, that this PMR be submitted by May 30, 2023. The monitoring was conducted per recommendations included in the 2022 "Interim Measures Final Report for Soil-Vapor Extraction of Volatile Organic Compounds from Material Disposal Area L, Technical Area 54, Revision 1" (IM Final Report, Revision 1). The objectives of the vapor monitoring at MDA L are to monitor for potential plume rebound following an interim measure (IM) conducted in 2015 and to monitor for potential new releases.

Vapor monitoring for calendar year 2022 consisted of two sampling rounds. The first round was performed in June and July and involved collecting 36 vapor samples from 36 sample ports within the 7 sentry boreholes. The second calendar year 2022 sampling event was performed in October 2022 and also involved collecting 36 samples from 36 sample ports within the 7 sentry boreholes. Vapor samples were then submitted for laboratory analysis of volatile organic compounds (VOCs) and tritium. Analytical methods and data review procedures are discussed in Appendix C.

Validated analytical results demonstrated the presence of 28 VOCs in the first sampling round and 34 VOCs in the second sampling round. The sampling confirmed the presence of 2 VOC source areas. The VOC screening evaluation identified 14 VOCs in the first round and 15 VOCs in the second round (the same 14 from the first round plus one additional) that exceeded Tier I screening levels (SLs), which are based on groundwater SLs.

The October 2022 data show concentrations of 1,4-dioxane that are greater than Tier I SLs in the two deepest sample ports in the basalt in borehole 54-24399. The measured value in the deepest sample is greater than the method detection limit; however, it is much less than the analytical laboratory's report detection limit (i.e., quantitation limit). The measured value from the shallower of the two samples was greater than the report detection limit. Data from the first round of sampling for 2022 (July 2022) show no detected 1,4-dioxane in borehole 54-24399. This compound should be monitored carefully for continued detection, and a focused validation of the raw data will be performed to verify that the measured detections are valid. No other VOCs were detected above Tier I SLs in basalt.

VOC measurements in sentry boreholes are substantially lower than concentrations before the 2015 IM, but have shown some rebound from possible leakage over the last 7 yr since the IM. The decreases in concentration are primarily the result of the soil-vapor extraction operations during the 2015 IM, during which time more than 1000 lb of VOCs were removed from the VOC plume under the mesa.

A preliminary screening of VOC concentrations versus vapor intrusion screening levels (VISLs), conducted for both sampling rounds, shows that VISLs were exceeded in some of the shallowest sampling ports near buildings.

Tritium was detected in 9 of 36 samples in the first round and 14 of the 36 samples in the second round. The second-round result at 173 ft in borehole 54-24241 was the maximum detected tritium activity in the second round, and was substantially higher than all previous results at this location. Results from this location will be monitored to determine whether this result is anomalous, or represents an increasing trend.

SVE activities for 2022 consisted of submittal of the IM Final Report, Revision 1. Operation of the SVE system as recommended in the IM Final Report, Revision 1 will be initiated in 2023.

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1.0 INTRODUCTION

This periodic monitoring report (PMR) presents the results of vapor-monitoring and soil-vapor extraction (SVE) activities conducted for calendar year 2022 at Material Disposal Area (MDA) L, Solid Waste Management Unit (SWMU) 54-006, in Technical Area 54, at Los Alamos National Laboratory (LANL or the Laboratory). Submittal of this PMR fulfills the requirement in Appendix B, Milestones and Targets, of the 2016 Compliance Order on Consent (Consent Order) Milestone 14, that this PMR be submitted by May 30, 2023. The monitoring was conducted per the recommendations included in the "Interim Measures Final Report for Soil-Vapor Extraction of Volatile Organic Compounds from Material Disposal Area L, Technical Area 54, Revision 1" (IM Final Report, Revision 1) (N3B 2022, 702169). Consistent with the recommendations of the IM Final Report, Revision 1, a single annual report that replaces the annual MDA L vapor-sampling periodic monitoring report is being submitted to report all monitoring data and SVE operations details.

The objectives of the current vapor monitoring and SVE activities at MDA L are to:

1. monitor for potential plume rebound following an interim measure (IM) conducted in 2015,
2. monitor for potential new releases,
3. operate the soil-vapor extraction (SVE) IM system twice annually, in the spring and fall, and
4. provide early warning of possible impacts to the regional groundwater.

This report discusses the results obtained during the vapor-monitoring rounds in June–July and October, 2022; however, for comparison, vapor monitoring data from previous monitoring activities beginning in 2014 at MDA L are included in the data-evaluation section of this report. Vapor-monitoring activities included collecting vapor samples from vapor-monitoring boreholes. All pore-gas samples from both sampling rounds were submitted for off-site analysis of volatile organic compounds (VOCs) and tritium.

No regulatory criteria exist for vapor-phase contaminants; therefore, this report presents results of a screening evaluation of the pore-gas VOC data. The VOC concentration for the hypothetical case of the VOC pore gas being in contact with groundwater is determined by a Henry's law calculation using the maximum concentrations of VOCs in pore gas.

Section IX of the Consent Order describes the role of data screening in the corrective action process. Screening values are used to identify the *potential* for unacceptable risk resulting from the presence of contaminants in groundwater. Screening levels (SLs) for evaluating pore-gas monitoring data for potential impacts to groundwater are based on New Mexico Water Quality Control Commission (NMWQCC) groundwater standards, U.S. Environmental Protection Agency (EPA) maximum contaminant levels (MCLs), New Mexico Environment Department (NMED) SLs for tap water, and EPA regional SLs for tap water.

VOC pore-gas concentrations are also compared with NMED vapor intrusion screening levels (VISLs) as detailed in NMED "Risk Assessment Guidance for Site Investigations and Remediation Volume 1, Soil Screening Guidance for Human Health Risk Assessments" (NMED Risk Assessment Guidance) (NMED 2022, 702484)to ensure worker protection if the VOCs in pore gas were to migrate above the ground surface into structures,.

Tritium samples were collected in both sampling rounds. 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.

SVE activities for 2022 consisted of submittal of IM Final Report, Revision 1. Operation of the SVE system as recommended in the IM Final Report, Revision 1 will be initiated in 2023.

This introductory section of the report describes the site location and history. Section 2 describes the scope of the vapor-monitoring activities, section 3 addresses regulatory criteria, section 4 presents field-screening results, section 5 presents analytical data results, section 6 summarizes the information presented in this report, and section 7 includes references and map data sources.

The appendices include acronyms, a metric conversion table, and definitions of data qualifiers (Appendix A); field methods (Appendix B); analytical program descriptions and summaries of data quality (Appendix C); a VOC plume trend analysis (Appendix D); and analytical suites and results and analytical reports (Appendix E on DVD included with this document).

1.1 Background

MDA L, also known as SWMU 54-006, is located in the east-central portion of the Laboratory on Mesita del Buey (Figure 1.1-1), within a 2.5-acre fenced area known as Area L. MDA L operated from the early 1960s to 1986 as the designated disposal area for containerized and uncontainerized nonradiological liquid chemical wastes; bulk quantities of treated aqueous waste; batch-treated salt solutions and electroplating waste, including precipitated heavy metals; and small-batch quantities of treated lithium hydride. Waste was disposed of in 1 pit, 3 impoundments, and 34 shafts (Figure 1.1-2). Two additional shafts (shafts 36 and 37) were used for storage of solid mixed waste.

Disposal shafts 1 through 34 were dry-drilled directly into the Tshirege Member of the Bandelier Tuff. The shafts range from 3 to 8 ft in diameter and from 15 to 65 ft in depth. The 34 disposal shafts were used to dispose of containerized and uncontainerized liquid chemical wastes and precipitated solids from the treatment of aqueous waste. Before 1982, containerized liquids were disposed of without the addition of absorbents. Small containers were typically dropped into a shaft. Larger drums were lowered by crane and arranged in layers of 1 drum in a 3- or 4-ft-diameter shaft, 4 to 5 drums in a 6-ft-diameter shaft, or 6 drums in an 8-ft-diameter shaft. The space around the drums was filled with crushed tuff, and a 6-in. layer of crushed tuff was placed between each layer of drums. Uncontainerized liquid wastes were also disposed of in the shafts. Between 1982 and 1985, only containerized wastes, including organic and inorganic liquids, precipitated heavy metals, and stabilized heavy metals, were disposed of in the shafts. These shafts are the primary source for the subsurface VOC vapor plume beneath MDA L (LANL 2011, 205756).

Soil-vapor monitoring boreholes located within and around MDA L have been used to characterize the nature and extent of the subsurface vapor plume at the site since 1986. Figure 1.1-3 shows the pore-gas monitoring boreholes at MDA L. Concentrations in the subsurface VOC plume are generally highest within 150 ft below ground surface (bgs) and decrease significantly with depth to the top of the Cerros del Rio basalts. Concentrations are highest within and below the two source regions, corresponding to the east and west shaft clusters shown in Figure 1.1-2. The west shaft cluster includes shafts 29–34 while the east shaft cluster comprises shafts 1–28.

The hydrogeologic framework for the contaminated subsurface at MDA L is based on years of data collection, including results from a 2006 pilot SVE test at the site (LANL 2006, 094152) and the 2015 SVE IM (N3B 2018, 700039). The current IM uses the same two wells used during the 2006 pilot test: SVE-East and SVE-West (Figure 1.1-3). After disposal activities at the site ended, most of the site's surface was covered with asphalt and/or chemical waste storage structures. The site is currently used for Resource Conservation and Recovery Act–permitted chemical waste storage and treatment and for mixed-waste storage.

2.0 SCOPE OF ACTIVITIES

Recommendations in the IM Final Report, Revision 1, which form the basis for vapor-sampling and SVE activities at MDA L, include the following:

1. Conduct semiannual monitoring of sentry boreholes located in the source region to allow early detection of potential container failure. Boreholes 54-24240 and 54-27641 on the western side of MDA L are sentry boreholes. On the eastern side of MDA L, boreholes 54-24238, 54-24241, and 54-27642 and open borehole 54-24399 are sentry boreholes. Peripheral borehole 54-02089 was added to the sentry borehole sampling network in 2020 because of an increase in concentrations over the last several sampling events.
2. Monitor peripheral boreholes once every 2 yr for evidence of plume expansion.
3. Conduct semiannual monitoring of deep borehole 54-24399 as a sentry borehole to further characterize long-term trends of VOC concentrations in the basalt and to provide data needed to support the corrective–measures. evaluation process (e.g., updating the conceptual model for transport and developing cleanup goals).
4. Operate the SVE units in the spring and fall seasons to continue mass removal. The first run is planned for a duration of four weeks, and could start in the spring or fall of 2023, depending on the maintenance required to restore the SVE system to operational status. The results of the effluent analyses for the initial operation cycle will be used to determine run times for the next operation cycle. Thereafter, the operation schedule of the SVE units will be adjusted as necessary to adapt to changing subsurface concentration data, and will continue until a final remedy is implemented at MDA L.
5. In addition to the planned spring and fall operation, activate the eastern SVE unit if, at any time, total VOC concentrations in any ports in the eastern sentry boreholes rise above 2000 ppmv, with a trend of consistent increase with each consecutive measurement for ports to depths of 100 ft, and adapt the eastern SVE system as necessary to run as continuously as possible until concentrations drop below 2000 ppmv.
6. In addition to the planned spring and fall operation, activate the western SVE unit if, at any time, total VOC concentrations in any ports in the western sentry boreholes rise above 2000 ppmv, with a trend of consistent increase with each consecutive measurement for ports to depths of 100 ft, and adapt the western SVE system as necessary to run as continuously as possible until concentrations drop below 2000 ppmv.
7. Report all monitoring data and SVE operations details in a single report to be submitted annually to NMED. This report will replace the current MDA L Periodic Monitoring Report, and renamed to indicate the addition of the SVE operational details.

The first round of calendar year 2022 pore-gas monitoring sampling occurred in June and July 2022, and the second round occurred in October 2022. Tables 2.0-1 and 2.0-2 list the vapor-monitoring locations, port depths, and corresponding sampling intervals. (For details of sampling protocols, see “Sampling Subsurface Vapor,” N3B-SOP-ER-2008.) The following pore-gas monitoring activities were conducted.

- Before sampling, boreholes were field-screened using portable gas detectors to measure concentrations of carbon dioxide (CO_2), oxygen (O_2), and total VOCs. For both sampling rounds, a total of 36 ports in 7 vapor-monitoring boreholes (Figure 1.1-3) were field-screened.

- In the first sampling round, a total of 44 pore-gas samples (36 regular samples, 4 field duplicate samples, and 4 field blank samples) were collected for VOC analysis, and a total of 44 pore-gas samples (36 regular samples, 4 field duplicate samples, and 4 field blank samples) were collected for tritium analysis from the 7 sentry boreholes (Figure 1.1-3).
- In the second sampling round, a total of 44 pore-gas samples (36 regular samples, 4 field duplicate samples, and 4 field blank samples) were collected for VOC analysis, and a total of 44 pore-gas samples (36 regular samples,4 field duplicate samples, and 4 field blank samples) were collected for tritium analysis from the 7 sentry boreholes (Figure 1.1-3).
- After collection, samples were submitted to the Newport News Nuclear BWXT-Los Alamos, LLC (N3B) Sample Management Office for shipment to analytical laboratories per N3B-SOP-SDM-1102, “Sample Receiving and Shipping by the N3B Sample Management Office.” Vapor samples were submitted to off-site analytical laboratories in SUMMA canisters for VOC analysis using EPA Method TO-15 and in silica-gel columns for tritium analysis using EPA Method 906.
- All analytical data were subjected to data validation reviews in accordance with N3B guidance and procedures. Field duplicate samples were collected at a minimum frequency of 1 for every 10 samples. The data validation process for reviews of MDA L pore-gas data is presented in Appendix C.

Waste generated from sampling activities was handled in accordance with the waste characterization strategy form for MDA L developed in accordance with N3B-AP-TRU-2150, “Waste Characterization Strategy Form.”

Further discussion of the field methods used for pore-gas field screening and sample collection is presented in Appendix B. Field chain-of-custody forms and sample collection logs are provided in Appendix E (on DVD included with this document).

The pore-gas field-screening results are discussed in section 4, and the pore-gas analytical results are discussed in section 5. There were no deviations from the monitoring recommendations of the IM Final Report, Revision 1 in either sampling round.

3.0 REGULATORY CRITERIA

VOCs present in wastes disposed of at MDA L may vaporize and be released into subsurface media (e.g., soil, tuff, fractured rock). These vapor-phase contaminants may potentially be transported through the subsurface to the water table and dissolve into the water. Thus, vapor-phase contaminants are a potential source of groundwater contamination. For MDA L, subsurface vapors are being monitored to evaluate the potential for groundwater contamination or, if necessary, to evaluate the need for corrective actions to prevent possible groundwater contamination.

Under the Consent Order, results of environmental investigations and monitoring are compared with SLs, which are media-specific contaminant concentrations that indicate the potential for unacceptable risk. The Consent Order specifies the use of SLs for soil and groundwater developed by NMED to evaluate soil and groundwater contamination. NMED has developed VISLs for evaluating the potential for vapor intrusion into buildings and subsequent exposure through inhalation; however, NMED’s VISLs do not address potential migration of vapors to groundwater.

Because the Consent Order does not identify SLs for subsurface vapor as a potential groundwater contamination source, N3B developed Tier I SLs to evaluate the potential for contamination of groundwater by VOCs in pore gas. The Tier I approach evaluates whether pore gas containing a VOC at the concentration detected in the vapor sample could contaminate groundwater above the groundwater SL. The approach assumes that pore gas containing VOCs at the concentrations detected in the pore-gas sample is in hypothetical contact with the water table in sufficient quantity to dissolve into groundwater in accordance with Henry's law. If Tier I SLs are not exceeded, VOCs cannot contaminate groundwater above cleanup levels even if the vapor plume comes into direct contact with groundwater, and no further screening is necessary.

3.1 Tier I Soil-Vapor Screening

The Tier I screening analysis calculates the pore-gas concentration that would be in equilibrium with a groundwater concentration equal to the groundwater SL. The equilibrium between pore-gas and groundwater SLs is described by Henry's law partitioning. If the maximum pore-gas concentration is less than the pore-gas SL, then no potential exists for exceedances of groundwater cleanup levels.

Because there are no SLs for soil vapor that address the potential for groundwater contamination, the screening evaluation is based on Section IX of the Consent Order, which describes the role of data screening in the corrective action process, and the Henry's law constant that describes the equilibrium between vapor and water concentrations. As described in Section IX.C of the Consent Order, SLs are contaminant concentrations that indicate the potential for unacceptable risk. The presence of contaminants at concentrations greater than SLs does not necessarily indicate that cleanup is required but does indicate the need for additional risk evaluation to determine the potential need for cleanup. The source of Henry's law constants is the NMED Risk Assessment Guidance or the EPA regional screening tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables). The following dimensionless form of Henry's law constant is used:

$$H' = \frac{C_{air}}{C_{water}}$$ **Equation 3.1-1**

where, H' = the dimensionless Henry's law constant,

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

C_{air} = the volumetric concentration of the contaminant in air (or pore gas).

If the air concentration is equal to the pore-gas SL and the water concentration is equal to the groundwater SL, Equation 3.1-1 can be used to calculate the Tier I pore-gas SL as follows:

$$SL_{pgI} = H' \times SL_{gw} \times 1000$$ **Equation 3.1-2**

where, SL_{pgI} = the Tier I pore gas SL (µg/m^3),

SL_{gw} = the groundwater SL (µg/L), and

1000 = a conversion factor (to convert L to m^3).

The Tier I methodology conservatively assumes that groundwater is in equilibrium with the maximum detected concentration of a VOC in pore gas. This assumption would be true only if the maximum pore-gas concentration was immediately above the water table. At MDA L, the samples with maximum VOC concentrations are hundreds of feet above the water table, and VOC concentrations decrease with depth below the maximum concentrations because of diffusion (see cross-sections in Appendix D). The Tier I methodology also assumes that the equilibrium groundwater concentration is representative of the aquifer. This equilibrium exists only at the air-water interface, and water concentrations in the aquifer away from the interface decrease because of mixing with clean water. Therefore, assuming equilibrium conditions conservatively overestimates the concentration in groundwater.

Identification of groundwater SLs is consistent with the process in Section XXVI.D of the Consent Order for evaluating groundwater monitoring data. For each individual VOC, the lower concentration of the NMWQCC groundwater standard or EPA MCL is used as the groundwater SL. If an NMWQCC groundwater standard or an MCL has not been established for a specific substance for which toxicological information is published, the NMED SL for tap water is used as the groundwater SL. NMED tap water SLs are established for either a cancer- or noncancerous-risk type; for the cancer-risk type, SLs are based on a 10^{-5} excess cancer risk specified by the Consent Order. If a VOC has SLs for both cancer and noncancer risk, the lower of the two SLs is used. This report was prepared using the November 2022 "NMED Risk Assessment Guidance for Site Investigations and Remediation Volume 1, Soil Screening Guidance for Human Health Risk Assessments" (NMED 2022, 702484). If an NMED tap water SL has not been established for a specific substance for which toxicological information is published, the EPA regional SL for tap water (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables) is used. EPA tap water SLs are also established for either a cancer- or noncancerous-risk type. The EPA tap-water SLs, based on a 10^{-6} excess cancer risk, are multiplied by 10 to convert them to 10^{-5} risk for equivalence with NMED SLs.

Table 3.1-1 presents Tier I pore gas SLs calculated using Equation 3.1-2. Table 3.1-2 presents the results of the Tier I screening for the first round of 2022 soil-vapor data. Table 3.1-3 presents the results of the Tier I screening for the second round of 2022 soil-vapor data. The first round of sampling identified 14 VOCs that exceeded the Tier I SL, while the second round identified 15 VOCs that exceeded the Tier I SL (1,1,2,2-tetrachloroethane in addition to the same 14 VOCs that were detected in the first round). An analysis of the MDA L data is presented in section 5.0 and Appendix D.

3.2 Vapor Intrusion Screening Levels for Potential Human Exposure

NMED has developed VISLs for chemicals determined to be sufficiently volatile and toxic that are most commonly associated with environmental releases within the state. These are listed in the NMED Risk Assessment Guidance.

NMED guidance on evaluating a vapor intrusion pathway does not specify a sample depth that needs to be evaluated against the VISLs. The guidance does specify that evaluation is required if a pathway for exposure is complete or potentially complete; for example, detected VOC concentrations near buildings with occupants. Therefore, the concentrations of VOC contaminants in pore-gas samples located closest to buildings with occupants are the relevant locations for comparison with the VISLs for soil-gas. The focus should be on VOC contaminants in the first 30 ft of subsurface based on the potential movement of the VOC vapor contaminants through the subsurface and into the building, where human exposure can take place.

The two sentry boreholes and sampling ports shown in Table 3.2-1 were chosen to screen VISLs. The shallowest depth was chosen from each of the boreholes, and their locations relevant to structures are shown in Figure 1.1-3. Based on the analytical results presented in section 5, VISLs were exceeded in both of the shallowest sampling ports shown in Table 3.2-1.

4.0 FIELD-SCREENING RESULTS

Before each sampling event, field screening was performed in each borehole at the targeted sampling interval to ensure CO_2, and O_2 levels at each sampling port had stabilized at values representative of subsurface pore-gas conditions. Subsurface vapor monitoring was conducted at the locations and depths described in section 2.0 and shown in Table 2.0-1. Before sampling, each interval was purged in accordance with N3B-SOP-ER-2008, “Sampling Subsurface Vapor,” to ensure pore gas was being collected. The pore gas from each port was field-screened using a MiniRAE multi-gas detector equipped with a 10.6-eV photoionization detector (PID) and RKI Instruments Eagle 2 gas detector. Each interval was purged until the CO_2, O_2, and total VOC concentrations stabilized. The stabilized concentrations from the 2022 monitoring rounds performed at each sampling location are shown in Appendix B.

5.0 ANALYTICAL DATA RESULTS

This section presents a summary and evaluation of VOC and tritium pore-gas data.

All analytical data were subject to validation reviews in accordance with N3B guidance and procedures. Appendix C presents a description of these data validation reviews for 2022 MDA L pore-gas data. All validated analytical results from 2022 pore-gas sampling are presented in Appendix E (on DVD included with this document).

MDA L pore-gas data are also available at the Intellus New Mexico website (http://www.intellusnm.com/).

5.1 VOC and Tritium Pore-Gas Results

Subsurface vapor samples were collected at MDA L from the seven sentry boreholes in the first sampling round (June–July 2022) and in the second sampling round (October 2022). VOC samples were collected in SUMMA canisters and submitted for laboratory analysis according to EPA Method TO-15. Tritium samples were collected in silica-gel cartridges and submitted for laboratory analysis according to EPA Method 906.0.

VOC analytical data from the first round of 2022 sampling are presented in Table 5.1-1 and Plate 1, and data from the second round are presented in Table 5.1-2 and Plate 2. Tritium analytical data from the first round of 2022 sampling are presented in Table 5.1-3, and data from the second round are presented in Table 5.1-4. The N3B data management program used to review the data is presented in Appendix C. Analytical data and reports for 2022 are included in Appendix E (on DVD included with this document).

During the first sampling round, 28 different VOCs were detected at least once in vapor samples collected from MDA L. During the second sampling round, 34 different VOCs were detected at least once. Trichloroethane[1,1,1-] (TCA[1,1,1-]), which was detected in all 36 samples analyzed in the first round and 34 of the 36 samples analyzed in the second round, was the VOC detected at the highest concentration for both rounds, at 1,020,000 $\mu g/m^3$ in borehole 54-02089 at 86 ft bgs during the first round and 1,090,000 $\mu g/m^3$ in borehole 54-24240 at 28 ft bgs in the second round. Other VOCs detected frequently during the first round of sampling were:

- dichlorodifluoromethane; 1,1-dichloroethane (1,1-DCA); 1,1-dichloroethene (1,1-DCE); tetrachloroethene (PCE); 1,1,2-trichloro-1,2,2-trifluoroethane (Freon-113); and trichloroethene (TCE) (each detected in 36 of 36 samples);
- chloroform and trichlorfluoromethane (Freon-11) (each detected in 35 of 36 samples); and
- carbon tetrachloride and 1,2-dichloroethane (1,2-DCA) (each detected in 34 of 36 samples)

These same ten VOCs were also detected frequently during the second round of sampling (detected in 34 of 36 samples); additionally, cyclohexane and 1,2-dichloropropane (1,2-DCP) were detected in 34 of 36 samples.

In the first round of sampling, tritium was detected in 9 of 36 samples, with activities ranging from 546 pCi/L at 93 ft in borehole 54-24241 to 23,883 pCi/L at 44 ft in borehole 54-24238. In the second round, tritium was detected in 14 of the 36 samples analyzed, at activities ranging from 561 pCi/L at 28 ft in borehole 54-24240 to 69,537 pCi/L at 173 ft in borehole 54-24241, which was substantially higher than all previous results. Results from this location will be monitored to determine whether this result is anomalous, or represents an increasing trend.

5.2 Evaluation of VOC Pore-Gas Data as Related to Hypothetical Groundwater Contamination

5.2.1 Potential for Groundwater Contamination

The VOC results from the 2022 monitoring rounds were screened in a Tier I analysis to evaluate whether the concentrations would be a potential source of contamination if the pore gas were in contact with groundwater (Section 3.1). If the maximum concentration of a particular VOC in pore gas is less than the appropriate pore-gas SL, then no potential exists for exceedances of groundwater cleanup levels (see section 3.1).

Equation 3.1-2 was used to calculate pore-gas SLs for VOCs detected in pore-gas samples at MDA L during the two sampling rounds. As shown in Table 3.1-1, 32 VOCs were detected for which there are MCLs, NMWQCC standards, or NMED or EPA regional tap water SLs.

Tables 5.1-1 and 5.1-2 show the 15 VOCs that exceeded Tier I groundwater screening levels. These VOCs are benzene; carbon tetrachloride; chloroform; 1,1-DCA; 1,2-DCA; 1,1-DCE; 1,2-DCP; 1,4-dioxane; methylene chloride; 2-propanol; 1,1,2,2-tetrachloroethane; PCE; 1,1,1-TCA; 1,1,2-TCA; and TCE. Because some concentrations exceeded screening levels, further screening was performed using the concentrations from the deepest pore-gas sample (i.e., the sample collected closest to the regional aquifer). The deepest sample was collected from borehole location 54-24399 at a depth of 587.8 ft, and this sample had 1 VOC detected above Tier I pore-gas SLs.

Dioxane[1,4-] was detected at a concentration of 70.9 $\mu g/m^3$, which is approximately 79 times greater than the Tier I pore-gas SL (0.9 $\mu g/m^3$), in the sample collected from borehole 54-24399 during the second round of monitoring. Dioxane[1,4-] was not detected in the deepest sample collected from borehole location 54-24399 during the first round of sampling, and has been detected in only three of the nine samples collected since the permanent packer was installed in this borehole in August 2017.

The data from the October 2022 sampling show 1,4-dioxane concentrations greater than Tier I SL in the two deepest sample ports in the basalt in borehole 54-24399. The measured value in the deepest port is greater than the method detection limit; however, it is much less than the analytical laboratory's report detection limit (i.e., quantitation limit). The measured value in the shallower of the two ports in the basalt was greater than the laboratory reporting limit. May 2021 data from the seven other ports in the basalt in boreholes 54-01015 and 54-01016 show no 1,4-dioxane detections. (These boreholes were not sampled during 2022.) Data from the first round of sampling for 2022 (July 2022) show no detections of 1,4-dioxane in borehole 54-24399. This compound should be watched carefully to see if detections continue to occur, and a focused validation of the raw data will be performed to determine if the measured detections are valid. The measured concentrations of all other compounds in the basalt in the October 2022 sampling were less than Tier I SLs.

5.2.2 VOC Concentration Trends in Subsurface Vapor Over Time

The objective of monitoring sentry boreholes is to evaluate whether potential new releases of VOCs are occurring from source areas and to monitor rebound after the SVE IM. The following concentration trends over time are discussed in detail in Appendix D.

Sentry boreholes on the east side of the site are used to sample the VOC plume within the Bandelier Tuff, with depths to 338 ft bgs, while Sentry borehole 54-24399 provides data from over 500 ft bgs within the Cerros del Rio basalt. Shallow data from boreholes 54-02089 (Appendix D, Figures D-4.1-1 [TCE]) and 54-24238 (Appendix D, Figures D-4.1-2 [TCE] and D-4.1-3 [methylene chloride]) show that TCE currently is higher than pre-SVE measurements. Both of these boreholes previously showed strong evidence of possible increased leakage from subsurface sources, starting during the period of the 2015 IM SVE operation. and peaking in 2019. Total VOC concentrations in these wells have returned to near pre-SVE values (Figures D-5.0-1,2). Data from borehole 54-24399 shows that concentrations of seven analytes have stabilized below Tier I values after installation of a permanent packer in 2017.

Data from the sentry boreholes on the west side (54-24240 and 54-27641) are shown in Appendix D, Figures D-4.2-1 and D-4.2-2. Borehole 54-24240 previously showed the strongest rebound at 28 ft bgs (Appendix D, Figure D-4.2-1) to slightly greater than pre-SVE values, but decreased to less than half pre-SVE values in July and October 2022 samples. Borehole 54-27641 shows limited rebound with a maximum rebound at 32 ft bgs in February 2022 (Appendix D, Figure D-4.2-2), but decreasing in the July and October 2022 rounds.

Concentrations of total VOCs near the base of the Otowi member of the Bandelier tuff (just above the basalt) on the west side of MDA L in borehole 54-27641 show little change from 2014 through 2021. Concentrations near the base of the Otowi on the east side of MDA L in borehole 54-27642 previously showed decreases from 2014 through 2021, but have increased to near pre-SVE values at 330 ft in borehole 54-27642.

Data from 2022 show that the SVE IM has led to overall reductions in concentration in the plume persisting more than 7 yr (Figure D-3.0-1). Maximum TCE concentrations between the two source areas are lower and have not rebounded to the red (100 times Tier I) levels seen in 2014. The 100-times-Tier I red regions have also been reduced vertically as shown on the A-A′ vertical cross-sections. The lateral extent of the plume edge shows some reductions as well, as seen in the top, map view panels of Figure D-3.0-1. In these map view panels, the width of the plume along the B-B′ line is reduced, and there is a slight increase to the north along the C-C’ line with no change to the south. The same lateral reduction in plume extent can be seen at depth in the lower vertical panels, where the lateral extent of the 100-times-Tier I SL contours have reduced significantly. Thus, the IM objective of reducing the plume concentration and extent has been met.

5.2.3 Evaluation of VOC Pore-Gas Data for Human Health Using Vapor Intrusion Screening Levels

Concentration of VOCs in the shallowest borehole port depth, located closest to buildings with occupants, are the relevant locations to be compared with the VISLs for soil-gas. NMED lists VISLs for both industrial soil-gas and residential soil-gas. Because MDA L is an industrial site, the comparison of VOC concentrations with VISLs was based on industrial soil-gas.

It is reasonable to work with a conceptual model that focuses on volatiles in about the first 30 ft of subsurface, based on the potential movement of the VOC gases through the subsurface and into the building. The shallower contamination has the higher potential to migrate into the building, which poses a risk of human exposure.

The majority of MDA L is covered by asphalt, which tends to block upwardly migrating VOCs. However, the trailers at MDA L are not on asphalt; thus, the asphalt could focus upward VOC migration toward the trailers. There are no monitoring boreholes near the trailers shown in Figure 1.1-3 (trailers 54-0037, -0051, -0060, -0083, and -0084, which are located east of the lower portion of the Mesita del Buey Rd. label on the figure).

As discussed in section 3.2, the data from the shallowest sampling ports in two sentry boreholes located near structures were compared with VISLs for exceedances. VOCs in the borehole ports nearest to the trailers exceeded VISLs as shown in Tables 5.1-1 and 5.1-2. For both rounds of monitoring:

- Eight VOCs (carbon tetrachloride; chloroform; 1,1-DCA; 1,2-DCA; 1,2-DCP; PCE; 1,1,2-TCA, and TCE) were detected above VISLs.
- DCP[1,2-] was detected above the VISL at one of two boreholes.
- The other VOCs were detected above VISLs in both boreholes.

These tables serve as a preliminary screening tool to evaluate on-site worker safety. The data will be shared with N3B Environment, Safety and Health, and if interior sampling is determined to be warranted, a sampling plan will be developed and implemented.

5.2.4 Soil-Vapor Extraction System Restart Criteria

As recommended in the IM Final Report, Rev. 1, the SVE units will be operated twice annually, in the spring and fall, to continue mass removal. In addition to this scheduled operation, operation of the SVE units may also be triggered by vapor monitoring results.

Monitoring sentry boreholes allows early detection of potential waste container failure in the disposal shafts and provides data for the decision to restart either or both of the SVE systems. Recommendations included in the IM Final Report, Revision 1 are to activate the eastern and/or western SVE unit if total VOC concentrations in any ports in the respective sentry boreholes rise above 2000 ppmv, with a trend of consistent increase with each consecutive measurement for ports to depths of 100 ft. Once this trend is observed, the applicable SVE system should be activated and adapted as necessary to run as continuously as possible until concentrations drop below 2000 ppmv.

Tables 5.2-1 and 5.2-2 show individual and total VOC concentrations in ppmv for the first and second sampling rounds, respectively. The highest total VOC concentrations were in borehole 54-24238 at 64 ft, at 405 ppmv and 386 ppmv in the first and second sampling rounds, respectively. While the data demonstrate that there is no need to restart the SVE system now, semiannual pore gas monitoring of sentry boreholes will continue and total VOC concentrations will continue to be evaluated

Section 8.0 in the IM Final Report, Rev. 1 recommended operating the SVE system twice annually, once in the spring and once in the fall. The SVE system is proposed to operate for approximately four weeks once the system has been restored and is fully functional. The first four-week run could start in the spring or fall of 2023, depending on the maintenance required to restore the SVE system. Results from the first four-week run will be evaluated and will guide subsequent SVE operations. SVE monitoring results will be reported in the 2023 annual PMR.

6.0 SUMMARY

The purpose of monitoring VOCs in pore gas at MDA L is to identify changes in the configuration of the VOC plumes, monitor changes in contaminant concentration distribution, and identify gaps in VOC data for future modeling or trend analyses.

The results from the two 2022 sampling rounds are summarized below.

- VOC concentrations at MDA L are consistent with a diffusive plume (Stauffer et al. 2005, 090537). The diffusive plume has been significantly modified by the 2015 SVE IM, which removed 1000 lb of VOCs (N3B 2018, 700039; Behar et al. 2019, 700854). The graphs in Appendix D show concentrations dropping from the 2014 pre-SVE levels in nearly all ports. VOC concentrations are highest from ground surface to approximately 60 ft bgs, within the depth of the VOC disposal shafts.
- VOC concentrations decreased with depth from the base of the disposal units (60 ft bgs) to borehole total depth, with the exception of borehole 54-27642 (e.g., Figure D-4.1-5 in Appendix D).
- VOC concentrations in the source areas rebounded, implying continued leakage from subsurface containers (e.g., Figure D-5.0-2 in Appendix D). The source areas are the disposal shafts shown in Figure 1.1-2.
- VOC concentrations at two wells on the east side of MDA L show strong evidence of possible increased leakage from subsurface sources, starting during the period of SVE operation and continuing until 2019. Data from the second round for one of these wells suggest that the leakage has not continued and concentrations are dropping back toward pre-SVE levels. This trend suggests that a logical action level would be to turn on SVE systems only in the face of a sustained leak with concentrations of more than 2000 ppmv for two or more sampling rounds, perhaps with an increasing trend for a full year.
- Dioxane[1,4-] was detected above the Tier I SL derived from groundwater cleanup standards in two ports in borehole 54-24399 in October 2022 but not in July 2022. VOC concentrations measured deep below the central portion of all other source areas in the Cerros del Rio basalt are less than Tier I SL concentrations.
- Continued observation of data from the basalt (two ports in borehole 54-24399) are confirming expectations that values in the deep basalt are stabilizing after installation of the permanent packer in August 2017. Stabilization of VOC measurements in the deep basalt is allowing more confidence in determinations of the MDA L VOC plume impact on the quality of regional groundwater. Some variation in basalt concentration values is expected as barometric pumping pushes and pulls mass through fractures.

Discussions with NMED in January 2020 resulted in the decision to delay the replacement of borehole 54-24399. Observing the deep boreholes will reveal if the concentrations are now reaching an equilibrium no longer impacted by deep breathing in borehole 54-24399. If/when concentrations in borehole 54-24399 stabilize, NMED and N3B will re-evaluate the original request to replace that borehole.

Additionally, N3B will continue to monitor VOC concentrations in boreholes 54-01015 and 54-01016 to ensure that subsurface VOC values at all available monitoring points in the basalt are (1) consistent with the conceptual model (i.e., not changing rapidly or erratically) and (2) less than levels of concern for impacting groundwater. If either of these conditions begin to deviate from current conditions, N3B and NMED should meet again to discuss the adequacy of the current basalt monitoring locations for ensuring groundwater safety (Stauffer et al. 2019, 700871).

The IM Final Report, Rev. 1, specified operating the SVE units twice annually, in the spring and fall, to continue mass removal. The SVE units will also be operated at other times if borehold VOC conentrations indicate that the additional operation is necessary. This operation will be implemented beginning in 2023.

7.0 REFERENCES AND MAP DATA SOURCES

7.1 References

The following reference list includes documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID.ERIDs were assigned by Los Alamos National Laboratory's (the Laboratory's) Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above).

Behar, H.R., E.E. Snyder, S. Marczak, L.J. Salazar, B. Rappe, G.F. Fordham, S.P. Chu, D.M. Strobridge, K.H. Birdsell, T.A. Miller, K.C. Rich, and P.H. Stauffer, February 2019. "An Investigation of Plume Response to Soil Vapor Extraction and Hypothetical Drum Failure," *Vadose Zone Journal,* Vol. 18, No. 1. (Behar et al. 2019, 700854)

LANL (Los Alamos National Laboratory), November 2006. "Summary Report: 2006 In Situ Soil Vapor Extraction Pilot Study at Material Disposal Area L, Technical Area 54, Los Alamos National Laboratory," Los Alamos National Laboratory document LA-UR-06-7900, Los Alamos, New Mexico. (LANL 2006, 094152)

LANL (Los Alamos National Laboratory), September 2011. "Corrective Measures Evaluation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54, Revision 2," Los Alamos National Laboratory document LA-UR-11-4798, Los Alamos, New Mexico. (LANL 2011, 205756)

N3B (Newport News Nuclear BWXT-Los Alamos, LLC), August 2018. "Interim Measures Final Report for Soil-Vapor Extraction of Volatile Organic Compounds from Material Disposal Area L, Technical Area 54," Newport News Nuclear BWXT-Los Alamos, LLC, document EM2018-0008, Los Alamos, New Mexico. (N3B 2018, 700039)

N3B (Newport News Nuclear BWXT-Los Alamos, LLC), June 2022. "Interim Measures Final Report for Soil-Vapor Extraction of Volatile Organic Compounds from Material Disposal Area L, Technical Area 54, Revision 1," Newport News Nuclear BWXT-Los Alamos, LLC, document EM2022-0290, Los Alamos, New Mexico. (N3B 2022, 702169)

NMED (New Mexico Environment Department), November 2022. "Risk Assessment Guidance for Site Investigations and Remediation, Volume 1, Soil Screening Guidance for Human Health Risk Assessments," Hazardous Waste Bureau and Ground Water Quality Bureau, Santa Fe, New Mexico. (NMED 2022, 702484)

Stauffer, P.H., K.H. Birdsell, M.S. Witkowski, and J.K. Hopkins, 2005. "Vadose Zone Transport of 1,1,1-Trichloroethane: Conceptual Model Validation through Numerical Simulation," *Vadose Zone Journal,* Vol. 4, pp. 760–773. (Stauffer et al. 2005, 090537)

Stauffer, P.H., T. Rahn, J.P. Ortiz, L.J. Salazar, H. Boukhalfa, H.R. Behar, and E.E. Snyder, March 2, 2019. "Evidence for High Rates of Gas Transport in the Deep Subsurface," *Geophysical Research Letters,* Vol. 46, No. 7. (Stauffer et al. 2019, 700871)

7.2 Map Data Sources

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

Legend Item	Data Source
Disposal pit/ impoundment	Waste Storage Features; LANL, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007.
Disposal shaft	Waste Storage Features; LANL, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007.
Elevation contour	Hypsography, 10, 20, & 100 Foot Contour Intervals; LANL, ENV Environmental Remediation and Surveillance Program; 1991.
Fence	Security and Industrial Fences and Gates; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 10 September 2007.
LANL boundary	LANL Areas Used and Occupied; LANL, Site Planning & Project Initiation Group, Infrastructure Planning Division; 19 September 2008.
Material disposal area	Materials Disposal Areas; LANL, ENV Environmental Remediation and Surveillance Program; ER2004-0221; 1:2,500 Scale Data; 23 April 2004.
Paved road	Los Alamos National Laboratory, FWO Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.
Structure	Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.
TA boundary	As published; Triad SDE Spatial Geodatabase: GISPUBPRD1\PUB.Boundaries\PUB.Tecareas; February 2020.
Major Road	As published; Q:\16-Projects\16-0033\project_data.gdb\line\major_road; February 2020.
Unpaved road	Dirt Road Arcs; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 10 September 2007.
Drainage	As published; Q:\16-Projects\16-0033\project_data.gdb\line\drainage_features; February 2020.
Vapor monitoring well	Point Feature Locations of the Environmental Restoration Project Database; LANL, Environment and Remediation Support Services Division, EP2007-0754; 30 November 2007.

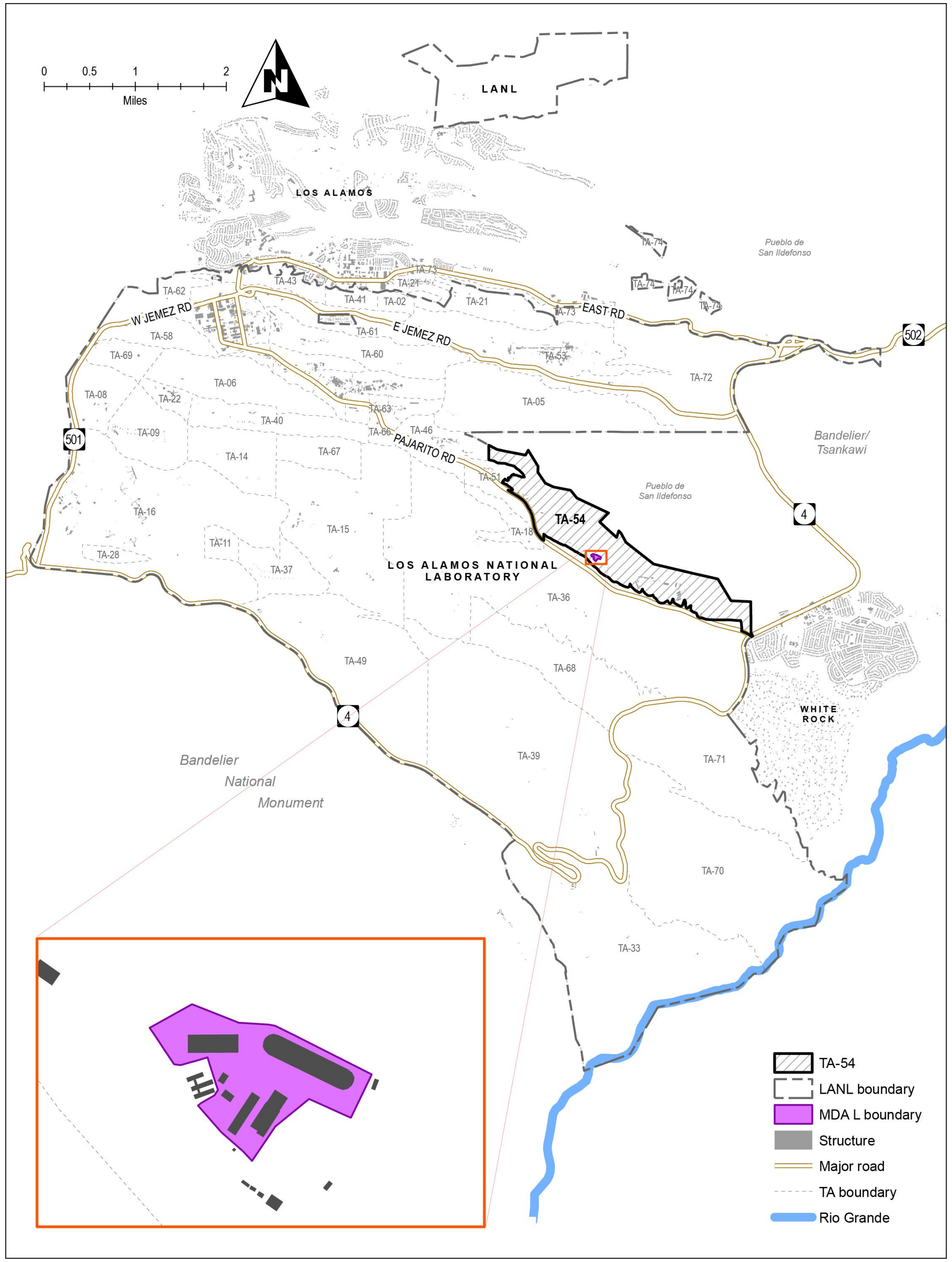


Figure 1.1-1 Location of MDA L with respect to Laboratory technical areas

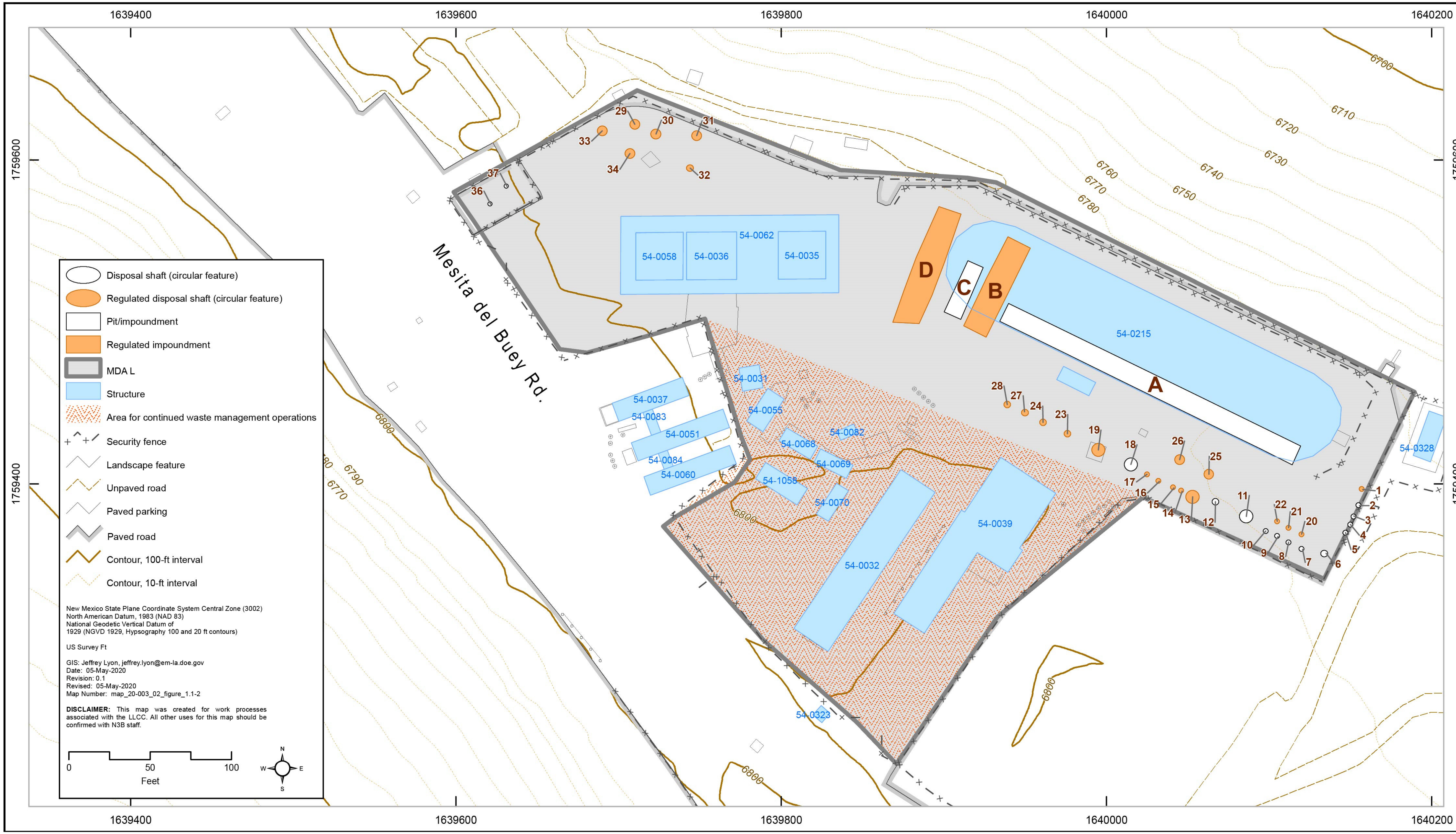


Figure 1.1-2 **Inactive subsurface disposal units and existing surface structures at MDA L**

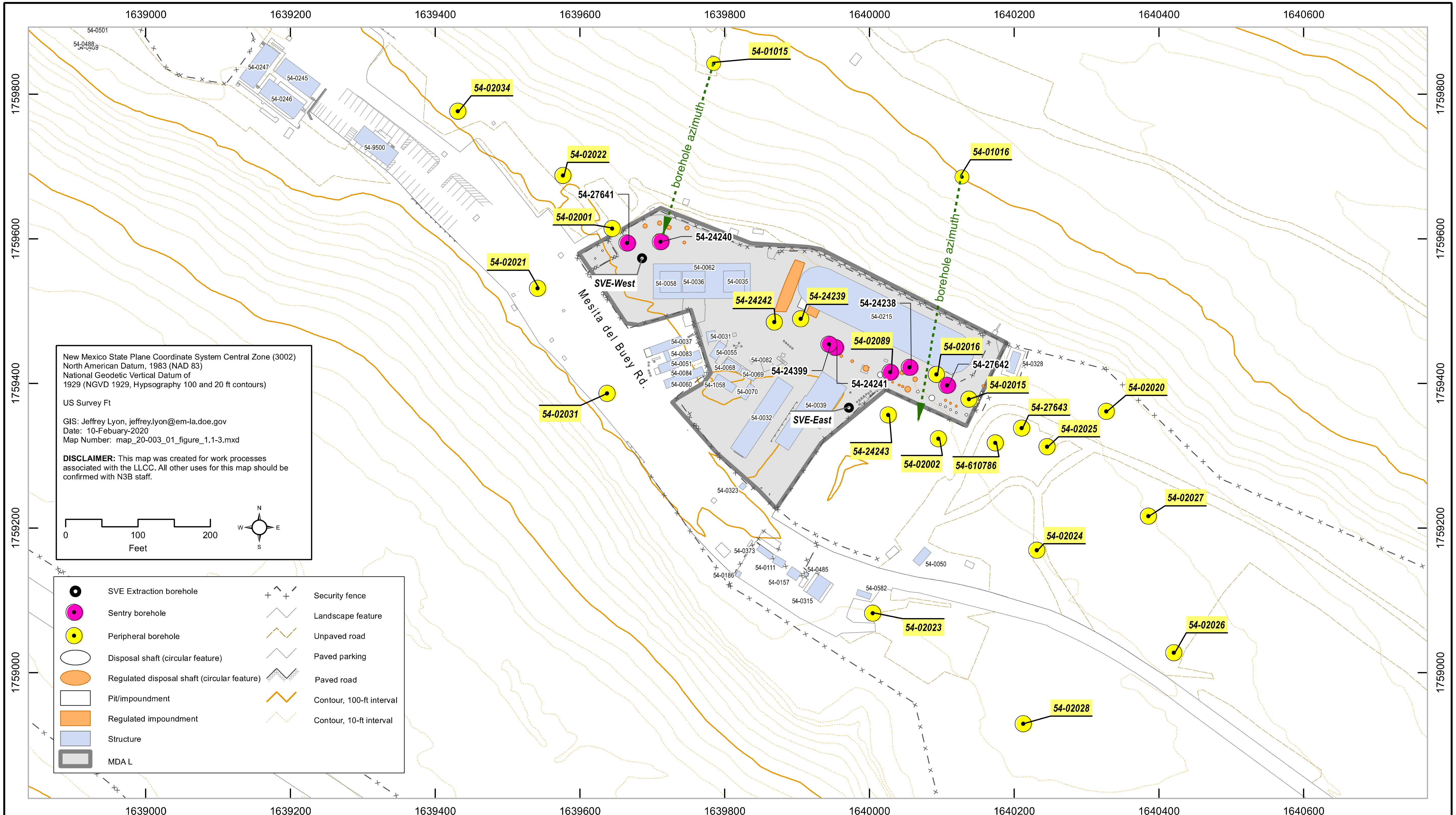


Figure 1.1-3 Location of MDA L pore-gas monitoring boreholes

Table 2.0-1
First Round 2022 MDA L
Subsurface Vapor-Monitoring Locations—Sentry Boreholes

Borehole	Screening Conducted	Sampling Port Depth (vertical depth in ft)
54-02089	Yes	13, 31, 46, 86
54-24238	Yes	44, 64, 84
54-24240	Yes	28, 53, 78, 103, 128, 153
54-24241	Yes	73, 93, 113, 133, 153, 173, 193
54-24399*	Yes	566.7, 587.8
54-27641	Yes	32, 82, 115, 182, 232, 271, 332.5
54-27642	Yes	30, 75, 116, 175, 235, 275, 338

* Open borehole.

Table 2.0-2
Second Round 2022 MDA L
Subsurface Vapor-Monitoring Locations—Sentry Boreholes

Borehole	Screening Conducted	Sampling Port Depth (vertical depth in ft)
54-02089	Yes	13, 31, 46, 86
54-24238	Yes	44, 64, 84
54-24240	Yes	28, 53, 78, 103, 128, 153
54-24241	Yes	73, 93, 113, 133, 153, 173, 193
54-24399*	Yes	566.7, 587.8
54-27641	Yes	32, 82, 115, 182, 232, 271, 332.5
54-27642	Yes	30, 75, 116, 175, 235, 275, 338

* Open borehole.

Table 3.1-1
MDA L Tier I Pore-Gas Screening Levels

VOC	Henry's Law Constant[a] (dimensionless)	Groundwater SL (µg/L)	Source of Groundwater SL	Tier I Pore-Gas SLs (µg/m³)
Acetone	0.00144	14,100	NMED Tap Water[b]	20,300
Benzene	0.228	5	NM GW[c]	1140
Carbon disulfide	0.59	810	NMED Tap Water	478,000
Carbon tetrachloride	1.13	5	NM GW	5650
Chlorobenzene	0.128	100	EPA MCL[d]	12,800
Chloroform	0.15	80	EPA MCL	12,000
Cyclohexane	6.13	68.6	NMED Tap Water	421,000
Dichlorodifluoromethane	14.1	197	NMED Tap Water	2,780,000
Dichloroethane[1,1-] (1,1-DCA)	0.23	25	NM GW	5750
Dichloroethane[1,2-] (1,2-DCA)	0.0484	5	NM GW	242
Dichloroethene[1,1-] (1,1-DCE)	1.07	7	NM GW	7490
Dichloroethene[cis-1,2-]	0.167	70	NM GW	11,700
Dichloroethene[trans-1,2-]	0.167	100	NM GW	16,700
Dichloropropane[1,2-] (1,2-DCP)	0.116	5	NM GW	580
Dioxane[1,4-]	0.000197	4.59	NMED Tap Water	0.9
Ethanol	na[e]	na	na	na
Ethylbenzene	0.323	700	NM GW	226,000
Heptane[n-]	81.8	6	EPA Tap Water[f]	491,000
Hexane	73.8	319	NMED Tap Water	23,500,000
Isooctane	na	na	na	na
Methylene chloride	0.133	5	NM GW	665
Propanol[2-]	0.000331	410	EPA Tap Water	136
Tetrachloroethane[1,1,2,2-]	0.015	0.757	NMED Tap Water	11.4
Tetrachloroethene (PCE)	0.726	5	NM GW	3630
Tetrahydrofuran	0.00288	3400	EPA Tap Water	9790
Toluene	0.272	1000	NM GW	272,000
Trichloro-1,2,2-trifluoroethane[1,1,2-] (Freon-113)	21.6	55,000	NMED Tap Water	1,190,000,000
Trichloroethane[1,1,1-] (1,1,1-TCA)	0.705	200	NM GW	141,000
Trichloroethane[1,1,2-] (1,1,2-TCA)	0.0338	5	NM GW	169
Trichloroethene (TCE)	0.404	5	NM GW	2020

Table 3.1-1 (continued)

VOC	Henry's Law Constant[a] (dimensionless)	Groundwater SL (µg/L)	Source of Groundwater SL	Tier I Pore-Gas SLs (µg/m^3)
Trichlorofluoromethane (Freon-11)	3.98	1140	NMED Tap Water	4,540,000
Vinyl chloride	1.14	2	NM GW	2280
Xylene[1,2-]	0.212	193	NM Tap Water	40,900
Xylene[1,3-]+xylene[1,4-][g]	0.212	193	NM Tap Water	40,900

Note: Tier I screening concentration is the calculated concentration in pore gas exceeding groundwater standard derived from Equation 3.1-2.

[a] Henry's law constants are taken from the NMED "NMED Risk Assessment Guidance for Site Investigations and Remediation Volume 1, Soil Screening Guidance for Human Health Risk Assessments" (NMED 2022, 702484) or the EPA regional screening tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables).

[b] NMED 2022, 702484.

[c] 20.6.2.3103 New Mexico Administrative Code.

[d] 40 Code of Federal Regulations 141 Subpart G.

[e] na = Not available.

[f] https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

[g] SL for xylene [1,3-]+xylene[1,4-] is for xylene mixture.

Table 3.1-2
Tier I Screening of VOCs Detected in Pore Gas during First 2022 Sampling Round at MDA L

VOCs	Maximum Pore-Gas Concentration (µg/m^3)	Tier I Pore-Gas SL (µg/m^3)	Tier I Potential for Groundwater Impact[a]
Benzene	1640	1140	Yes
Carbon tetrachloride	11,600	5650	Yes
Chlorobenzene	492	12,800	No
Chloroform	33,000 (J+)	12,000	Yes
Cyclohexane	5060	421,000	No
Dichlorodifluoromethane	3670	2,780,000	No
Dichloroethane[1,1-] (1,1-DCA)	49,000 (J+)	5750	Yes
Dichloroethane[1,2-] (1,2-DCA)	75,200	242	Yes
Dichloroethene[1,1-] (1,1-DCE)	44,000	7490	Yes
Dichloroethene[cis-1,2-]	65.8 (J)	11,700	No
Dichloroethene[trans-1,2-]	168	16,700	No
Dichloropropane[1,2-] (1,2-DCP)	284,000	580	Yes
Dioxane[1,4-]	6990	0.9	Yes
Hexane	560 (J)	23,500,000	No
Isooctane	150 (J)	na[b]	na
Methylene chloride	29,800	665	Yes
Propanol[2-]	161 (J)	136	Yes
Tetrachloroethene (PCE)	95,600	3630	Yes

Table 3.1-2 (continued)

VOCs	Maximum Pore-Gas Concentration (µg/m³)	Tier I Pore-Gas SL (µg/m³)	Tier I Potential for Groundwater Impact[a]
Tetrahydrofuran	542	9790	No
Toluene	1810	272,000	No
Trichloro-1,2,2-trifluoroethane[1,1,2-] (Freon-113)	468,000	1,190,000,000	No
Trichloroethane[1,1,1-] (1,1,1-TCA)	1,020,000 (J+)	141,000	Yes
Trichloroethane[1,1,2-] (1,1,2-TCA)	7470	169	Yes
Trichloroethene (TCE)	422,000	2020	Yes
Trichlorofluoromethane (Freon-11)	50,200	4,540,000	No
Vinyl chloride	106 (J)	2280	No
Xylene[1,2-]	350	40,900	No
Xylene[1,3-]+xylene[1,4-][c]	351 (J)	40,900	No

Notes: Tier I screening level is the calculated concentration in pore gas exceeding groundwater standard derived from Equation 3.1-2. Shaded cells indicate VOCs that did not pass the Tier I screen.

[a] If concentration of a VOC measured in a pore-gas sample is less than the pore-gas SL, the concentration of the VOC in soil vapor will not exceed the groundwater SL, even if the VOC plume is in direct contact with groundwater.

[b] na = Not available.

[c] SL for xylene [1,3-]+xylene[1,4-] is for xylene mixture.

Table 3.1-3
Tier I Screening of VOCs Detected in
Pore Gas during Second 2022 Sampling Round at MDA L

VOCs	Maximum Pore-Gas Concentration (µg/m³)	Tier I Pore-Gas SL (µg/m³)	Tier I Potential for Groundwater Impact[a]
Acetone	1500 (J)	20,300	No
Benzene	1370	1140	Yes
Carbon disulfide	548 (J)	478,000	No
Carbon tetrachloride	13,100	5650	Yes
Chlorobenzene	594	12,800	No
Chloroform	32,000	12,000	Yes
Cyclohexane	4780	421,000	No
Dichlorodifluoromethane	3900	2,780,000	No
Dichloroethane[1,1-] (1,1-DCA)	34,700	5750	Yes
Dichloroethane[1,2-] (1,2-DCA)	65,500 (J+)	242	Yes
Dichloroethene[1,1-] (1,1-DCE)	30,600 (J)	7490	Yes
Dichloroethene[cis-1,2-]	72.9 (J)	11,700	No
Dichloroethene[trans-1,2-]	167 (J)	16,700	No
Dichloropropane[1,2-] (1,2-DCP)	233,000 (J+)	580	Yes
Dioxane[1,4-]	4500	0.9	Yes
Ethanol	2540 (J)	na[b]	na
Ethylbenzene	86.4 (J)	226,000	No

Table 3.1-3 (continued)

VOCs	Maximum Pore-Gas Concentration (µg/m³)	Tier I Pore-Gas SL (µg/m³)	Tier I Potential for Groundwater Impact[a]
Heptane[n-]	170 (J)	491,000	No
Hexane	460 (J)	23,500,000	No
Isooctane	384 (J)	na[b]	na
Methylene chloride	17,300	665	Yes
Propanol[2-]	3120 (J)	136	Yes
Tetrachloroethane[1,1,2,2-]	64.6 (J)	11.4	Yes
Tetrachloroethene (PCE)	118,000 (J)	3630	Yes
Tetrahydrofuran	389 (J)	9790	No
Toluene	1420	272,000	No
Trichloro-1,2,2-trifluoroethane[1,1,2-] (Freon-113)	479,000	1,190,000,000	No
Trichloroethane[1,1,1-] (1,1,1-TCA)	1,090,000	141,000	Yes
Trichloroethane[1,1,2-] (1,1,2-TCA)	6920	169	Yes
Trichloroethene (TCE)	494,000	2020	Yes
Trichlorofluoromethane (Freon-11)	77,500	4,540,000	No
Vinyl chloride	473 (J)	2280	No
Xylene[1,2-]	253	40,900	No
Xylene[1,3-]+xylene[1,4-][c]	55.1 (J)	40,900	No

Notes: Tier I screening level is the calculated concentration in pore gas exceeding groundwater standard derived from Equation 3.1-2. Shaded cells indicate VOCs that did not pass the Tier I screen.

[a] If concentration of a VOC measured in a pore-gas sample is less than the pore-gas SL, the concentration of the VOC in soil vapor will not exceed the groundwater SL, even if the VOC plume is in direct contact with groundwater.

[b] na = Not available.

[c] SL for xylene [1,3-]+xylene[1,4-] is for xylene mixture.

Table 3.2-1
Boreholes and Sampling Ports used to Evaluate Vapor Intrusion Screening Levels

Borehole	Shallowest Port Depth (ft)	Description
54-27641	32	Located on west side of MDA L adjacent to SVE-West and near entrance to transportable office building
54-27642	30	Located between shafts and southeast corner of building 54-215

Table 5.1-1
First Round 2022 VOC Pore-Gas Detected Results at MDA L (in µg/m³)

Sample ID	Location ID	Depth (ft)	Benzene	Carbon Tetrachloride	Chlorobenzene	Chloroform	Cyclohexane	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloroethene[trans-1,2-]	Dichloropropane[1,2-]	Dioxane[1,4-]	Hexane	Isooctane	Methylene Chloride
Groundwater Tier I SL[a]			**1140**	**5650**	**12,800**	**12,000**	**79,300,000**	**2,780,000**	**5750**	**242**	**7490**	**11,700**	**16,700**	**580**	**0.9**	**23,500,000**	**na**	**665**
Industrial VISL[b]			**588**	**765**	**8190**	**199**	**164,000**	**16,400**	**2870**	**176**	**32,800**	**na[c]**	**6550**	**459**	**918**	**115,000**	**na**	**98,300**
MD54-22-249407	54-02089 P13	13	—[d]	1180	—	9810 (J+)	399	865	24,000 (J+)	—	10,500 (J+)	—	—	60,000 (J+)	—	—	—	—
MD54-22-249408	54-02089 P31	31	—	2570	—	14,600 (J+)	1570	1860	36,200 (J+)	10,800 (J+)	17,000 (J+)	—	—	127,000 (J+)	—	—	—	—
MD54-22-249409	54-02089 P46	466	450 (J)	3160	—	—	5060	3440	49,000 (J+)	18,700 (J+)	25,200 (J+)	—	—	240,000 (J+)	—	560 (J)	—	—
MD54-22-249410	54-02089 P86	86	651 (J)	2270 (J)	—	25,600 (J+)	3510	2880	42,100 (J+)	24,100 (J+)	34,400 (J+)	—	—	229,000 (J+)	—	—	—	—
MD54-22-249411	54-24238 P44	44	421 (J)	2270	—	25,200	4510	3320	33,200	51,000	39,000	—	—	224,000	—	—	—	—
MD54-22-249412	54-24238 P64	64	741 (J)	2560 (J)	—	30,400	4160	3670	33,400	75,200	44,000	—	—	284,000	—	—	—	4240 (J)
MD54-22-249413	54-24238 P84	84	377 (J)	1600	—	17,400	2000	2130	18,200	56,200	29,000	—	—	127,000	—	—	—	958 (J)
MD54-22-249417	54-24240 P28	28	—	11,600	—	13,200	1790	608 (J)	36,000	3010	22,100	—	—	404 (J)	—	—	—	—
MD54-22-249418	54-24240 P53	53	186 (J)	9050	421 (J)	25,200	4710	1270	30,000	22,000	18,100	—	—	540	—	—	—	—
MD54-22-249419	54-24240 P78	78	700	2430	163 (J)	17,800	4710	677	17,200	15,300	12,400	—	—	830	940	166 (J)	150 (J)	—
MD54-22-249414	54-24240 P103	103	570	1470	164	14,900	4370	746	15,000	11,600	13,700	65.8 (J)	46.4 (J)	1370	378	71.5 (J)	97.6 (J)	—
MD54-22-249415	54-24240 P128	128	305	660	91.1 (J)	7660	2330	731	9220	9830	15,600	—	—	1150	—	—	60.7 (J)	—
MD54-22-249416	54-24240 P153	153	265	592	85.6 (J)	6300	2210	746	8410	7400	16,700	—	—	1210	—	—	—	—
MD54-22-249425	54-24241 P73	73	203	2710	51.1 (J)	12,600 (J+)	2130	855	12,800 (J+)	24,000 (J+)	17,700 (J+)	—	168	18,500 (J+)	987	—	—	—
MD54-22-249426	54-24241 P93	93	143	1230	35.8 (J)	9610 (J+)	1250	652	8620 (J+)	23,700 (J+)	11,300 (J+)	—	80.8 (J)	15,900 (J+)	6990	—	—	—
MD54-22-249420	54-24241 P113	113	152	792	21.6 (J)	8880 (J+)	784	613	6920 (J+)	17,700 (J+)	13,200 (J+)	—	72.1 (J)	14,000 (J+)	2000	—	—	—
MD54-22-249421	54-24241 P133	133	295	868	43.8 (J)	9660 (J+)	681	850	6710 (J+)	6670 (J+)	22,200 (J+)	—	84.4 (J)	11,700 (J+)	558	—	—	—
MD54-22-249422	54-24241 P153	153	338	824	31 (J)	7270 (J+)	602	746	5180 (J+)	6310 (J+)	20,400 (J+)	—	53.5 (J)	—	490	—	—	639
MD54-22-249423	54-24241 P173	173	437	1160	42.5 (J)	10,100 (J+)	774	934	6920 (J+)	7320 (J+)	30,200 (J+)	—	85.2 (J)	10,500 (J+)	121 (J)	—	—	1300
MD54-22-249424	54-24241 P193	193	172	1000	—	10,500 (J+)	743	1010	7080 (J+)	6270 (J+)	33,000	—	—	10,300 (J+)	1540	—	—	193 (J)
MD54-22-249427	54-24399 P566.7	566.7	—	—	20.4 (J)	28.9 (J)	—	19.8 (J)	44.5	32.7 (J)	187	—	—	20.1 (J)	—	—	—	57.6 (J)
MD54-22-249428	54-24399 P587.8	587.8	—	—	47.8 (J)	22 (J)	—	22.7 (J)	33.7 (J)	25.8 (J)	168	—	—	18 (J)	—	—	—	53.1 (J)
MD54-22-249433	54-27641 P32	32	—	**2430 (J)**	—	**6490 (J)**	3330 (J)	474 (J)	**31,300 (J)**	**7850 (J+)**	8560 (J)	—	—	—	—	—	—	—
MD54-22-249435	54-27641 P82	82	275	1400 (J)	229 (J)	5660 (J)	4750 (J)	524 (J)	14,200 (J)	11,300	9750 (J)	—	—	—	598	251 (J)	—	614 (J)

Table 5.1-1 (continued)

Sample ID	Location ID	Depth (ft)	Benzene	Carbon Tetrachloride	Chlorobenzene	Chloroform	Cyclohexane	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloroethene[trans-1,2-]	Dichloropropane[1,2-]	Dioxane[1,4-]	Hexane	Isooctane	Methylene Chloride
Groundwater Tier I SL[a]			**1140**	**5650**	**12,800**	**12,000**	**79,300,000**	**2,780,000**	**5750**	**242**	**7490**	**11,700**	**16,700**	**580**	**0.9**	**23,500,000**	**na**	**665**
Industrial VISL[b]			**588**	**765**	**8190**	**199**	**164,000**	**16,400**	**2870**	**176**	**32,800**	**na[c]**	**6550**	**459**	**918**	**115,000**	**na**	**98,300**
MD54-22-249429	54-27641 P115	115	246	767	182	5610	3850	652	11,000	14,200	12,400 (J+)	32 (J)	—	947 (J+)	—	68.7 (J)	43.5 (J)	304 (J)
MD54-22-249430	54-27641 P182	182	169	451	57.1 (J)	2860 (J+)	1520	801	7400	9510	19,600	—	—	1020 (J+)	—	32.1 (J)	50 (J)	4340
MD54-22-249431	54-27641 P232	232	131	635	30 (J)	2250 (J+)	1200	850	8050	3460 (J+)	22,100	—	—	—	—	33.8 (J)	46.7 (J)	4620
MD54-22-249432	54-27641 P271	271	79.5	439 (J)	—	971 (J)	592 (J)	722 (J)	3580 (J)	490 (J+)	21,000 (J)	—	—	—	78.5 (J)	29.5 (J)	21.2 (J)	2770 (J)
MD54-22-249434	54-27641 P332.5	332.5	20 (J)	214 (J)	—	251 (J)	279 (J)	376 (J)	770 (J)	239 (J+)	7690 (J)	—	—	—	680	18.8 (J)	—	346 (J)
MD54-22-249440	54-27642 P30	30	—	**4500**	—	**32,800 (J+)**	—	1090	**8410 (J+)**	**7360 (J+)**	15,000 (J+)	—	—	**36,400 (J+)**	—	—	—	—
MD54-22-249442	54-27642 P75	75	82.4 (J)	2920	—	33,000 (J+)	1340	1760	12,900 (J+)	20,000 (J+)	34,600 (J+)	—	—	80,400 (J+)	—	—	—	—
MD54-22-249436	54-27642 P116	116	—	267	—	7610	—	19.3 (J)	2010 (J+)	1640 (J+)	995 (J+)	30.7 (J)	—	8170 (J+)	—	—	—	—
MD54-22-249437	54-27642 P175	175	1640	2210	492	21,900 (J+)	1000	1480	9220 (J+)	15,500 (J+)	40,400	—	—	41,400 (J+)	—	347	—	29,800
MD54-22-249438	54-27642 P235	235	1330	2550	305	19,900 (J+)	974	1290	7520 (J+)	9870 (J+)	37,600	—	—	32,600 (J+)	—	290	—	28,300
MD54-22-249439	54-27642 P275	275	151 (J)	2670	—	32,900 (J+)	1130	1690	13,500 (J+)	—	40,800 (J+)	—	—	79,400 (J+)	—	—	—	—
MD54-22-249441	54-27642 P338	338	629	3030	124 (J)	30,700 (J+)	1500	1620	12,100 (J+)	26,400 (J+)	35,500 (J+)	—	—	73,400 (J+)	—	190 (J)	—	4200

Table 5.1-1 (continued)

Sample ID	Location ID	Depth (ft)	Propanol[2-]	Tetrachloroethene	Tetrahydrofuran	Toluene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane	Vinyl Chloride	Xylene[1,2-]	Xylene[1,3-]+Xylene[1,4-]
Groundwater Tier I SL[a]			**136**	**3630**	**9790**	**272,000**	**1,190,000,000**	**141,000**	**169**	**2020**	**4,540,000**	**2280**	**40,900**	**40,900**
Industrial VISL[b]			**na**	**6550**	**na**	**819,000**	**4,920,000**	**819,000**	**32.8**	**328**	**115,000**	**1040**	**16,400**	**16,400**
MD54-22-249407	54-02089 P13	13	—	29,600 (J+)	—	—	132,000 (J+)	467,000 (J+)	2090	364,000 (J+)	50,200	—	—	190 (J)
MD54-22-249408	54-02089 P31	31	—	33,800 (J+)	—	—	227,000 (J+)	676,000 (J+)	5150	379,000 (J+)	35,200	—	—	351 (J)
MD54-22-249409	54-02089 P46	466	—	46,200 (J+)	—	—	325,000 (J+)	938,000 (J+)	7470	418,000 (J+)	25,900	—	—	—
MD54-22-249410	54-02089 P86	86	—	50,900 (J+)	—	—	340,000 (J+)	1,020,000 (J+)	4250	370,000 (J+)	17,300	—	—	—
MD54-22-249411	54-24238 P44	44	—	45,300	—	199 (J)	385,000	769,000	7100	318,000	24,000	—	—	—
MD54-22-249412	54-24238 P64	64	—	52,900	—	—	468,000	889,000	4750	320,000	16,200	—	—	—
MD54-22-249413	54-24238 P84	84	—	30,300	—	95.3 (J)	260,000	520,000	2100	186,000	8400	—	—	—
MD54-22-249417	54-24240 P28	28	—	31,700	—	—	51,600	785,000	—	422,000	4960	—	—	—
MD54-22-249418	54-24240 P53	53	—	37,100	—	—	85,000	643,000	—	416,000	4160	—	—	—
MD54-22-249419	54-24240 P78	78	—	33,000	339	—	59,800	274,000	99.2 (J)	250,000	1850	106 (J)	—	—
MD54-22-249414	54-24240 P103	103	—	41,500	94.3	25.6 (J)	50,800	258,000	103 (J)	236,000	1990	28.6 (J)	—	—
MD54-22-249415	54-24240 P128	128	—	31,000	151	24.4 (J)	31,500	177,000	76.3 (J)	135,000	1600	—	—	—
MD54-22-249416	54-24240 P153	153	—	29,900	—	16.9 (J)	27,600	168,000	74.2 (J)	120,000	1690	—	—	—
MD54-22-249425	54-24241 P73	73	139 (J)	95,600	—	—	67,200 (J+)	311,000 (J+)	—	140,000 (J+)	5060 (J+)	93.5	—	—
MD54-22-249426	54-24241 P93	93	161 (J)	71,200 (J+)	—	—	51,500 (J+)	216,000 (J+)	—	103,000 (J+)	3000 (J+)	—	—	—
MD54-22-249420	54-24241 P113	113	—	54,000	—	—	44,000 (J+)	200,000 (J+)	—	83,800 (J+)	2870 (J+)	—	—	—
MD54-22-249421	54-24241 P133	133	—	63,000	—	14.3 (J)	47,900 (J+)	158,000 (J+)	—	92,900 (J+)	3270 (J+)	—	—	—
MD54-22-249422	54-24241 P153	153	—	47,800 (J+)	—	150	42,000 (J+)	132,000 (J+)	—	77,300 (J+)	3030 (J+)	—	—	—
MD54-22-249423	54-24241 P173	173	—	60,400	—	214	57,100 (J+)	179,000 (J+)	—	104,000 (J+)	4230 (J+)	—	—	—
MD54-22-249424	54-24241 P193	193	—	64,100	—	16.5 (J)	60,700 (J+)	188,000 (J+)	—	112,000 (J+)	4530 (J+)	30.4 (J)	—	—
MD54-22-249427	54-24399 P566.7	566.7	—	321	—	42.6	232	611	—	495	34.1 (J)	—	—	—
MD54-22-249428	54-24399 P587.8	587.8	—	214	—	45.9	217	401	—	344	29.5 (J)	—	—	—
MD54-22-249433	54-27641 P32	32	—	**23,100 (J)**	—	—	39,000 (J)	472,000 (J)	**118 (J)**	**412,000 (J)**	1980	—	—	—
MD54-22-249435	54-27641 P82	82	—	30,000 (J)	157 (J)	—	32,000 (J)	222,000 (J)	46.6 (J)	200,000 (J)	1360	53.4 (J)	—	—

Table 5.1-1 (continued)

Sample ID	Location ID	Depth (ft)	Propanol[2-]	Tetrachloroethene	Tetrahydrofuran	Toluene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane	Vinyl Chloride	Xylene[1,2-]	Xylene[1,3-]+Xylene[1,4-]
Groundwater Tier I SL[a]			**136**	**3630**	**9790**	**272,000**	**1,190,000,000**	**141,000**	**169**	**2020**	**4,540,000**	**2280**	**40,900**	**40,900**
Industrial VISL[b]			**na**	**6550**	**na**	**819,000**	**4,920,000**	**819,000**	**32.8**	**328**	**115,000**	**1040**	**16,400**	**16,400**
MD54-22-249429	54-27641 P115	115	—	25,400 (J+)	44.2 (J)	—	29,700 (J+)	198,000	53.9 (J)	173,000	1500	40.4 (J)	—	—
MD54-22-249430	54-27641 P182	182	—	22,000 (J+)	—	67.8 (J+)	18,600 (J+)	165,000	26.1 (J)	83,800 (J+)	1700	—	—	—
MD54-22-249431	54-27641 P232	232	—	17,800 (J+)	—	74.2 (J+)	17,800 (J+)	168,000	—	90,800 (J+)	1860	—	—	—
MD54-22-249432	54-27641 P271	271	—	9900 (J)	—	61.8 (J+)	12,300 (J)	90,000 (J)	—	41,900 (J)	1530	—	—	—
MD54-22-249434	54-27641 P332.5	332.5	—	2320 (J)	—	—	5940 (J)	20,300 (J)	—	13,200 (J)	797	—	—	—
MD54-22-249440	54-27642 P30	30	—	**23,700 (J+)**	—	—	280,000 (J+)	288,000 (J+)	**189 (J)**	**151,000 (J+)**	4000 (J+)	—	—	—
MD54-22-249442	54-27642 P75	75	—	32,900 (J+)	—	—	231,000 (J+)	422,000 (J+)	938	176,000 (J+)	5950 (J+)	—	—	—
MD54-22-249436	54-27642 P116	116	51.3 (J)	5750 (J+)	—	—	9570 (J+)	41,000 (J+)	57.3 (J)	33,400 (J+)	—	—	—	—
MD54-22-249437	54-27642 P175	175	—	27,000 (J+)	64.3 (J)	1810	128,000 (J+)	286,000 (J+)	437	150,000 (J+)	6850 (J+)	—	71.6 (J)	—
MD54-22-249438	54-27642 P235	235	—	24,200 (J+)	—	1340	149,000 (J+)	274,000 (J+)	337	137,000 (J+)	6910 (J+)	—	350	—
MD54-22-249439	54-27642 P275	275	—	33,000 (J+)	—	—	182,000 (J+)	374,000 (J+)	1240	180,000 (J+)	6850 (J+)	—	—	—
MD54-22-249441	54-27642 P338	338	—	32,700 (J+)	542	117 (J)	240,000 (J+)	415,000 (J+)	894	178,000 (J+)	6340 (J+)	—	—	—

Notes: Results are in µg/m3. Data qualifiers are defined in Appendix A. Shading denotes concentrations greater than Tier 1 SLs. Bolding denotes exceedance of VISLs in shallowest sampling ports in boreholes closest to occupied buildings

[a] Tier I SLs are based on NMED 2022, 702484.

[b] VISLs from NMED (2022, 702484).

[c] na = Not available.

[d] — = Not detected.

Table 5.1-2
Second Round 2022 VOC Pore-Gas Detected Results at MDA L (in µg/m^3)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Carbon Disulfide	Carbon Tetrachloride	Chlorobenzene	Chloroform	Cyclohexane	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloroethene[trans-1,2-]	Dichloropropane[1,2-]	Dioxane[1,4-]	Ethanol	Ethylbenzene	Heptane[n-]
Groundwater Tier I SL[a]			**20,3000**	**1140**	**478,000**	**5650**	**12,800**	**12,000**	**79,300,000**	**2,780,000**	**5750**	**242**	**7490**	**11,700**	**16,700**	**580**	**0.9**	**na**	**226,000**	**23,500,000**
Industrial VISL[b]			**5,080,000**	**588**	**115,000**	**765**	**8190**	**199**	**164,000**	**16,400**	**2870**	**176**	**32,800**	**na[c]**	**6550**	**459**	**918**	**na**	**1840**	**na**
MD54-22-259034	54-02089 P13	13	—[d]	42.1 (J)	—	1230	—	9170	389	870	18,800	3070	9590 (J)	—	—	51,300	—	—	—	—
MD54-22-259035	54-02089 P31	31	—	134 (J)	—	2790	—	14,000	1820	1850	27,700	8700	21,600 (J)	—	—	110,000	—	—	—	—
MD54-22-259036	54-02089 P46	46	—	488 (J)	—	3220	—	18,700	4500	2840	34,700	15100	16,000 (J)	—	—	190,000	—	—	—	—
MD54-22-259037	54-02089 P86	86	—	549 (J)	—	2460	—	23,000	3200	2650	30,500	17800	30,600 (J)	—	—	183,000	—	—	—	—
MD54-22-258137	54-24238 P44	44	—	260 (J)	—	1990	—	20,000 (J+)	3290	2260	22,700 (J+)	36,400 (J+)	16,200 (J+)	—	—	157,000 (J+)	—	—	—	—
MD54-22-258138	54-24238 P64	64	—	773 (J)	548 (J)	2820	—	27,500 (J+)	3890	3900	26,000 (J+)	61,100 (J+)	23,000 (J+)	—	—	233,000 (J+)	—	—	—	—
MD54-22-258139	54-24238 P84	84	1500 (J)	578 (J)	—	2780	—	28,200 (J+)	2950	3000	22,400 (J+)	65,500 (J+)	26,800 (J+)	—	—	173,000 (J+)	—	—	—	—
MD54-22-258143	54-24240 P28	28	—	—	—	13,100	141 (J)	14,000	1800	964	32,500	3080	10,300	—	—	499 (J)	—	—	—	—
MD54-22-258144	54-24240 P53	53	—	223 (J)	—	9310	594	24,300	4780	1220	25,000	18,100	9590	—	—	651	414 (J)	—	—	170 (J)
MD54-22-258145	54-24240 P78	78	—	570	—	1870	188	14,100	3400	638	11,600	11,400	9870	72.9 (J)	—	757	1030	—	—	—
MD54-22-258140	54-24240 P103	103	—	393	—	887	142	8980	2470	682	8330	7810	11,000	46 (J)	—	938	290 (J)	—	—	110 (J)
MD54-22-258141	54-24240 P128	128	—	269	—	582	91.1 (J)	5470	1740	761	6800	5870	15,000	—	—	993	—	—	—	88.5 (J)
MD54-22-258142	54-24240 P153	153	—	256	—	577	75 (J)	5000	1630	806	6430	2710	18,000	—	—	905	—	—	—	73.7 (J)
MD54-22-258151	54-24241 P73	73	—	189	—	2820	71.8 (J)	11,400 (J+)	1840	790	10,200 (J+)	20,100 (J+)	11,100 (J+)	—	167 (J)	15,400 (J+)	749	167 (J)	—	—
MD54-22-258152	54-24241 P93	93	—	111 (J)	—	1130	35.7 (J)	6930 (J+)	860	514	5420 (J+)	15,200 (J+)	7410 (J+)	—	81.2 (J)	9650 (J+)	4500	81.2 (J)	—	—
MD54-22-258146	54-24241 P113	113	—	117	—	905	20.3 (J)	7370 (J+)	846	519	5340	14,000 (J+)	9830	—	69.3 (J)	9840 (J+)	3080	69.3 (J)	—	—
MD54-22-258147	54-24241 P133	133	—	204	—	880	29.5 (J)	6640 (J+)	612	578	4250 (J+)	3950 (J+)	14,100	—	59 (J)	6790 (J+)	951	59 (J)	—	—
MD54-22-258148	54-24241 P153	153	—	315	47.3 (J)	1010	41.9 (J)	7080 (J+)	650	682	4610	5220 (J+)	17,000	—	78.9 (J)	6560 (J+)	493	78.9 (J)	—	—
MD54-22-258149	54-24241 P173	173	227	431	—	1430	57.5 (J)	9420 (J+)	829	924	5780	6390 (J+)	24,500	—	99.1	8450 (J+)	526	99.1	—	—
MD54-22-258150	54-24241 P193	193	—	164	—	1400	—	9320 (J+)	764	983	5700	5380 (J+)	26,000	—	99.9	7530 (J+)	774	99.9	—	—
MD54-22-258153	54-24399 P566.7	566.7	49.1 (J)	—	—	—	—	—	—	21.3 (J)	—	—	—	—	—	—	236	—	—	—
MD54-22-258154	54-24399 P587.8	587.8	—	—	142 (J)	—	—	—	—	18 (J)	—	—	—	—	—	—	70.9 (J)	—	—	—
MD54-22-258159	54-27641 P32	32	—	39 (J)	—	**2590**	—	**6000**	2920	509	**22,000**	**6550**	6660	—	—	361	—	—	—	—
MD54-22-258161	54-27641 P82	82	—	277	—	1410	187	5030	3720	409	10,600	9470	5390	51.9 (J)	—	461	475 (J)	—	—	—

Table 5.1-2 (continued)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Carbon Disulfide	Carbon Tetrachloride	Chlorobenzene	Chloroform	Cyclohexane	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloroethene[trans-1,2-]	Dichloropropane[1,2-]	Dioxane[1,4-]	Ethanol	Ethylbenzene	Heptane[n-]
Groundwater Tier I SL[a]			**20,3000**	**1140**	**478,000**	**5650**	**12,800**	**12,000**	**79,300,000**	**2,780,000**	**5750**	**242**	**7490**	**11,700**	**16,700**	**580**	**0.9**	**na**	**226,000**	**23,500,000**
Industrial VISL[b]			**5,080,000**	**588**	**115,000**	**765**	**8190**	**199**	**164,000**	**16,400**	**2870**	**176**	**32,800**	**na[c]**	**6550**	**459**	**918**	**na**	**1840**	**na**
MD54-22-258155	54-27641 P115	115	—	183	—	750	148	4430	2740	473	7640	9830	7500	—	—	656	—	—	—	—
MD54-22-258156	54-27641 P182	182	—	166	—	514	57.5 (J)	2800	1410	707	6510	8000	17,200	—	—	804	—	—	—	—
MD54-22-258157	54-27641 P232	232	—	140	—	792	29 (J)	2290	1220	899	6920	3380	19,900	—	—	459	—	—	—	—
MD54-22-258158	54-27641 P271	271	—	80.5	—	511	10.4 (J)	981	681	677	3110	530	17,500	—	—	138	—	—	—	—
MD54-22-258160	54-27641 P332.5	332.5	—	22.3 (J)	—	232	—	244	265	397	659	195	6660	—	—	14.2 (J)	56.5 (J)	—	—	—
MD54-22-258166	54-27642 P30	30	—	—	—	**5380**	—	**32,000**	588	1410	**6960**	**6800**	13,100	—	—	**30,000**	—	—	—	—
MD54-22-258168	54-27642 P75	75	—	37.4 (J)	—	2500	—	23,700	908	1030	7770	11,200	19,700	—	—	49,000	—	—	—	—
MD54-22-258162	54-27642 P116	116	—	46.6 (J)	—	3300	—	26,300	987	1350	7700	11,400	18,400	—	—	40,800	—	—	—	—
MD54-22-258163	54-27642 P175	175	—	1370	—	2200	459	18,900	870	1210	6630	12,300	30,000	—	—	31,500	—	—	—	—
MD54-22-258164	54-27642 P235	235	—	1100	—	2220	272	15,200	819	1010	4980	6900	24,100	—	—	20,400	—	—	86.4 (J)	—
MD54-22-258165	54-27642 P275	275	—	99.9 (J)	—	3000	—	26,900	905	1400	9550	2220	25,500	—	—	60,000	—	—	—	—
MD54-22-258167	54-27642 P338	338	—	434	—	3320	122 (J)	28,800	1430	1430	9340	21,400	26,800	—	—	59,100	—	—	—	—

Table 5.1-2 (continued)

Sample ID	Location ID	Depth (ft)	Hexane	Isooctane	Methylene Chloride	Propanol[2-]	Tetrachloroethane[1,1,2,2-]	Tetrachloroethene	Tetrahydrofuran	Toluene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane	Vinyl Chloride	Xylene[1,2-]	Xylene[1,3-]+Xylene[1,4-]
Groundwater Tier I SL[a]			**23,500,000**	**na**	**665**	**136**	**11.4**	**3630**	**9790**	**272,000**	**1,190,000,000**	**141,000**	**169**	**2020**	**4,540,000**	**2280**	**40,900**	**40,900**
Industrial VISL[b]			**115,000**	**na**	**98,300**	**na**	**79.1**	**6550**	**na**	**819,000**	**4,920,000**	**819,000**	**32.8**	**328**	**115,000**	**1040**	**16,400**	**16,400**
MD54-22-259034	54-02089 P13	13	—	—	—	—	—	37,400	—	—	141,000	470,000	2300	436,000	77,500	150 (J)	—	—
MD54-22-259035	54-02089 P31	31	—	—	—	—	—	43,700 (J+)	—	—	256,000	710,000	5300	440,000	48,000	401 (J)	—	—
MD54-22-259036	54-02089 P46	46	356 (J)	—	—	—	—	51,900	—	—	319,000	894,000	6920	450,000	25,500	—	—	—
MD54-22-259037	54-02089 P86	86	—	—	—	—	—	60,900	—	—	358,000	987,000	4290	390,000	15,700	473 (J)	—	—
MD54-22-258137	54-24238 P44	44	—	—	—	—	—	44,800 (J+)	—	—	343,000 (J+)	643,000 (J+)	6110 (J+)	308,000 (J+)	29,300 (J+)	—	—	—
MD54-22-258138	54-24238 P64	64	460 (J)	—	3350 (J)	3120 (J)	—	54,800 (J+)	389 (J)	122 (J)	479,000 (J+)	851,000 (J+)	5140 (J+)	350,000 (J+)	16,000 (J+)	—	—	—
MD54-22-258139	54-24238 P84	84	—	—	—	—	—	57,000 (J+)	—	—	442,000 (J+)	820,000 (J+)	3450 (J+)	320,000 (J+)	12,400 (J+)	—	—	—
MD54-22-258143	54-24240 P28	28	—	—	—	—	—	38,500	—	—	70,000	1,090,000	—	494,000	7970	232 (J)	—	—
MD54-22-258144	54-24240 P53	53	—	384 (J)	—	—	—	44,500	—	103 (J)	93,400	682,000	142 (J)	428,000	4120	235 (J)	—	—
MD54-22-258145	54-24240 P78	78	112 (J)	109 (J)	—	—	64.6 (J)	41,000	259	70.4 (J)	50,900	249,000	108 (J)	247,000	1670	120	—	—
MD54-22-258140	54-24240 P103	103	99.7	129	—	—	—	39,700	52.2 (J)	137	36,300	197,000	122 (J)	170,000	1650	59.8 (J)	—	55.1 (J)
MD54-22-258141	54-24240 P128	128	51.1 (J)	76.6 (J)	—	—	—	37,000	58.4 (J)	108	29,000	180,000	76.9 (J)	123,000	1800	36.5 (J)	—	—
MD54-22-258142	54-24240 P153	153	52.1 (J)	85 (J)	—	—	—	37,200	—	83.6 (J)	28,600	182,000	56.7 (J)	114,000	1930	71.5	—	—
MD54-22-258151	54-24241 P73	73	—	—	—	—	—	118,000 (J)	—	—	73,400 (J+)	322,000 (J)	228 (J)	162,000 (J)	4950	101 (J)	—	—
MD54-22-258152	54-24241 P93	93	—	—	—	—	—	64,800 (J)	—	—	46,300 (J+)	181,000 (J)	110 (J)	89,200 (J)	2800	52.9 (J)	—	—
MD54-22-258146	54-24241 P113	113	—	—	—	—	—	65,500 (J)	—	—	48,100 (J+)	172,000 (J)	101 (J)	88,100 (J)	2950	—	—	—
MD54-22-258147	54-24241 P133	133	—	—	—	—	—	55,100 (J)	—	14.6 (J)	44,000 (J+)	135,000 (J)	54.4 (J)	76,800 (J)	2770	39.3 (J)	—	—
MD54-22-258148	54-24241 P153	153	23.2 (J)	—	434	—	—	63,300 (J)	—	163	48,800 (J+)	151,000 (J)	61.6 (J)	91,000 (J)	3300	31.2 (J)	—	—
MD54-22-258149	54-24241 P173	173	30 (J)	—	878	—	—	81,000 (J)	—	234	66,600 (J+)	202,000 (J)	55.6 (J)	122,000 (J)	4480	46 (J)	—	—
MD54-22-258150	54-24241 P193	193	—	—	93 (J)	—	—	46,900 (J)	—	18.9 (J)	69,200 (J+)	200,000 (J)	32.3 (J)	110,000 (J)	4710	35.8 (J)	—	—
MD54-22-258153	54-24399 P566.7	566.7	—	—	48.6 (J)	—	—	—	—	54.2	—	—	—	—	38.5 (J)	—	—	—
MD54-22-258154	54-24399 P587.8	587.8	—	—	—	—	—	—	—	44.1	—	—	—	—	31.9 (J)	—	—	—
MD54-22-258159	54-27641 P32	32	—	—	—	—	—	**27,900**	—	—	41,500	475,000	**116 (J)**	**431,000**	2060	152	—	—
MD54-22-258161	54-27641 P82	82	159	—	—	—	—	29,300	125	49.7 (J)	33,100	220,000	—	205,000	1270	55.2 (J)	—	—

Table 5.1-2 (continued)

Sample ID	Location ID	Depth (ft)	Hexane	Isooctane	Methylene Chloride	Propanol[2-]	Tetrachloroethane[1,1,2,2-]	Tetrachloroethene	Tetrahydrofuran	Toluene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane	Vinyl Chloride	Xylene[1,2-]	Xylene[1,3-]+Xylene[1,4-]
Groundwater Tier I SL[a]			**23,500,000**	**na**	**665**	**136**	**11.4**	**3630**	**9790**	**272,000**	**1,190,000,000**	**141,000**	**169**	**2020**	**4,540,000**	**2280**	**40,900**	**40,900**
Industrial VISL[b]			**115,000**	**na**	**98,300**	**na**	**79.1**	**6550**	**na**	**819,000**	**4,920,000**	**819,000**	**32.8**	**328**	**115,000**	**1040**	**16,400**	**16,400**
MD54-22-258155	54-27641 P115	115	53.9 (J)	—	185 (J)	—	—	24,300	—	28.3 (J)	28,500	170,000	64.3 (J)	155,000	1220	55.2 (J)	—	—
MD54-22-258156	54-27641 P182	182	33.6 (J)	44.1 (J)	2930	—	—	25,200	—	76.5 (J)	22,700	183,000	—	90,200	1900	—	—	—
MD54-22-258157	54-27641 P232	232	37.7 (J)	51.8 (J)	3390	—	—	22,400	—	91.5	22,300	195,000	—	109,000	2040	—	—	—
MD54-22-258158	54-27641 P271	271	25.3 (J)	17.1 (J)	1860	—	—	12,000	—	66.7	15,100	102,000	—	50,000	1750	—	—	—
MD54-22-258160	54-27641 P332.5	332.5	16.5 (J)	—	251	—	—	2740	—	16.6 (J)	7020	21,900	—	13,900	882	—	—	—
MD54-22-258166	54-27642 P30	30	—	—	—	—	—	**29,700 (J)**	—	—	332,000	319,000	**221 (J)**	**184,000**	4260	105 (J)	—	—
MD54-22-258168	54-27642 P75	75	—	—	—	—	—	32,100 (J)	—	—	170,000	341,000	643	158,000	4000	151 (J)	—	—
MD54-22-258162	54-27642 P116	116	—	—	—	—	—	35,000 (J)	—	—	289,000	378,000	403	178,000	5010	107 (J)	—	—
MD54-22-258163	54-27642 P175	175	235	103 (J)	17,300	—	—	27,900 (J)	122 (J)	1420	124,000	263,000	446	151,000	6060	91.5 (J)	—	—
MD54-22-258164	54-27642 P235	235	163 (J)	90.1 (J)	16,000	—	—	22,500 (J)	—	1130	139,000	232,000	215 (J)	125,000	5470	—	253	—
MD54-22-258165	54-27642 P275	275	—	—	—	—	—	32,900 (J)	—	—	170,000	336,000	1150	179,000	5780	—	—	—
MD54-22-258167	54-27642 P338	338	113 (J)	—	1150 (J)	—	—	37,100 (J)	210 (J)	—	270,000	428,000	960	191,000	5900	220 (J)	—	—

Notes: Results are in µg/m3. Data qualifiers are defined in Appendix A. Shading denotes concentrations greater than Tier 1 SLs. Bolding denotes exceedance of VISLs in shallowest sampling ports in boreholes closest to occupied buildings.

[a] Tier I SLs are based on NMED 2022, 702484.

[b] VISLs from NMED (2022, 702484).

[c] na = Not available.

[d] — = Not detected.

Table 5.1-3
First Round 2022 Tritium Pore-Gas Detected Results at MDA L

Field Sample ID	Location ID	Depth (ft bgs)	Analytical Result (pCi/L)
MD54-22-249525	54-02089 P46	46	572
MD54-22-249526	54-02089 P86	86	1895
MD54-22-249527	54-24238 P44	44	23,883
MD54-22-249528	54-24238 P64	64	774
MD54-22-249529	54-24238 P84	84	856
MD54-22-249535	54-24240 P78	78	1069
MD54-22-249542	54-24241 P93	93	546
MD54-22-249553	54-27642 P175	175	659 (J)
MD54-22-249555	54-27642 P275	275	6076 (J)

Table 5.1-4
Second Round 2022 Tritium Pore-Gas Detected Results at MDA L

Field Sample ID	Location ID	Depth (ft bgs)	Analytical Result (pCi/L)
MD54-22-258951	54-02089 P13	13	701
MD54-22-258952	54-02089 P31	31	1242
MD54-22-258953	54-02089 P46	46	3716
MD54-22-258954	54-02089 P86	86	3856
MD54-22-258092	54-24238 P44	44	1212
MD54-22-258093	54-24238 P64	64	1894
MD54-22-258094	54-24238 P84	84	2210
MD54-22-258098	54-24240 P28	28	561
MD54-22-258107	54-24241 P93	93	616
MD54-22-258104	54-24241 P173	173	69,537
MD54-22-258118	54-27642 P175	175	700
MD54-22-258119	54-27642 P235	235	699
MD54-22-258120	54-27642 P275	275	8690
MD54-22-258122	54-27642 P338	338	5521

Table 5.2-1
First Round 2022 VOC Pore-Gas Detected Results at MDA L (in ppmv)

Sample ID	Location ID	Depth (ft)	Benzene	Carbon Tetrachloride	Chlorobenzene	Chloroform	Cyclohexane	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloroethene[trans-1,2-]	Dichloropropane[1,2-]	Dioxane[1,4-]	Hexane	Isooctane	Methylene Chloride
MD54-22-249407	54-02089 P13	13	—*	0.188	—	2.01 (J+)	0.456	0.376	5.94 (J+)	—	2.64 (J+)	—	—	13 (J+)	—	—	—	—
MD54-22-249408	54-02089 P31	31	—	0.409	—	2.99 (J+)	1.47	0.696	8.96 (J+)	2.68 (J+)	4.28 (J+)	—	—	27.6 (J+)	—	—	—	—
MD54-22-249409	54-02089 P46	46	0.141 (J)	0.503	—	—	1.02	0.583	12 (J+)	4.63 (J+)	6.35 (J+)	—	—	53 (J+)	—	0.159 (J)	—	—
MD54-22-249410	54-02089 P86	86	0.204 (J)	0.361 (J)	—	5.24 (J+)	1.31	0.672	10.4 (J+)	5.95 (J+)	8.67 (J+)	—	—	49.6 (J+)	—	—	—	—
MD54-22-249411	54-24238 P44	44	0.132 (J)	0.361	—	5.16	1.21	0.743	8.21	12.6	9.8	—	—	48.4	—	—	—	—
MD54-22-249412	54-24238 P64	64	0.232 (J)	0.407 (J)	—	6.22	0.581	0.431	8.25	18.6	11	—	—	61.5	—	—	—	1.22 (J)
MD54-22-249413	54-24238 P84	84	0.118 (J)	0.255	—	3.57	0.521	0.123 (J)	4.49	13.9	7.2	—	—	27.6	—	—	—	0.276 (J)
MD54-22-249417	54-24240 P28	28	—	1.84	—	2.71	1.37	0.256	8.9	0.745	5.59	—	—	0.0875 (J)	—	—	—	—
MD54-22-249418	54-24240 P53	53	0.0583 (J)	1.44	0.0914 (J)	5.16	1.37	0.137	8	5.5	4.58	—	—	0.117	—	—	—	—
MD54-22-249419	54-24240 P78	78	0.22	0.387	0.0355 (J)	3.65	1.27	0.151	4.24	3.79	3.14	—	—	0.18	0.261	0.0471 (J)	0.0321 (J)	—
MD54-22-249414	54-24240 P103	103	0.18	0.234	0.0356	3.05	0.676	0.148	3.71	2.86	3.47	0.0166 (J)	0.0117 (J)	0.296	0.105	0.0203 (J)	0.0209 (J)	—
MD54-22-249415	54-24240 P128	128	0.0955	0.105	0.0198 (J)	1.57	0.643	0.151	2.28	2.43	3.93	—	—	0.249	—	—	0.013 (J)	—
MD54-22-249416	54-24240 P153	153	0.083	0.0941	0.0186 (J)	1.3	0.619	0.173	2.08	1.83	4.22	—	—	0.262	—	—	—	—
MD54-22-249425	54-24241 P73	73	0.0636	0.431	0.0111 (J)	2.59 (J+)	0.363	0.132	3.17 (J+)	5.94 (J+)	4.46 (J+)	—	0.0423	4.01 (J+)	0.274	—	—	—
MD54-22-249426	54-24241 P93	93	0.0447	0.195	0.00778 (J)	1.97 (J+)	0.228	0.124	2.13 (J+)	5.85 (J+)	2.86 (J+)	—	0.0204 (J)	3.45 (J+)	1.94	—	—	—
MD54-22-249420	54-24241 P113	113	0.0476	0.126	0.00469 (J)	1.82 (J+)	0.198	0.172	1.71 (J+)	4.38 (J+)	3.33 (J+)	—	0.0182 (J)	3.03 (J+)	0.556	—	—	—
MD54-22-249421	54-24241 P133	133	0.0924	0.138	0.00952 (J)	1.98 (J+)	0.175	0.151	1.66 (J+)	1.65 (J+)	5.61 (J+)	—	0.0213 (J)	2.53 (J+)	0.155	—	—	—
MD54-22-249422	54-24241 P153	153	0.106	0.131	0.00673 (J)	1.49 (J+)	0.225	0.189	1.28 (J+)	1.56 (J+)	5.14 (J+)	—	0.0135 (J)	—	0.136	—	—	0.184
MD54-22-249423	54-24241 P173	173	0.137	0.184	0.00924 (J)	2.06 (J+)	0.216	0.204	1.71 (J+)	1.81 (J+)	7.63 (J+)	—	0.0215 (J)	2.28 (J+)	0.0337 (J)	—	—	0.37
MD54-22-249424	54-24241 P193	193	0.0538	0.2	—	2.15 (J+)	0.456	0.00401 (J)	1.75 (J+)	1.55 (J+)	8.32	—	—	2.22 (J+)	0.428	—	—	0.0556 (J)
MD54-22-249427	54-24399 P566.7	566.7	—	—	0.00444 (J)	0.00592 (J)	—	0.0046 (J)	0.011	0.00808 (J)	0.0472	—	—	0.00436 (J)	—	—	—	0.0166 (J)
MD54-22-249428	54-24399 P587.8	587.8	—	—	0.0104 (J)	0.00451 (J)	—	0.0959 (J)	0.00832 (J)	0.00639 (J)	0.0425	—	—	0.00389 (J)	—	—	—	0.0153 (J)
MD54-22-249433	54-27641 P32	32	—	0.386 (J)	—	1.33 (J)	0.967 (J)	0.106 (J)	7.75 (J)	1.94 (J+)	2.16 (J)	—	—	—	—	—	—	—
MD54-22-249435	54-27641 P82	82	0.086	0.22 (J)	0.0498 (J)	1.16 (J)	1.38 (J)	0.132	3.51 (J)	2.79	2.46 (J)	—	—	—	0.166	0.0712 (J)	—	0.177 (J)
MD54-22-249429	54-27641 P115	115	0.0771	0.122	0.0396	1.15	1.12	0.162	2.8	3.51	3.12 (J+)	0.00807 (J)	—	0.205 (J+)	—	0.0195 (J)	0.00932 (J)	0.0876 (J)
MD54-22-249430	54-27641 P182	182	0.0528	0.0718	0.0124 (J)	0.586 (J+)	0.442	0.172	1.83	2.35	4.94	—	—	0.221 (J+)	—	0.00912 (J)	0.0107 (J)	1.25

Table 5.2-1 (continued)

Sample ID	Location ID	Depth (ft)	Benzene	Carbon Tetrachloride	Chlorobenzene	Chloroform	Cyclohexane	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloroethene[trans-1,2-]	Dichloropropane[1,2-]	Dioxane[1,4-]	Hexane	Isooctane	Methylene Chloride
MD54-22-249431	54-27641 P232	232	0.0411	0.101	0.00653 (J)	0.462 (J+)	0.35	0.146 (J)	1.99	0.855 (J+)	5.59	—	—	—	—	0.00959 (J)	0.01 (J)	1.33
MD54-22-249432	54-27641 P271	271	0.0249	0.0698 (J)	—	0.199 (J)	0.172 (J)	0.0761 (J)	0.884 (J)	0.12 (J+)	5.2 (J)	—	—	—	0.0218 (J)	0.00838 (J)	0.00455 (J)	0.797 (J)
MD54-22-249434	54-27641 P332.5	332.5	0.00626 (J)	0.034 (J)	—	0.0515 (J)	0.0812 (J)	0.376	0.19 (J)	0.0592 (J+)	1.94 (J)	—	—	—	0.19	0.00533 (J)	—	0.0998 (J)
MD54-22-249440	54-27642 P30	30	—	0.716	—	6.72 (J+)	—	0.221	2.08 (J+)	1.82 (J+)	3.9 (J+)	—	—	7.88 (J+)	—	—	—	—
MD54-22-249442	54-27642 P75	75	0.0258 (J)	0.464	—	6.8 (J+)	0.389	0.357	3.19 (J+)	4.9 (J+)	8.73 (J+)	—	—	17.4 (J+)	—	—	—	—
MD54-22-249436	54-27642 P116	116	—	0.0425	—	1.56	—	0.00391 (J)	0.497 (J+)	0.405 (J+)	0.251 (J+)	0.00775 (J)	—	1.77 (J+)	—	—	—	—
MD54-22-249437	54-27642 P175	175	0.513	0.351	0.107	4.48 (J+)	0.292	0.299	2.28 (J+)	3.83 (J+)	10.2	—	—	8.96 (J+)	—	0.0985	—	8.58
MD54-22-249438	54-27642 P235	235	0.417	0.406	0.0663	4.07 (J+)	0.283	0.261	1.86 (J+)	2.44 (J+)	9.48	—	—	7.06 (J+)	—	0.0823	—	8.15
MD54-22-249439	54-27642 P275	275	0.0472 (J)	0.424	—	6.75 (J+)	0.328	0.342	3.33 (J+)	—	10.3 (J+)	—	—	17.2 (J+)	—	—	—	—
MD54-22-249441	54-27642 P338	338	0.197	0.482	0.027 (J)	6.29 (J+)	0.43	0.327	2.99 (J+)	6.52 (J+)	8.95 (J+)	—	—	15.9 (J+)	—	0.054 (J)	—	1.21

Table 5.2-1 (continued)

Sample ID	Location ID	Depth (ft)	Propanol[2-]	Tetrachloroethene	Tetrahydrofuran	Toluene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane	Vinyl Chloride	Xylene[1,2-]	Xylene[1,3-]+Xylene[1,4-]	Total VOCs
MD54-22-249407	54-02089 P13	13	—	4.36 (J+)	—	—	17.3 (J+)	85.6 (J+)	0.384	67.8 (J+)	8.94	—	—	0.0438 (J)	208
MD54-22-249408	54-02089 P31	31	—	4.99 (J+)	—	—	29.7 (J+)	124 (J+)	0.945	70.6 (J+)	6.27	—	—	0.081 (J)	284
MD54-22-249409	54-02089 P46	46	—	6.81 (J+)	—	—	42.4 (J+)	172 (J+)	1.37	77.8 (J+)	4.61	—	—	—	384
MD54-22-249410	54-02089 P86	86	—	7.51 (J+)	—	—	45 (J+)	187 (J+)	0.779	68 (J+)	3.08	—	—	—	393
MD54-22-249411	54-24238 P44	44	—	6.69	—	0.0529 (J)	50.3	141	1.3	59.2	4.28	—	—	—	349
MD54-22-249412	54-24238 P64	64	—	7.81	—	—	61.1	163	0.871	59.5	2.89	—	—	—	405
MD54-22-249413	54-24238 P84	84	—	4.47	—	0.0253 (J)	34	95.3	0.385	34.6	1.5	—	—	—	229
MD54-22-249417	54-24240 P28	28	—	4.68	—	—	6.74	144	—	78.5	0.884	—	—	—	255
MD54-22-249418	54-24240 P53	53	—	5.47	—	—	11.1	118	—	77.5	0.741	—	—	—	239
MD54-22-249419	54-24240 P78	78	—	4.87	0.115	—	7.81	50.3	0.0182 (J)	46.5	0.329	0.0416 (J)	—	—	127
MD54-22-249414	54-24240 P103	103	—	6.12	0.032	0.00681 (J)	6.63	47.4	0.0188 (J)	43.9	0.355	0.0112 (J)	—	—	120
MD54-22-249415	54-24240 P128	128	—	4.57	0.0514	0.00647 (J)	4.11	32.4	0.014 (J)	25.2	0.29	—	—	—	78
MD54-22-249416	54-24240 P153	153	—	4.41	—	0.00448 (J)	3.61	30.9	0.0136 (J)	22	0.301	—	—	—	72
MD54-22-249425	54-24241 P73	73	0.0565 (J)	14.1	—	—	8.78 (J+)	57.1 (J+)	—	19.4 (J+)	0.901 (J+)	0.0366	—	—	129
MD54-22-249426	54-24241 P93	93	0.0655 (J)	10.5 (J+)	—	—	6.73 (J+)	39.6 (J+)	—	20.8 (J+)	0.6 (J+)	—	—	—	96
MD54-22-249420	54-24241 P113	113	—	7.97	—	—	5.74 (J+)	30 (J+)	—	0.0921	0.512 (J+)	—	—	—	75
MD54-22-249421	54-24241 P133	133	—	9.29	—	0.00381 (J)	6.26 (J+)	28.9 (J+)	—	0.064	0.582 (J+)	—	—	—	77
MD54-22-249422	54-24241 P153	153	—	7.05 (J+)	—	0.0399	5.48 (J+)	24.2 (J+)	—	76.8 (J)	0.539 (J+)	—	—	—	62
MD54-22-249423	54-24241 P173	173	—	8.91	—	0.0567	7.45 (J+)	32.8 (J+)	—	37.2 (J)	0.753 (J+)	—	—	—	86
MD54-22-249424	54-24241 P193	193	—	9.45	—	0.00439 (J)	7.92 (J+)	34.5 (J+)	—	32.2	0.806 (J+)	0.0119 (J)	—	—	91
MD54-22-249427	54-24399 P566.7	566.7	—	0.0474	—	0.0113	0.0303	0.112	—	15.6 (J+)	0.00608 (J)	—	—	—	0.401
MD54-22-249428	54-24399 P587.8	587.8	—	0.0315	—	0.0122	0.0283	0.0736	—	16.9 (J+)	0.00525 (J)	—	—	—	0.311
MD54-22-249433	54-27641 P32	32	—	3.41 (J)	—	—	5.1 (J)	86.5 (J)	0.0217 (J)	7.81 (J)	0.353	—	—	—	187
MD54-22-249435	54-27641 P82	82	—	4 (J)	0.0534 (J)	—	4.18 (J)	40.8 (J)	0.00854 (J)	2.45 (J)	0.242	0.0209 (J)	—	—	99
MD54-22-249429	54-27641 P115	115	—	3.75 (J+)	0.015 (J)	—	3.88 (J+)	36.4	0.00989 (J)	28.2 (J+)	0.268	0.0158 (J)	—	—	89
MD54-22-249430	54-27641 P182	182	—	3.25 (J+)	—	0.018 (J+)	2.43 (J+)	30.3	0.00478 (J)	32.8 (J+)	0.302	—	—	—	64

Table 5.2-1 (continued)

Sample ID	Location ID	Depth (ft)	Propanol[2-]	Tetrachloroethene	Tetrahydrofuran	Toluene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane	Vinyl Chloride	Xylene[1,2-]	Xylene[1,3-]+Xylene[1,4-]	Total VOCs
MD54-22-249431	54-27641 P232	232	—	2.62 (J+)	—	0.0197 (J+)	2.32 (J+)	30.8	—	6.22 (J+)	0.331	—	—	—	64
MD54-22-249432	54-27641 P271	271	—	1.46 (J)	—	0.0164 (J+)	1.61 (J)	16.5 (J)	—	28 (J+)	0.272	—	—	—	35
MD54-22-249434	54-27641 P332.5	332.5	—	0.342 (J)	—	—	0.776 (J)	3.73 (J)	—	25.6 (J+)	0.142	—	—	—	10
MD54-22-249440	54-27642 P30	30	—	3.49 (J+)	—	—	36 (J+)	52.8 (J+)	0.0346 (J)	33.5 (J+)	0.71 (J+)	—	—	—	145
MD54-22-249442	54-27642 P75	75	—	4.85 (J+)	—	—	30.1 (J+)	77.4 (J+)	0.172	33.2 (J+)	1.06 (J+)	—	—	—	189
MD54-22-249436	54-27642 P116	116	0.0209 (J)	0.849 (J+)	—	—	1.25 (J+)	7.52 (J+)	0.0105 (J)	19.4 (J+)	—	—	—	—	20
MD54-22-249437	54-27642 P175	175	—	3.99 (J+)	0.0218 (J)	0.481	16.7 (J+)	52.4 (J+)	0.0802	20.8 (J+)	1.22 (J+)	—	0.0165 (J)	—	143
MD54-22-249438	54-27642 P235	235	—	3.57 (J+)	—	0.356	19.5 (J+)	50.3 (J+)	0.0618	0.0921	1.23 (J+)	—	0.0806	—	135
MD54-22-249439	54-27642 P275	275	—	4.9 (J+)	—	—	23.8 (J+)	68.5 (J+)	0.227	0.064	1.22 (J+)	—	—	—	171
MD54-22-249441	54-27642 P338	338	—	4.83 (J+)	0.184	0.031 (J)	31 (J+)	76.1 (J+)	0.164	76.8 (J)	1.13 (J+)	—	—	—	190

Notes: Results are in ppmv. Data qualifiers are defined in Appendix A.

* — = Not detected.

Table 5.2-2
Second Round 2022 VOC Pore-Gas Detected Results at MDA L (in ppmv)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Carbon Disulfide	Carbon Tetrachloride	Chlorobenzene	Chloroform	Cyclohexane	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloroethene[trans-1,2-]	Dichloropropane[1,2-]	Dioxane[1,4-]	Ethanol	Ethylbenzene	Heptane[n-]
MD54-22-259034	54-02089 P13	13	—*	0.0132 (J)	—	0.196	—	1.88	0.113	0.176	4.64	0.758	2.42 (J)	—	—	11.1	—	—	—	—
MD54-22-259035	54-02089 P31	31	—	0.0419 (J)	—	0.443	—	2.87	0.529	0.374	6.85	2.15	5.45 (J)	—	—	23	—	—	—	—
MD54-22-259036	54-02089 P46	46	—	0.153 (J)	—	0.512	—	3.84	1.3	0.574	8.57	3.73	4.04 (J)	—	—	41.1	—	—	—	—
MD54-22-259037	54-02089 P86	86	—	0.172 (J)	—	0.391	—	4.8	0.931	0.537	7.53	4.41	7.72 (J)	—	—	39.6	—	—	—	—
MD54-22-258137	54-24238 P44	44	—	0.0815 (J)	—	0.316	—	4 (J+)	0.955	0.458	5.62 (J+)	8.99 (J+)	4.08 (J+)	—	—	33.9 (J+)	—	—	—	—
MD54-22-258138	54-24238 P64	64	—	0.242 (J)	0.176 (J)	0.449	—	5.63 (J+)	1.13	0.789	6.42 (J+)	15.1 (J+)	5.81 (J+)	—	—	50.4 (J+)	—	1.35 (J)	—	—
MD54-22-258139	54-24238 P84	84	0.631 (J)	0.181 (J)	—	0.442	—	5.78 (J+)	0.857	0.607	5.53 (J+)	16.2 (J+)	6.76 (J+)	—	—	37.5 (J+)	—	—	—	—
MD54-22-258143	54-24240 P28	28	—	—	—	2.08	0.0306 (J)	2.8	0.524	0.195	8.04	0.761	2.61	—	—	0.108 (J)	—	—	—	—
MD54-22-258144	54-24240 P53	53	—	0.0698 (J)	—	1.48	0.129	4.97	1.39	0.247	6.3	4.47	2.42	—	—	0.141	0.115 (J)	—	—	0.0414 (J)
MD54-22-258145	54-24240 P78	78	—	0.18	—	0.298	0.0409	2.88	0.99	0.129	2.87	2.83	2.49	0.0184 (J)	—	0.164	0.285	—	—	—
MD54-22-258140	54-24240 P103	103	—	0.123	—	0.141	0.0308	1.84	0.719	0.138	2.06	1.93	2.9	0.0116 (J)	—	0.203	0.0804 (J)	—	—	0.0268 (J)
MD54-22-258141	54-24240 P128	128	—	0.0841	—	0.0926	0.0198 (J)	1.12	0.507	0.154	1.68	1.45	3.79	—	—	0.215	—	—	—	0.0216 (J)
MD54-22-258142	54-24240 P153	153	—	0.0803	—	0.0918	0.0163 (J)	1	0.474	0.163	1.59	0.669	4.5	—	—	0.196	—	—	—	0.018 (J)
MD54-22-258151	54-24241 P73	73	—	0.0591	—	0.449	0.0156 (J)	2.34 (J+)	0.535	0.16	2.51 (J+)	4.97 (J+)	2.81 (J+)	—	0.0422 (J)	3.33 (J+)	0.208	—	—	—
MD54-22-258152	54-24241 P93	93	—	0.0348 (J)	—	0.179	0.00775 (J)	1.42 (J+)	0.25	0.104	1.34 (J+)	3.76 (J+)	1.87 (J+)	—	0.0205 (J)	2.09 (J+)	1.25	—	—	—
MD54-22-258146	54-24241 P113	113	—	0.0368	—	0.144	0.00441 (J)	1.51 (J+)	0.246	0.105	1.32	3.47 (J+)	2.48	—	0.0175 (J)	2.13 (J+)	0.856	—	—	—
MD54-22-258147	54-24241 P133	133	—	0.064	—	0.14	0.00642 (J)	1.36 (J+)	0.178	0.117	1.05 (J+)	0.976 (J+)	3.56	—	0.0149 (J)	1.47 (J+)	0.264	—	—	—
MD54-22-258148	54-24241 P153	153	—	0.0986	0.0152 (J)	0.161	0.0091 (J)	1.45 (J+)	0.189	0.138	1.14	1.29 (J+)	4.28	—	0.0199 (J)	1.42 (J+)	0.137	—	—	—
MD54-22-258149	54-24241 P173	173	0.0958	0.135	—	0.228	0.0125 (J)	1.93 (J+)	0.241	0.187	1.43	1.58 (J+)	6.18	—	0.025	1.83 (J+)	0.146	—	—	—
MD54-22-258150	54-24241 P193	193	—	0.0514	—	0.223	—	1.91 (J+)	0.222	0.199	1.4	1.33 (J+)	6.6	—	0.0252	1.63 (J+)	0.215	—	—	—
MD54-22-258153	54-24399 P566.7	566.7	0.0207 (J)	—	—	—	—	—	—	0.00431 (J)	—	—	—	—	—	—	0.0654	—	—	—
MD54-22-258154	54-24399 P587.8	587.8	—	—	0.0457 (J)	—	—	—	—	0.00365 (J)	—	—	—	—	—	—	0.0197 (J)	—	—	—
MD54-22-258159	54-27641 P32	32	—	0.0122 (J)	—	0.412	—	0.849	0.849	0.103	5.4	1.62	1.68	—	—	0.0782	—	—	—	—
MD54-22-258161	54-27641 P82	82	—	0.0869	—	0.224	0.0406	1.08	1.08	0.0828	2.61	2.34	1.36	0.0131 (J)	—	0.0999	0.132 (J)	—	—	—
MD54-22-258155	54-27641 P115	115	—	0.0572	—	0.12	0.0321	0.796	0.796	0.0958	1.89	2.43	1.9	—	—	0.142	—	—	—	—
MD54-22-258156	54-27641 P182	182	—	0.052	—	0.0818	0.0125 (J)	0.411	0.411	0.143	1.61	2	4.33	—	—	0.174	—	—	—	—
MD54-22-258157	54-27641 P232	232	—	0.0439	—	0.126	0.0063 (J)	0.354	0.354	0.182	1.71	0.835	5.02	—	—	0.0994	—	—	—	—
MD54-22-258158	54-27641 P271	271	—	0.0252	—	0.0812	0.00225 (J)	0.198	0.198	0.137	0.769	0.13	4.41	—	—	0.0298	—	—	—	—

Table 5.2-2 (continued)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Carbon Disulfide	Carbon Tetrachloride	Chlorobenzene	Chloroform	Cyclohexane	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloroethene[trans-1,2-]	Dichloropropane[1,2-]	Dioxane[1,4-]	Ethanol	Ethylbenzene	Heptane[n-]
MD54-22-258160	54-27641 P332.5	332.5	—	0.007 (J)	—	0.0369	—	0.0771	0.0771	0.0803	0.163	0.0481	1.68	—	—	0.00308 (J)	0.0157 (J)	—	—	—
MD54-22-258166	54-27642 P30	30	—	—	—	0.855	—	0.171	0.171	0.286	1.72	1.68	3.31	—	—	7	—	—	—	—
MD54-22-258168	54-27642 P75	75	—	0.0117 (J)	—	0.39	—	0.264	0.264	0.209	1.92	2.78	4.96	—	—	10.6	—	—	—	—
MD54-22-258162	54-27642 P116	116	—	0.0146 (J)	—	0.52	—	5.38	0.287	0.273	1.9	2.83	4.64	—	—	8.83	—	—	—	—
MD54-22-258163	54-27642 P175	175	—	0.428	—	0.35	0.0997	3.87	0.253	0.244	1.64	3.03	8	—	—	6.81	—	—	—	—
MD54-22-258164	54-27642 P235	235	—	0.345	—	0.353	0.0591	3.11	0.238	0.204	1.23	1.7	6.08	—	—	4.41	—	—	0.0199 (J)	—
MD54-22-258165	54-27642 P275	275	—	0.0313 (J)	—	0.4	—	5.52	0.263	0.284	2.36	0.549	6.43	—	—	13	—	—	—	—
MD54-22-258167	54-27642 P338	338	—	0.136	—	0.528	0.0266 (J)	5.91	0.417	0.289	2.31	5.29	6.77	—	—	12.8	—	—	—	—

Table 5.2-2 (continued)

Sample ID	Location ID	Depth (ft)	Hexane	Isooctane	Methylene Chloride	Propanol[2-]	Tetrachloroethane[1,1,2,2-]	Tetrachloroethene	Tetrahydrofuran	Toluene	Trichloro-1,2,2- trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane	Vinyl Chloride	Xylene[1,2-]	Xylene[1,3-]+Xylene[1,4-]	Total VOCs
MD54-22-259034	54-02089 P13	13	—	—	—	—	—	5.52	—	—	18.4	86	0.43	81.2	13.8	0.0588 (J)	—	—	227
MD54-22-259035	54-02089 P31	31	—	—	—	—	—	6.45 (J+)	—	—	33.4	130	0.97	82	8.6	0.157 (J)	—	—	303
MD54-22-259036	54-02089 P46	46	0.101 (J)	—	—	—	—	7.66	—	—	41.7	164	1.27	83.7	4.54	—	—	—	367
MD54-22-259037	54-02089 P86	86	—	—	—	—	—	8.98	—	—	46.7	181	0.786	72	2.79	0.185 (J)	—	—	379
MD54-22-258137	54-24238 P44	44	—	—	—	—	—	6.61 (J+)	—	—	44.8 (J+)	118 (J+)	1.12 (J+)	57.4 (J+)	5.22 (J+)	—	—	—	292
MD54-22-258138	54-24238 P64	64	0.13 (J)	—	0.966 (J)	1.27 (J)	—	8.08 (J+)	0.132 (J)	0.0325 (J)	62.5 (J+)	156 (J+)	0.943 (J+)	65.2 (J+)	2.8 (J+)	—	—	—	386
MD54-22-258139	54-24238 P84	84	—	—	—	—	—	8.4 (J+)	—	—	57.7 (J+)	150 (J+)	0.633 (J+)	59.6 (J+)	2.21 (J+)	—	—	—	353
MD54-22-258143	54-24240 P28	28	—	—	—	—	—	5.68	—	—	9	199	—	91.9	1.42	0.091 (J)	—	—	324
MD54-22-258144	54-24240 P53	53	—	0.0823 (J)	—	—	—	6.57	—	0.0273 (J)	12.2	125	0.0261 (J)	79.7	0.734	0.0921 (J)	—	—	246
MD54-22-258145	54-24240 P78	78	0.0318 (J)	0.0234 (J)	—	—	0.00941 (J)	6.1	0.0879	0.0187 (J)	6.64	45.6	0.0198 (J)	45.9	0.298	0.0469	—	—	118
MD54-22-258140	54-24240 P103	103	0.0283	0.0276	—	—	—	5.85	0.0177 (J)	0.0364	4.74	36.2	0.0224 (J)	32	0.293	0.0234 (J)	—	0.0127 (J)	89.5
MD54-22-258141	54-24240 P128	128	0.0145 (J)	0.0164 (J)	—	—	—	5.46	0.0198 (J)	0.0286	3.78	33	0.0141 (J)	22.9	0.321	0.0143 (J)	—	—	74.7
MD54-22-258142	54-24240 P153	153	0.0148 (J)	0.0182 (J)	—	—	—	5.49	—	0.0222 (J)	3.73	33.4	0.0104 (J)	21.2	0.344	0.028	—	—	73.1
MD54-22-258151	54-24241 P73	73	—	—	—	—	—	17.4 (J)	—	—	9.58 (J+)	59.1 (J)	0.0418 (J)	30.2 (J)	0.882	0.0394 (J)	—	—	135
MD54-22-258152	54-24241 P93	93	—	—	—	—	—	9.56 (J)	—	—	6.05 (J+)	33.2 (J)	0.0201 (J)	16.6 (J)	0.499	0.0207 (J)	—	—	78.3
MD54-22-258146	54-24241 P113	113	—	—	—	—	—	9.67 (J)	—	—	6.28 (J+)	31.5 (J)	0.0186 (J)	16.4 (J)	0.526	—	—	—	76.7
MD54-22-258147	54-24241 P133	133	—	—	—	—	—	8.13 (J)	—	0.00388 (J)	5.75 (J+)	24.7 (J)	0.00997 (J)	14.3 (J)	0.493	0.0154 (J)	—	—	62.6
MD54-22-258148	54-24241 P153	153	0.00659 (J)	—	0.125	—	—	9.34 (J)	—	0.0432	6.37 (J+)	27.7 (J)	0.0113 (J)	17 (J)	0.588	0.0122 (J)	—	—	71.5
MD54-22-258149	54-24241 P173	173	0.00852 (J)	—	0.253	—	—	12 (J)	—	0.0622	8.69 (J+)	37.1 (J)	0.0102 (J)	22.8 (J)	0.797	0.018 (J)	—	—	95.8
MD54-22-258150	54-24241 P193	193	—	—	0.0268 (J)	—	—	6.92 (J)	—	0.00503 (J)	9.04 (J+)	36.6 (J)	0.00592 (J)	20.5 (J)	0.838	0.014 (J)	—	—	87.8
MD54-22-258153	54-24399 P566.7	566.7	—	—	0.014 (J)	—	—	—	—	0.0144	—	—	—	—	0.00686 (J)	—	—	—	0.126
MD54-22-258154	54-24399 P587.8	587.8	—	—	—	—	—	—	—	0.0117	—	—	—	—	0.00569 (J)	—	—	—	0.0864
MD54-22-258159	54-27641 P32	32	—	—	—	—	—	4.12	—	—	5.42	87.1	0.0212 (J)	80.2	0.367	0.0595	—	—	189
MD54-22-258161	54-27641 P82	82	0.045	—	—	—	—	4.33	0.0425	0.0132 (J)	4.32	40.4	—	38.2	0.226	0.0216 (J)	—	—	96.7
MD54-22-258155	54-27641 P115	115	0.0153 (J)	—	0.0532 (J)	—	—	3.58	—	0.00752 (J)	3.72	32	0.0118 (J)	28.8	0.217	0.0216 (J)	—	—	76.8
MD54-22-258156	54-27641 P182	182	0.00954 (J)	0.00944 (J)	0.843	—	—	3.72	—	0.0203 (J)	2.96	33.6	—	16.8	0.33	—	—	—	67.7
MD54-22-258157	54-27641 P232	232	0.0107 (J)	0.0111 (J)	0.976	—	—	3.31	—	0.0243	2.91	35.7	—	20.3	0.364	—	—	—	72.5
MD54-22-258158	54-27641 P271	271	0.00718 (J)	0.00366 (J)	0.535	—	—	1.77	—	0.0177	1.97	18.7	—	9.4	0.311	—	—	—	38.7

Table 5.2-2 (continued)

Sample ID	Location ID	Depth (ft)	Hexane	Isooctane	Methylene Chloride	Propanol[2-]	Tetrachloroethane[1,1,2,2-]	Tetrachloroethene	Tetrahydrofuran	Toluene	Trichloro-1,2,2- trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane	Vinyl Chloride	Xylene[1,2-]	Xylene[1,3-]+Xylene[1,4-]	Total VOCs
MD54-22-258160	54-27641 P332.5	332.5	0.00467 (J)	—	0.0723	—	—	0.404	—	0.0044 (J)	0.916	4.02	—	2.59	0.157	—	—	—	10.3
MD54-22-258166	54-27642 P30	30	—	—	—	—	—	4.38 (J)	—	—	43.4	58.5	0.0406 (J)	34.2	0.758	0.0412 (J)	—	—	163
MD54-22-258168	54-27642 P75	75	—	—	—	—	—	4.73 (J)	—	—	22.2	62.5	0.118	29.5	0.71	0.0593 (J)	—	—	146
MD54-22-258162	54-27642 P116	116	—	—	—	—	—	5.17 (J)	—	—	37.7	69.4	0.074	33.2	0.893	0.0417 (J)	—	—	171
MD54-22-258163	54-27642 P175	175	0.0666	0.022 (J)	4.97	—	—	4.12 (J)	0.0414 (J)	0.378	16.2	48.2	0.0818	28.1	1.08	0.0358 (J)	—	—	128
MD54-22-258164	54-27642 P235	235	0.0464 (J)	0.0193 (J)	4.7	—	—	3.32 (J)	—	0.299	18.2	42.5	0.0394 (J)	23.3	0.974	—	0.0582	—	111
MD54-22-258165	54-27642 P275	275	—	—	—	—	—	4.85 (J)	—	—	22	61.6	0.211	33.3	1.03	—	—	—	152
MD54-22-258167	54-27642 P338	338	0.0321 (J)	—	0.332 (J)	—	—	5.48 (J)	0.0711 (J)	—	35.3	78.5	0.176	35.5	1.05	0.0862 (J)	—	—	191

Notes: Results are in ppmv. Data qualifiers are defined in Appendix A.

* — = Not detected.

Appendix A

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

A-1.0 ACRONYMS AND ABBREVIATIONS

ADR	automated data review
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylene
COC	chain of custody
Consent Order	2016 Compliance Order on Consent
DCA	dichloroethane
DCE	dichloroethene
DCP	dichloropropane
DOE	Department of Energy (U.S.)
DQO	data quality objective
EDD	electronic data deliverable
EIM	Environmental Information Management (database)
EPA	Environmental Protection Agency (U.S.)
FB	field blank
FD	field duplicate
IM	interim measure
LANL	Los Alamos National Laboratory
MCL	maximum contaminant level
MDA	material disposal area
N3B	Newport News Nuclear BWXT-Los Alamos, LLC
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
PCE	tetrachloroethene
PID	photoionization detector
PMR	periodic monitoring report
QA	quality assurance
QC	quality control

SCL	sample collection log
SL	screening level
SMO	Sample Management Office
SOP	standard operating procedure
SQL	Structured Query Language
SVE	soil-vapor extraction
SWMU	solid waste management unit
TCA	trichloroethane
TCE	trichloroethene
VISL	vapor intrusion screening level
VOC	volatile organic compound

A-2.0 METRIC CONVERSION TABLE

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

A-3.0 DATA QUALIFIER DEFINITIONS

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

Appendix B

Field Methods

B-1.0 INTRODUCTION

This appendix summarizes field methods used during calendar year 2022 sampling activities at Material Disposal Area (MDA) L, Solid Waste Management Unit 50-006, in Technical Area 54 at Los Alamos National Laboratory (LANL or the Laboratory). All activities were conducted in accordance with the applicable standard operating procedures (SOPs), quality procedures, and Newport News Nuclear BWXT-Los Alamos, LLC (N3B) implementation and procedural requirements. Table B-1.0-1 summarizes the field methods used, Table B-1.0-2 lists the applicable procedures, Table B-1.0-3 presents the field-screening data, and Table B-1.0-4 presents weights of tritium samples.

B-2.0 FIELD METHODS

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

B-2.1 Volatile Organic Compound Pore-Gas Sample Collection

Samples were collected following purging of the sample port and stabilization of field parameters. Monitored field parameters include static pressure of port, purge flow rate, carbon dioxide (CO_2), oxygen (O_2), and volatile organic compounds (VOCs). Each port was purged for a minimum of 10 min. A minimum purge flow rate of 0.3 standard liters per minute (slpm) is required for collection. Ports with purge flow rates of less than 0.3 slpm were considered plugged and not sampled.

After purging was completed, O_2, CO_2, and VOC concentrations were monitored using portable gas detectors to ensure that concentrations were stable before sample collection. Once stabilization occurred, the sample was collected in a SUMMA canister. Field crews recorded the pressure measurements of the SUMMA canister, before and after the sample was taken, and all field parameters, on appropriate sample collection logs (SCLs). Field duplicates (FDs) were collected immediately following the original sample. Field blanks (FBs) were collected using ultrapure nitrogen gas (99.9%). Field chain-of-custody (COC) forms and SCLs are provided in Appendix E (on CD included with this document).

All VOC samples were collected in accordance with the current version of N3B-SOP-ER-2008, "Sampling Subsurface Vapor."

All samples were submitted to the N3B Sample Management Office (SMO) for processing and transport to off-site contract analytical laboratories.

B-2.2 Volatile Organic Compound Pore-Gas Field Screening

All VOC samples were field-screened in accordance with the current version of N3B-SOP-ER-2008, "Sampling Subsurface Vapor." All field-screening results were recorded on the appropriate SCLs in the field logbook and/or in tables, and are provided in Appendix E (on CD included with this document) and summarized in Table B-1.0-3.

Before each sampling event, each sampling port was purged of stagnant air and then monitored until CO_2 and O_2 levels stabilized at values representative of subsurface pore-gas conditions. The total VOC concentration in ppmv was also estimated using a volatile gas monitor with photoionization detector

(PID). For both rounds of sampling, field screening was performed using a MiniRAE multi-gas detector equipped with a 10.6-eV PID and an RKI Instruments Eagle 2 gas detector. Each rented instrument was shipped factory-calibrated to the sampling subcontractor, and the calibration was checked daily.

Drawing sufficient air from the sampling interval through the line ensured that the vapor-sample tubing was purged of stagnant air. To ensure that the sample collected was representative of the subsurface air at depth, every sampling activity included a purge cycle.

The CO_2, O_2, and VOC screening results are presented in Table B.1-0.3.

B-2.3 Tritium Pore-Gas Sample Collection

All tritium samples were collected in accordance with the current version of N3B-SOP-ER-2008. A pore-gas sample was pulled through a canister of silica gel (silica-gel column) to collect water vapor intended for tritium analysis, and the sample information was recorded on the appropriate SCL (included in Appendix E [on CD included with this document]). The moisture was analyzed for tritium by liquid scintillation counting. Silica-gel column FD and FB samples were collected at a frequency of 1 per every 10 samples in accordance with the current version of N3B- SOP-SDM-1100, “Sample Containers, Preservation, and Field Quality Control.” FBs for tritium analysis were collected by filling a silica-gel column with approximately 5 g of distilled water.

Silica gel was prepared for sampling by drying at a temperature greater than 100°C. Drying removes moisture from the silica gel but does not remove bound water, as demonstrated when the bound-water percentage in each batch of silica gel is measured. Before sample collection, the amount of silica gel used in each sample was weighed (typically about 135 g). The sample canister with silica gel was also weighed before sampling. N3B-SOP-ER-2008 requires that at least 5 g of moisture be collected. After sampling, the sample canister with silica gel was weighed again to verify that 5 g of water vapor had been collected. Weights of tritium samples are presented in Table B-1.0-4.

The sample was shipped to the analytical laboratory where it was weighed again. The silica gel was emptied into a distillation apparatus and heated to 110°C, driving moisture off the silica gel. This moisture was collected and analyzed for tritium by liquid scintillation. The analytical laboratory also weighed the empty canister and calculated the percent moisture of the sample as the amount of moisture collected divided by the calculated weight of the wet silica gel. The value of the tritium activity and the calculated percent moisture were reported to N3B in the analytical data package and the electronic data deliverable.

Table B-1.0-1
Summary of Field Methods

Method	Summary
General Instructions for Field Investigations	General instructions for field investigations (e.g., prework briefings, plan-of-the-day meetings, tailgate meetings) provide an overview of instructions regarding activities performed before, during, and after field investigations. Field investigations are assumed to involve standard sampling equipment, personal protective equipment, waste management, and site-control equipment/materials. General fieldwork guidance 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 U.S. Environmental Protection Agency guidance for environmental sampling, preservation, and quality assurance. Specific requirements were met for each sample and were printed in the SCLs provided by N3B's SMO (size and type of container, preservatives, etc.).
Handling, Packaging, and Transporting Field Samples	Field team members sealed and labeled samples before packing to ensure sample and transport containers were free of external contamination. All environmental samples were collected, preserved, packaged, and transported to the SMO under COC (N3B- SOP-SDM-1102 R1, "Sample Receiving and Shipping by the N3B Sample Management Office"). The SMO arranged for shipping of the samples to analytical laboratories. Any levels of radioactivity (i.e., action-level or limited-quantity ranges) were documented in SCLs submitted to the SMO.
Sample Control and Field Documentation	The collection, screening, and transport of samples were documented in standard forms generated by the SMO. These forms include SCLs, COC forms, sample container labels, and custody seals. Collection logs were completed at the time of sample collection and were signed by the sampler and a reviewer who verified the logs for completeness and accuracy. Labels were initialed and applied to each sample container, and custody seals were placed around container lids or openings. COC forms were completed and signed to verify that the samples were not left unattended.
Field Quality Control Samples	Field quality control samples were collected as follows: Field duplicates were collected at a frequency of 10% and at the same time as a regular sample and submitted for the same analyses. Field blanks, required for all field events that include collecting samples for VOC analyses were collected at a frequency of 10% and at the same time as a regular sample. Field blanks were kept with the other sample containers during the sampling process and were submitted for laboratory analyses.
Sampling Subsurface Vapor	Vapor sampling was performed at seven monitoring wells in accordance with the current version of N3B-SOP-ER-2008, which describes the process of sampling subsurface air from vapor ports in monitoring wells and boreholes. The procedure covers pre-sampling activities, sampling to detect and quantify gaseous organic concentration in air, SUMMA sampling (a passive collection and containment system of laboratory-quality air samples), adsorbent column sampling, sampling through the packer system (a sampling system that uses inflatable bladders to seal off a desired interval in an open borehole or at the end of a drill casing to obtain a sample from a discrete section), and post-sampling activities. Samples were analyzed for VOCs and tritium.

Table B-1.0-2
List of Procedures Used for MDA L Pore-Gas Monitoring Activities

Document Number	N3B Procedure Title
N3B-AP-ER-1002	Environmental Remediation (ER) Field Work Requirements
N3B-SOP-SDM-1100	Sample Containers, Preservation, and Field Quality Control
N3B-SOP-SDM-1101	Sample Control and Field Documentation
N3B-SOP-ER-2002	Field Decontamination of Equipment
N3B-SOP-ER-2008	Sampling Subsurface Vapor
N3B-P101-6	Personal Protective Equipment
N3B-AP-SDM-1200	Requesting and Managing Data Sets
N3B-POL-QAT-0019	Notification, Investigation and Learning from Events
N3B-AP-SDM-1103	Preparation and Storage of Final Records Packages for Analytic Data
N3B-SOP-SDM-1102	Sample Receiving and Shipping by the N3B Sample Management Office
N3B-AP-ER-1001	Environmental Remediation Project Preparedness Review
N3B-AP-TRU-2150	Waste Characterization Strategy Form

Table B-1.0-3
Field-Screening Results

Borehole ID	Sampling Port Depth (ft bgs*)	Analyte	Result First Round 2022	Result Second Round 2022
54-02089	13	CO_2 (ppmv)	27,000	32,000
		O_2 (%)	17.2	16.2
		VOC (ppmv)	174.7	430.9
	31	CO_2 (ppmv)	33,000	35,000
		O_2 (%)	16.3	15.7
		VOC (ppmv)	177.7	466.2
	46	CO_2 (ppmv)	35,000	35,000
		O_2 (%)	16.0	15.7
		VOC (ppmv)	212.6	507.3
	86	CO_2 (ppmv)	29,000	27,000
		O_2 (%)	16.7	16.9
		VOC (ppmv)	226.4	483.0
54-24238	44	CO_2 (ppmv)	12,000	31,000
		O_2 (%)	19.2	16.3
		VOC (ppmv)	67.7	370.4
	64	CO_2 (ppmv)	8000	33,000
		O_2 (%)	20.1	16.9
		VOC (ppmv)	45.1	431.8
	84	CO_2 (ppmv)	0	18,000
		O_2 (%)	20.9	17.6
		VOC (ppmv)	2.5	434

Table B-1.0-3 (continued)

Borehole ID	Sampling Port Depth (ft bgs*)	Analyte	Result First Round 2022	Result Second Round 2022
54-24240	28	CO_2 (ppmv)	14,000	15,000
		O_2 (%)	18.7	18.6
		VOC (ppmv)	207.4	481.9
	53	CO_2 (ppmv)	13,000	12,000
		O_2 (%)	18.6	19.0
		VOC (ppmv)	239	486.1
	78	CO_2 (ppmv)	10,000	9000
		O_2 (%)	19.1	19.8
		VOC (ppmv)	163	273.3
	103	CO_2 (ppmv)	9000	8000
		O_2 (%)	19.4	20.0
		VOC (ppmv)	115.2	194.7
	128	CO_2 (ppmv)	8000	7000
		O_2 (%)	19.4	20.0
		VOC (ppmv)	86.1	149.2
	153	CO_2 (ppmv)	8000	6000
		O_2 (%)	19.5	20.0
		VOC (ppmv)	74.5	127.4
54-24241	73	CO_2 (ppmv)	15,000	12,000
		O_2 (%)	18.3	18.9
		VOC (ppmv)	98.5	155.3
	93	CO_2 (ppmv)	12,000	8000
		O_2 (%)	18.8	20.0
		VOC (ppmv)	70.9	100.9
	113	CO_2 (ppmv)	8000	7000
		O_2 (%)	19.2	20.0
		VOC (ppmv)	49.3	89.6
	133	CO_2 (ppmv)	7000	6000
		O_2 (%)	19.5	20.5
		VOC (ppmv)	60.5	77.9
	153	CO_2 (ppmv)	7000	5000
		O_2 (%)	19.5	20.7
		VOC (ppmv)	47.3	85.5
	173	CO_2 (ppmv)	7000	6000
		O_2 (%)	19.4	20.5
		VOC (ppmv)	57.2	106.0
	193	CO_2 (ppmv)	8000	5000
		O_2 (%)	19.5	20.9
		VOC (ppmv)	59.7	76.8

Table B-1.0-3 (continued)

Borehole ID	Sampling Port Depth (ft bgs*)	Analyte	Result First Round 2022	Result Second Round 2022
54-24399	566.7	CO_2 (ppmv)	1000	2000
		O_2 (%)	20.9	20.9
		VOC (ppmv)	0.4	12.5
	587.5	CO_2 (ppmv)	1000	2000
		O_2 (%)	20.9	20.9
		VOC (ppmv)	0.4	7.1
54-27641	32	CO_2 (ppmv)	10,000	11,000
		O_2 (%)	19.5	19.5
		VOC (ppmv)	247.6	382.1
	82	CO_2 (ppmv)	8000	8000
		O_2 (%)	19.7	20.2
		VOC (ppmv)	119.7	205.5
	115	CO_2 (ppmv)	7000	7000
		O_2 (%)	19.7	20.2
		VOC (ppmv)	77.7	163.4
	182	CO_2 (ppmv)	6000	6000
		O_2 (%)	19.8	20.2
		VOC (ppmv)	46	99.0
	232	CO_2 (ppmv)	6000	6000
		O_2 (%)	19.8	20.2
		VOC (ppmv)	47.4	104.8
	271	CO_2 (ppmv)	5000	5000
		O_2 (%)	19.7	20.2
		VOC (ppmv)	27.4	58.1
	332.5	CO_2 (ppmv)	3000	4000
		O_2 (%)	20.2	20.5
		VOC (ppmv)	10.0	24.0
54-27642	30	CO_2 (ppmv)	17,000	18,000
		O_2 (%)	18.4	17.8
		VOC (ppmv)	85.5	199.1
	75	CO_2 (ppmv)	16,000	13,000
		O_2 (%)	18.3	18.9
		VOC (ppmv)	107.3	179.5
	116	CO_2 (ppmv)	12,000	16,000
		O_2 (%)	14.5	18.3
		VOC (ppmv)	20.7	174.6

Table B-1.0-3 (continued)

Borehole ID	Sampling Port Depth (ft bgs*)	Analyte	Result First Round 2022	Result Second Round 2022
54-27642 (cont'd)	175	CO_2 (ppmv)	10,000	10,000
		O_2 (%)	19.4	19.8
		VOC (ppmv)	106.9	188.0
	235	CO_2 (ppmv)	10,000	10,000
		O_2 (%)	19.2	19.5
		VOC (ppmv)	91.6	156.4
	275	CO_2 (ppmv)	12,000	12,000
		O_2 (%)	19.0	19.3
		VOC (ppmv)	108.9	217.1
	338	CO_2 (ppmv)	15,000	15,000
		O_2 (%)	18.4	18.6
		VOC (ppmv)	112.4	229.5

* bgs = Below ground surface.

Table B-1.0-4
Weights of Tritium Samples

Borehole ID	Sampling Port Depth (ft bgs*)	Weight of Tritium Sample, g	
		First Round	Second Round
54-02089	13	7	5
	31	11	9
	46	12	7
	86	13	8
54-24238	44	13	7
	64	10	11
	84	12	12
54-24240	28	9	12
	53	9	10
	78	9	7
	103	10	8
	128	8	10
	153	7	9
54-24241	73	11	6
	93	12	7
	113	11	9
	133	12	8
	153	15	8
	173	10	8
	193	8	8
54-24399	566.7	10	5
	587.5	9	6
54-27641	32	8	6
	82	8	9
	115	7	8
	182	7	6
	232	8	6
	271	9	10
	332.5	6	6
54-27642	30	10	12
	75	14	12
	116	10	6
	175	9	11
	235	10	9
	275	8	12
	338	9	9

Appendix C

Analytical Program

C-1.0 INTRODUCTION

This appendix discusses analytical methods and data-quality review for samples collected during vapor-sampling activities at Material Disposal Area (MDA) L, Solid Waste Management Unit (SWMU) 54-006, at Technical Area 54 at Los Alamos National Laboratory (LANL or the Laboratory).

Newport News Nuclear BWXT-Los Alamos, LLC (N3B) uses the Environmental Information Management (EIM) database for data management. This is a cloud-based data management platform used for managing sampling events, tracking the packaging and transportation of samples, and storing the resultant data. In addition to N3B, Triad National Security, LLC (Triad) and the U.S. Department of Energy (DOE) Oversight Bureau of the New Mexico Environment Department (NMED) share the EIM for all LANL environmental analytical data. EIM interfaces with Intellus New Mexico (Intellus), a fully searchable database available to the public through the Intellus website (http://www.intellusnm.com).

The system, written and maintained by Locus Technologies, consists of a cloud-based Structured Query Language (SQL) server database platform coupled with a web-based user interface. It is a comprehensive sample and data management application, designed to manage the process from sample planning through data review and reporting. It includes modules for sample planning, sample tracking, manual and electronic field data upload, electronic data deliverables (EDDs) upload, Automated Data Review (ADR) routines, notification emails, and reporting tools.

The analytical data are submitted in EDDs by the analytical laboratory and are uploaded to the N3B EIM database. The received data are then independently validated through the N3B data validation process, per the data quality objectives (DQOs) described in section C-2.1, to qualify the data. The laboratory also submits PDFs that detail the entire analytical process for each sample analysis.

The entire data validation process includes a description of the reasons for any failure to meet method, procedural, or contractual requirements, and an evaluation of the impact of such failure on the associated data or data set.

C-2.0 ANALYTICAL DATA

Data evaluated in this report come from the analysis of vapor samples collected during semiannual vapor-sampling activities at MDA L. All investigation samples were submitted to and analyzed by approved off-site analytical laboratories. These data are determined to be of sufficient quality for decision-making purposes and have been reviewed and revalidated to current quality assurance/quality control (QA/QC) standards as described in section C-2.1.

In the first 2022 sampling round, a total of 44 samples (36 regular samples, 4 field blanks [FBs], and 4 field duplicates [FDs]) were collected and analyzed for volatile organic compounds (VOCs), and a total of 44 samples (36 regular samples, 4 FBs, and 4 FDs) were collected and analyzed for tritium. In the second 2022 sampling round, a total of 44 samples (36 regular samples, 4 FBs, and 4 FDs) were collected and analyzed for VOCs, and a total of 44 samples (36 regular samples, 4 FBs, and 4 FDs) were collected and analyzed for tritium. The analytical methods are listed in Table C-2.0-1.

These samples were planned using the EIM Sample Request module, and sample collection logs (SCLs) were created and printed to serve as chain of custody (COC) documents and analytical request forms.

Sampling events included collection of FB and FD field QA/QC samples. Detection of analytes in FBs may indicate contamination resulting from sample collection, transportation, or the analytical laboratory processes. Differences in analytical results between an FD and the corresponding regular sample may indicate that samples were not uniform or that significant variation in analysis occurred between the two samples.

The FBs for VOC analysis are SUMMA canisters filled with pure nitrogen (99.9%), subjected to the same conditions as regular samples. FBs for tritium analysis are collected by filling a silica-gel column with approximately 5 g of distilled water. FBs are collected at a minimum frequency of 10% of all VOC samples and 10% of all tritium samples collected during the monitoring event, and are collected from locations where the regular samples are collected.

FDs are collected at a rate of 10% of all VOC samples and 10% of all tritium samples collected during the monitoring event. FDs are split samples collected from locations where the regular samples are collected.

Following sample collection, sampling personnel deliver the samples and the SCLs to sample management personnel at the N3B Sample Management Office (SMO). An analytical COC is then created, which includes the field sample identification number, the date and time of field sample collection, the analytical parameters group code(s), and the number of bottles for each analytical parameter group. The N3B SMO then ships the samples to the appropriate laboratory for analysis.

In addition to analyzing the field samples and field QA/QC samples, laboratories also employ laboratory batch QA/QC samples. These include matrix spikes, duplicates, method blanks, and laboratory control samples that are prepared and analyzed by the laboratories to monitor their analytical process quality. The laboratory QA/QC process is defined in the appropriate analytical method (Table C-2.0-1) and the external analytical laboratory statement of work.

Tables within the main text of this MDA L vapor-sampling periodic monitoring report summarize the analytical results from all samples collected at MDA L for calendar year 2022. All VOC and tritium analytical results are provided in Appendix E (on CD included with this document). Analytical chemical and radiological data presented in this report can also be found in the public Intellus database at http://www.intellusnm.com.

C-2.1 Data Validation Definitions and Procedures

Analytical results meet the N3B minimum DQOs as outlined in N3B-PLN-SDM-1000: "Sample and Data Management Plan." N3B-PLN-SDM-1000 sets the validation frequency criteria at 100% Level 1 examination and Level 2 verification of data and at 10% minimum Level 3 validation of data.

- A Level 1 examination assesses the completeness of the data as delivered from the analytical laboratory, identifies any reporting errors, and checks the usability of the data based on the analytical laboratory's evaluation of the data.
- A Level 2 verification evaluates the data to determine the extent to which the laboratory met the analytical method and the contract-specific quality control and reporting requirements.
- A Level 3 validation includes Level 1 and 2 criteria and determines the effect of potential anomalies encountered during analysis and possible effects on data quality and usability. A Level 3 validation is performed manually with method-specific data validation procedures.

Laboratory analytical data are validated by N3B personnel as outlined in N3B-PLN-SDM-1000; N3B-AP-SDM-3000: “General Guidelines for Data Validation”; N3B-AP-SDM-3014: “Examination and Verification of Analytical Laboratory Data”; and additional method-specific analytical data validation procedures.

All associated validation procedures have been developed, where applicable, from the U.S. Environmental Protection Agency (EPA) QA/G-8 “Guidance on Environmental Data Verification and Data Validation,” the U.S. Department of Defense/DOE “Consolidated Quality Systems Manual for Environmental Laboratories,” the EPA “National Functional Guidelines for Data Validation,” and the American National Standards Institute/American Nuclear Society 41.5: “Verification and Validation of Radiological Data.”

N3B data validation is performed externally from the analytical laboratory and end users of the data. Data validation provides a level of assurance of the data quality based on this technical evaluation of the data quality.

Validation qualifiers and reason codes applied during this process are also reviewed and approved by an N3B chemist to assess data usability and quality. The EIM data are then made available to the public in the Intellus New Mexico database (https://intellusnm.com/).

Validated data are qualified as accepted or rejected. Data accepted per the validation criteria have one of the following qualifiers:

- not detected (U),
- estimated but not detected (UJ),
- estimated (J), or
- detected without data qualification (NQ).

Accepted data can be used as needed, assuming that no problems occurred during the sampling events. Data that are qualified as rejected (R) per the validation criteria are unusable. In addition, the analytical results can also be further labeled with data validation reason codes that explain the reason for the qualification. (See Appendix A of this report, which includes data qualifier definitions.)

The analytical data, laboratory report, and data validation reports are provided in Appendix E (on CD included with this report). In addition to the laboratory analytical data, SCLs and COC forms are also provided in Appendix E.

Table C-2.0-1
Volatile Organic Compound and
Radionuclide Analytical Methods for Samples Collected at MDA L

Analytical Method	Analytical Description	Analytical Suite
VOCs		
EPA Air Method Toxic Organics (TO15)	Determination of VOCs in air collected in specially prepared canisters and analyzed by gas chromatography/mass spectrometry	VOCs
Radionuclides		
EPA 906.0	Tritium in water (liquid scintillation)	Tritium

Appendix D

Volatile Organic Compound Plume Trend Analysis

D-1.0 INTRODUCTION

This appendix summarizes data from the Material Disposal Area (MDA) L volatile organic compound (VOC) plume at Technical Area 54, Los Alamos National Laboratory (LANL) (Figure D-1.0-1). The data were collected as part of an ongoing soil-vapor extraction (SVE) interim measure (IM) (N3B 2022, 702169) and represent a first phase, pilot-project-scale demonstration of the ability of SVE to effectively remove plume mass and reduce the likelihood of VOCs impacting groundwater beneath MDA L (Behar et al. 2019, 700854).

Boreholes reported in this document include a set of sentry wells in the source region of the plume designed to provide an early warning of leakage from buried drums of VOCs. Table D-1.0-1 lists the sentry wells that are discussed. These sentry wells have been modified slightly from those presented in the 2018 IM report and now include borehole 54-02089. The original 6 sentry wells were chosen as the likeliest to detect any new leakage from the subsurface VOC waste drums. Although previously not called out as a sentry well (N3B 2018, 700039), borehole 54-24399 was included in semiannual monitoring beginning in 2020 to better characterize the lower reaches of the VOC plume and is now designated as a sentry well. In both sampling rounds for 2022, data were collected from the 7 sentry wells. The other vapor monitoring wells at MDA L are sampled once every two years and were not sampled in 2022.

Section D-2 gives an overview of the plume through discussion of a series of 14 plume images. These 14 figures show map-view and vertical cross-sections of 14 compounds that exceeded Tier I screening levels (SLs) at more than one sample port.

Section D-3 compares the maximum concentrations of the plume as currently measured (maximum value at any port from the two 2022 sampling rounds) with the pre-SVE 2014 baseline plume concentrations.

Section D-4 discusses data from selected boreholes completed in the Cerros del Rio basalt in the east source area; the west source area; and deep borehole 54-24399. Data from these boreholes are shown as X-Y plots of concentration versus depth and include data from previous sampling rounds. In many cases, 2014 data from before the SVE IM are used to show the impact of SVE and subsequent rebound of the plume. However, some boreholes have more limited historic data, and plots for these boreholes show as much data as are available. The figures discussed in this section are limited to selected boreholes and selected compounds exceeding Tier I SLs.

Section D-5 discusses total VOC concentrations in boreholes where total VOC concentrations are approaching SVE reactivation trigger values. Current recommendations from the IM final report (N3B 2022, 702169) call for operating the SVE pumping units biannually for four-week periods during the spring and fall, and also for restarting them in the interim if total VOC concentrations at any port rise to more than 2000 parts (of total VOCs) ppmv, with a trend of consistent increase with each consecutive measurement for ports to depths of 100 ft. The units of ppmv were chosen for the following reasons: (1) these units are directly scalable to the units of measurement reported by the analytical laboratory (ppbv), and (2) ppmv units remove the molecular weight of each compound and normalize to mole fraction of the sum of different compounds.

Attachment D-1 (on CD included with this document) presents 63 figures representing all boreholes in which any of 14 compounds exceeded Tier I SLs. The Tier I SL value is shown as a vertical red line on all of these X-Y plots.

D-2.0 PLUME OVERVIEW

This section presents an overview of the VOC plume through discussion of a series of 14 plume images (Figures D-2.0-1 through D-2.0-14), which show map-view and vertical cross-sections of 14 compounds that exceeded Tier I SLs at more than one sample port in 2022. Each figure shows the plume for a single compound. The compounds are presented in the following order, based on Tier I exceedance levels.

- First, the plots showing the eight compounds that represent the bulk of the plume by mass and/or area of Tier I impact are presented in order of decreasing contribution to plume mass: trichlorethene (TCE); 1,2-dichloroethane (1,2-DCA); 1,2-dichloropropane (1,2-DCP); methylene chloride; tetrachloroethene (PCE); 1,1,1-trichloroethane (1,1,1-TCA); 1,1-dichloroethene (1,1-DCE); and 1,4-dioxane.
- After this, the plots for the remaining six compounds with lower mass and less consistent Tier I impacts are presented in alphabetical order: benzene; carbon tetrachloride; chloroform; 1,1-dichloroethane (1,1-DCA); 2-propanol; and 1,1,2-trichloroethane (1,1,2-TCA).

D-2.1 Eight Primary Compounds of Concern at MDA L

The eight primary compounds of concern listed above were chosen using a two-tiered screening process developed in consultation with NMED in 2010/2011, and are reported in Appendix B of the MDA L corrective measures evaluation report (LANL 2011, 205756).

Figure D-2.0-1 shows the TCE plume at MDA L in map and cross-section views. Maximum concentrations of TCE are found in both the east and west source areas. The TCE plume spreads laterally beyond the MDA L fenceline at concentrations greater than 100 times the Tier I SL. At depth, the eastern source plume maintains concentrations 50 to 100 times the Tier I SL to the 338-ft port in borehole 54-27642. Beneath the west source region, the 100-times-Tier-1 SL contour reaches midway from the surface to the basalt. Note that concentrations at all ports measured in the basalt at 54-24399 are less than the Tier I SL. Low concentrations in the basalt are likely due to the atmospheric connection and high estimated diffusivity within this massive fracture unit that outcrops in White Rock canyon (Stauffer et al. 2019, 700871). Concentration contours showing values higher than the Tier I SL in the basalt are artifacts of the contouring algorithm filling space between measured points. Data from the two sampling rounds are quite similar with no significant differences. TCE is found in six of the seven sentry wells sampled at values above the Tier I SL, with no detections above the Tier I SL in the deep vertical basalt well 54-24399.

Figure D-2.0-2 shows the 1,2-DCA plume with characteristics similar to those seen in the TCE data. The extent of the 25× contour in map view is reduced from previous years, and concentrations at depth are not as pronounced. Concentrations in the port in 54-27642 at nearly 350 ft bgs have decreased, but remain at approximately 100 times the Tier I SL. Concentrations in the basalt are below the Tier I SL for all samples. Data from the two sampling rounds are quite similar with no significant differences. The difference in appearance of the vertical plume is due to a nondetected result with a high detection limit at 275 ft bgs in the first round. The detection limit for that sample (2500 $\mu g/m^3$) is comparable to the detected result at the same depth in the second round (2220 $\mu g/m^3$). DCA[1,2-] is found at values above the Tier I SL in six of the seven sentry wells sampled.

Figure D-2.0-3 shows the 1,2-DCP plume, which exhibits behavior comparable with that of 1,2-DCA on the east side of the site. However, 1,2-DCP has a much smaller impact on the west side of the site (cross-section B-B′). Concentrations in the basalt are below the Tier I SL for all samples. Data from the two sampling rounds also show no significant differences. DCP[1,2-] is found at values above the Tier I SL in six of the seven sentry wells sampled.

Figure D-2.0-4 shows the methylene chloride plume. As with 1,2-DCP, concentrations on the east side are higher and reach greater depth than concentrations on the west side, with no measured values in the basalt above the Tier I SL. Data from the two sampling rounds are comparable with no significant differences. Methylene chloride is found at values greater than the Tier I SL in four of the seven sentry wells sampled.

Figure D-2.0-5 shows the PCE plume, which varies significantly from the previously described plumes in that there seems to be a source of PCE near the middle of MDA L, not associated with either the east or west shaft cluster. PCE in this region was reduced during SVE in 2015 but has since rebounded. The vertical extent of the PCE plume is also reduced compared with the TCE plume, with the concentration 25 times the Tier I SL extending only to the top of the Qbt 1g unit. Concentrations in the basalt are less than the Tier I SL for all samples. Data from the two sampling rounds are comparable with no significant differences. PCE is found at values greater than the Tier I SL in six of the seven sentry wells sampled.

Figure D-2.0-6 shows the 1,1,1-TCA plume. This compound has the highest mass of any compound in the plume; however, because the Tier I value for 1,1,1-TCA is very high (141,000 $\mu g/m^3$), the impact of 1,1,1-TCA is less than that of many of the previous five compounds. The plume is again stronger on the east side of MDA L, with concentrations 10 times the Tier I SL confined to a small area in the Qbt 1v-u unit. Concentrations in the basalt are less than the Tier I SL for all samples. Data from the two sampling rounds are comparable with no significant differences. TCA[1,1,1-] is found at values greater than the Tier I SL in six of the seven sentry wells sampled.

Figure D-2.0-7 shows the 1,1-DCE plume. Data from the 2021 sampling show that concentrations have decreased since 2020, with no concentrations of this compound more than five times the Tier I SL in the second round. Concentrations in the basalt are less than the Tier I SL for all samples. Data from the two sampling rounds are similar, with no significant differences other than a decrease in concentrations at 54-27642 in the second round. DCE[1,1-] is found at values greater than the Tier I SL in six of the seven sentry wells sampled.

Figure D-2.0-8 shows the 1,4-dioxane plume data. Although not widely detected, this compound has the highest Tier I SL exceedance, approximately 7800 times, because of a low 0.9-$\mu g/m^3$ Tier I SL, and as a result is included in the compounds of concern. The concentration in the 332.5 ft bgs sample at 54-27641 decreased substantially in the second round, resulting in a different appearance of the western plume cross-section. The October 2022 data show 1,4-dioxane concentrations greater than Tier I SLs in the two deepest sample ports in the basalt in borehole 54-24399. The measured value in the deepest sample is greater than the method detection limit; however, it is much less than the analytical laboratory's report detection limit. The other result is greater than the report detection limit. Dioxane[1,4-] is found at values greater than the Tier I SL in four of the seven sentry wells sampled.

D-2.2 Six Minor Compounds at MDA L

This section presents data for the remaining six compounds that are minor contributors to the MDA L plume. These compounds exist at greatly reduced concentrations and multiples of the Tier I screening than the eight primary compounds described in the previous section.

Figure D-2.0-9 shows the benzene plume at MDA L. Benzene was detected above the Tier I SL, but less than two times the Tier I SL, in one well on the east side of MDA L in both sampling rounds. Concentrations in the basalt are below the Tier I SL for all samples. Data from the two sampling rounds are quite similar with no significant differences.

Figure D-2.0-10 shows the carbon tetrachloride plume. Carbon tetrachloride was detected at slightly greater than two times the Tier I SL in one well on the west side of MDA L, in both sampling rounds. Concentrations in the basalt are less than the Tier I SL for all samples. Data from the two sampling rounds are similar with no significant differences.

Figure D-2.0-11 shows the chloroform plume, with sources on both the east and west sides of MDA L. The plume reaches a maximum of a little more than two times the Tier I SL in the Qbt 1v-u unit, in one sample in the Cerro Toledo interval, and in one sample in the Guaje pumice. Concentrations in the basalt are less than the Tier I SL for all samples. Data from the two sampling rounds are similar with no significant differences. Chloroform is found at values greater than the Tier I SL in five of the seven sentry wells sampled.

Figure D-2.0-12 shows the 1,1-DCA plume. Data from 2022 sampling show concentrations of this compound slightly less than 10 times the Tier I SL in a limited region on the east side of MDA L, and concentrations slightly greater than 5 times the Tier I SL in a very limited region on the west side of MDA L, primarily in the Qbt 1v-u unit. Concentrations in the basalt are less than the Tier I SL for all samples. Data from the 2 sampling rounds are comparable except for concentrations in the intermediate depth screens at location 54-24241, which decreased to below the Tier I SL in the second round. DCA[1,1-] is found at values greater than the Tier I SL in six of the seven sentry wells sampled.

Figure D-2.0-13 shows the 2-propanol plume at MDA L. Propanol[2-] was detected above the Tier I SL on the east side of MDA L at location 54-24241 in the first round and at location 54-24238 in the second round. The maximum concentration was slightly above the Tier I SL in the first round and approximately 23 times the Tier I SL in the second round. Concentrations in the basalt are below the Tier I SL for all samples.

Figure D-2.0-14 shows the 1,1,2-TCA plume. Here the east and west source regions are distinct, with no detections above the Tier I SL on the west side of MDA L, and concentrations less than 50 times the Tier I SL limited in depth to the Qbt 1v-u unit on the east side. Concentrations in the basalt are less than the Tier I SL for all samples. Data from the 2 sampling rounds are comparable, although 1,1,2-TCA was detected more frequently in the second round, resulting in slightly different plume cross-sections. TCA[1,1,2-] is found at values greater than the Tier I in four of the seven sentry wells sampled SL.

D-3.0 TCE PLUME COMPARISON, 2014 VERSUS 2022

Figure D-3.0-1 shows a comparison of the maximum 2022 MDA L TCE data and interpolated plume with the FY 2014 Quarter 4 pre-SVE baseline. Data from 2022 show that the SVE IM has led to overall reductions in concentration in the plume persisting more than 7 yr (Figure D-3.0-1). The SVE has clearly had a long-term impact on reducing the peak concentrations of TCE in the central portions of the plume on both the east and west sides of MDA L. Pre-SVE contours of 100 times the Tier I SL have been reduced in many places to less than 50 times the Tier I SL, and the depth of the 100-times-Tier-I contour has been reduced from nearly 300 ft bgs in 2014 to approximately 120 ft bgs in 2022. The lateral extent of the overall plume has changed only slightly, although the lateral extent of the 100-times-Tier-I SL contours have reduced significantly.

Maximum TCE concentrations between the two source areas are lower and have not rebounded to the red (100 times Tier I) levels seen in 2014. The 100-times-Tier-I red regions have also been reduced vertically as shown on the A-A′ vertical cross-sections. The lateral extent of the plume edge shows some reductions as well, as seen in the top, map-view panels of Figure D-3.0-1. In these map-view panels, the width of the plume along the B-B′ line is reduced, and there is a slight increase to the north along the C-C’ line with no change to the south.

D-4.0 CONCENTRATION VERSUS DEPTH AND TIME FOR SELECTED BOREHOLES

Because many of the primary compounds of concern follow similar patterns, this section presents concentration versus depth and time for only selected compounds. The eastside sentry wells are discussed first (D-4.1), followed by the westside sentry wells (D-4.2). Section D-4.3 presents data from the deepest borehole completed in the Cerros del Rio basalt. Beyond the figures presented in this section, Attachment D-1 (on CD included with this document) presents 63 figures representing all boreholes with Tier I SL exceedances for any of the 14 compounds at more than 1 sample port. The Tier I SL value is shown as a vertical red line on all of these X-Y plots.

D-4.1 Eastside Bandelier Tuff Sentry Borehole Data

The sentry boreholes on the east side of the site (54-02089, 54-24238, 54-24241, and 54-26742) sample the VOC plume within the Bandelier Tuff, with depths to 338 ft bgs. (Borehole 54-24399 is also located on the east side of MDA L, but it monitors the basalt rather than the Bandelier Tuff.) TCE data from boreholes 54-02089 (Figure D-4.1-1) and 54-24238 (Figure D-4.1-2) both previously showed strong evidence of possible increased leakage from subsurface sources, starting during the period of SVE operation and continuing until the present, with the highest measured concentrations in many ports for borehole 54-02089 seen in the 2022 second round (farthest right blue-colored triangles on Figure D-4.1-1). Borehole 54-24238 has values at or above pre-SVE concentrations at most ports, although concentrations in the 2022 samples (Figure D-4.1-2, red triangles and farthest right blue-colored triangles) decreased slightly from previous results. Total VOC concentrations in these wells have rebounded to near pre-SVE values.

Increased leakage relative to pre-SVE leakage was observed from subsurface sources of VOCs that were supporting plume concentrations seen in September 2014. DCP[1,2-], PCE, and chloroform also showed evidence of leakage, in the form of concentration increases above pre-SVE values, in both 54-02089 and 54-24238, with PCE concentrations at 54-02089 continuing to increase to maximum values in 2022 (figures in Attachment D-1 [on CD included with this document]).

Methylene chloride in borehole 54-24238 also showed large increases from pre-SVE values, rising to over 1,000,000 μg/m^3 in August 2016 before dropping back to values below pre-SVE conditions in the latest sampling rounds (Figure D-4.1-3). Similar behavior is seen for 1,2-DCA in both 54-02089 and 54-24238 (figures in Attachment D-1 [on CD in included with this document]).

The remaining eastside sentry boreholes, 54-24241 (Figure D-4.1-4) and 54-27642 (Figure D-4.1-5), both show TCE concentrations above 200 ft depth rebounding approximately halfway towards levels seen in September 2014, although many ports remain well below pre-SVE concentrations.

Concentrations of TCE near the base of the Otowi Member of the Bandelier Tuff (just above the basalt) on the east side previously showed noticeable decreases from 2014 through 2021, but have increased to near pre-SVE values at 330 ft in borehole 54-27642. Similarly, concentrations of 1,2-DCA and 1,2-DCP at 330 ft in borehole 54-27642 increased to greater than 2014 levels in the first round 2022 samples.

Other compounds in the eastside sentry wells follow similar patterns to those described above, which can be seen in the figures of Attachment D-1 (on CD included with this document).

D-4.2 Westside Sentry Borehole Data

TCE data from the westside sentry boreholes (54-24240 and 54-27641) are shown in Figures D-4.2-1 and D-4.2-2. Borehole 54-24240 previously showed the strongest rebound at 28 ft bgs to slightly greater than pre-SVE values, but decreased to less than half pre-SVE values in 2022 samples. Borehole 54-27641 shows a maximum rebound at 32 ft bgs in February 2022 nearing the pre-SVE value, but decreasing in the July and October 2022 rounds. Concentrations of total VOCs near the base of the Otowi Member of the Bandelier Tuff (just above the basalt) on the west side of MDA L show little change from 2014 through 2021. Values at the base of the Bandelier Tuff in borehole 54-27641 on the west side are significantly less than those seen on the east side in borehole 54-27642.

D-4.3 Deep Basalt Sentry Borehole 54-24399 Data

Borehole 54-24399 is completed deep in the Cerros del Rio basalt, with an open interval extending beneath casing that ends at a depth of 566.7 ft bgs (Figure D-4.3-1). The open interval extends from 566.7 to 660 ft bgs; however, attempts to video-log deeper sections of the open interval were halted after unstable conditions were encountered. Borehole video logs show alternating consolidated sections and sections containing cavernous voids. Figure D-4.3-1 shows that the shoe and bottom of the casing are completed in consolidated basalt, reducing the likelihood of a flowing, short-circuit connection on the outside of the casing.

In August 2017 a packer was permanently installed in the casing just above the open borehole. The packer is designed with two sampling ports, one that collects gas from directly beneath the packer, and another that collects gas from 20 ft below the packer in a section of the basalt that contains cavernous voids. The new permanent packer has several benefits, including (1) a simpler sampling process needing no drill rig, (2) a substantial reduction in borehole breathing because of new construction of the wellhead, and (3) the ability to maintain longer periods of packer inflation to ensure isolation of the deep basalt.

Figures D-4.3-2 through D-4.3-8 plot individual concentrations for seven analytes from borehole 54-24399. Data in these plots are for 1,1,1-TCA; methylene chloride; TCE; 1,1- DCE; PCE; 1,2-DCP; and 1,2-DCA and span the period from April 2005 to February 2022. These plots also contain data from two nearby boreholes (54-01015 and 54-01016 [Figure D-1.0-1]) that have vapor-sampling ports completed in the basalt. The nearby borehole data from February 2019 and May 2021 are presented to confirm that concentrations seen in borehole 54-24399 are representative of values throughout the deep basalt. Each figure also shows a vertical black line indicating the timing of the installation of the permanent packer, and a horizontal line at the Tier I SL for each of the VOCs.

Dioxane[1,4-] concentrations were above the Tier I SL in the two deepest sample ports in the basalt in borehole 54-24399 in October 2022. The measured values are more than the method detection limit (based on theoretical measurements); however, the value from the deeper sample is well below the analytical laboratory's report detection limit (based on measurement data from the analytical laboratory). Dioxane[1,4-] was previously detected above the Tier I SL and method detection limit, but below the reporting limit, in both samples from borehole 54-24399 in the first round of sampling in 2021, but not in either sample in the second round. Boreholes 54-01015 and 54-01016 were not sampled during 2022, but May 2021 data from the seven other ports in the basalt in these boreholes show no 1,4-dioxane detections. Dioxane[1,4-] should be monitored to see if detections continue to occur. The concentrations of all other compounds of concern measured during the 2022 sampling events are less than Tier 1 SLs.

Figure D-4.3-8 also includes the laboratory detection limit for 1,2-DCA (15 ppbv) and shows that recently measured values are close to the laboratory detection limit.

Data from the 2022 sampling for each of the seven analytes measured in borehole 54-24399 indicate that results appear to be stabilizing and now represent the true state of VOC concentrations in the deep basalt. Recommendations from these observations are to continue monitoring boreholes 54-24399, 54-01015, and 54-01016 to ensure that long-term data from these boreholes are representative of concentrations in the deep basalt, and to provide early warning if higher concentrations from the base of the Bandelier Tuff begin to migrate into the basalt.

Data from the two 2022 sampling rounds are comparable and may be indicating that the packer in borehole 54-24399 is finally providing stable deep measurements, that are no longer impacted by the deep breathing from the surface to depth in the open borehole casing that occurred from the installation of 54-24399 until placement of the deep packer in August 2017. The deep breathing caused measurable increases in benzene, toluene, ethylbenzene, and xylene (BTEX) compounds relative to other parts of the VOC plume. BTEX compounds are components of exhaust from vehicles, such as from the vehicles that often idled near the top of borehole 54-24399 (N3B 2022, 702169). Concentrations of BTEX compounds in samples from borehole 54-24399 have decreased since installation of the permanent packer.

Propanol[2-] was detected in borehole 54-24399 in December 2016 at 19 μg/m^3, and twice in January 2020 at 20 and 340 μg/m^3, the latter being 2.5 times the Tier I SL for 2-propanol (136 μg/m^3). Propanol[2-] was not detected in samples collected from borehole 54-24399 during the 2022 sampling.

D-5.0 TOTAL VOCS APPROACHING SVE TRIGGER

This section presents data for the two ports where concentrations of total VOCs have most closely approached the proposed SVE reactivation trigger of 2000 ppmv. These ports are at depths of 46 ft bgs in borehole 54-02089 and 44 ft bgs in borehole 54-24238. In Figures D-5.0-1 and D-5.0-2, the maximum total VOC trigger of 2000-ppmv total VOC concentration is located at the top of each figure. Each figure represents a single depth, and each bar shows an individual sampling, with the concentrations of seven analytes of interest plus an “other” category shown as the individual colored segments, such that the total height of each bar is the total of the concentrations of all measured VOCs.

In both cases, total VOC concentration reached nearly 1750 ppmv in February 2019, with 1,1,1-TCA (blue) contributing the bulk in each port . By November 2020, total VOCs at these ports had dropped back significantly, to approximately 250 ppmv. During the first and second rounds of monitoring in 2021, the concentrations at these ports had increased slightly, ranging from 366 ppm to 446 ppm. Concentrations then decreased during the 2022 sampling, ranging from 292 ppmv to 384 ppmv, well below the proposed trigger of 2000 ppmv. These ports should continue to be monitored closely for any new evidence of continued leakage.

D-6.0 REFERENCES AND MAP DATA SOURCES

D-6.1 References

The following reference list includes documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID.ERIDs were assigned by Los Alamos National Laboratory’s (the Laboratory’s) Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory’s Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above).

Behar, H.R., E.E. Snyder, S. Marczak, L.J. Salazar, B. Rappe, G.F. Fordham, S.P. Chu, D.M. Strobridge, K.H. Birdsell, T.A. Miller, K.C. Rich, and P.H. Stauffer, February 2019. “An Investigation of Plume Response to Soil Vapor Extraction and Hypothetical Drum Failure,” *Vadose Zone Journal,* Vol. 18, No. 1. (Behar et al. 2019, 700854)

LANL (Los Alamos National Laboratory), September 2011. “Corrective Measures Evaluation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54, Revision 2,” Los Alamos National Laboratory document LA-UR-11-4798, Los Alamos, New Mexico. (LANL 2011, 205756)

N3B (Newport News Nuclear BWXT-Los Alamos, LLC), August 2018. “Interim Measures Final Report for Soil-Vapor Extraction of Volatile Organic Compounds from Material Disposal Area L, Technical Area 54,” Newport News Nuclear BWXT-Los Alamos, LLC, document EM2018-0008, Los Alamos, New Mexico. (N3B 2018, 700039)

N3B (Newport News Nuclear BWXT-Los Alamos, LLC), June 2022. “Interim Measures Final Report for Soil-Vapor Extraction of Volatile Organic Compounds from Material Disposal Area L, Technical Area 54, Revision 1,” Newport News Nuclear BWXT-Los Alamos, LLC, document EM2022-0290, Los Alamos, New Mexico. (N3B 2022, 702169)

Stauffer, P.H., T. Rahn, J.P. Ortiz, L.J. Salazar, H. Boukhalfa, H.R. Behar, and E.E. Snyder, March 2, 2019. “Evidence for High Rates of Gas Transport in the Deep Subsurface,” *Geophysical Research Letters,* Vol. 46, No. 7. (Stauffer et al. 2019, 700871)

D-6.2 Map Data Sources

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

Legend Item	Data Source
Disposal pit/ impoundment	Waste Storage Features; LANL, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007.
Disposal shaft	Waste Storage Features; LANL, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007.
Elevation contour	Hypsography, 10, 20, & 100 Foot Contour Intervals; LANL, ENV Environmental Remediation and Surveillance Program; 1991.
Fence	Security and Industrial Fences and Gates; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 10 September 2007.
LANL boundary	LANL Areas Used and Occupied; LANL, Site Planning & Project Initiation Group, Infrastructure Planning Division; 19 September 2008.
Material disposal area	Materials Disposal Areas; LANL, ENV Environmental Remediation and Surveillance Program; ER2004-0221; 1:2,500 Scale Data; 23 April 2004.
Paved road	Los Alamos National Laboratory, FWO Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.
Structure	Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

TA boundary	As published; Triad SDE Spatial Geodatabase: GISPUBPRD1\PUB.Boundaries\PUB.Tecareas; February 2020.
Major Road	As published; Q:\16-Projects\16-0033\project_data.gdb\line\major_road; February 2020.
Unpaved road	Dirt Road Arcs; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 10 September 2007.
Drainage	As published; Q:\16-Projects\16-0033\project_data.gdb\line\drainage_features; February 2020.
Vapor monitoring well	Point Feature Locations of the Environmental Restoration Project Database; LANL, Environment and Remediation Support Services Division, EP2007-0754; 30 November 2007.

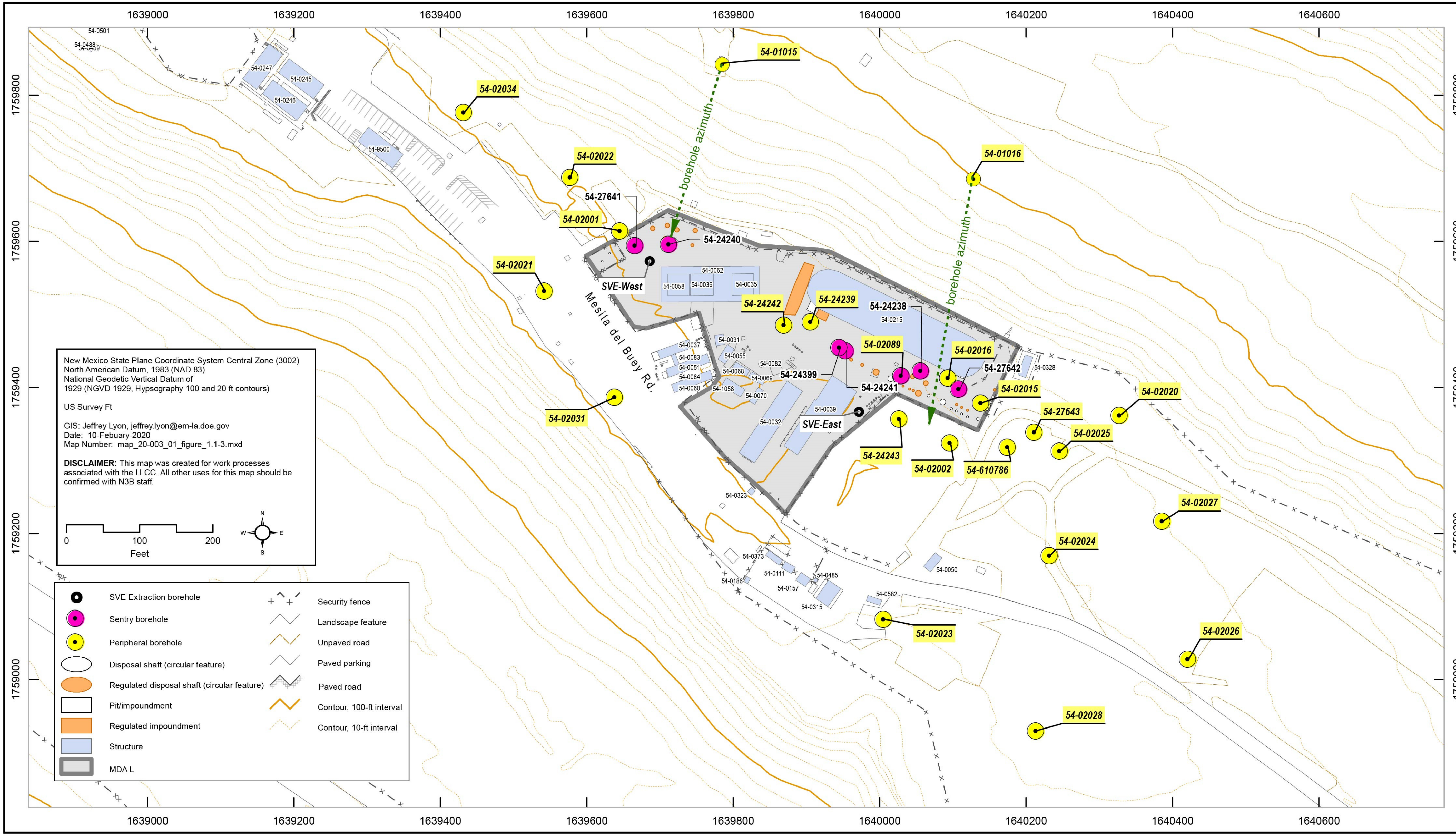


Figure D-1.0-1 MDA L site map showing borehole locations

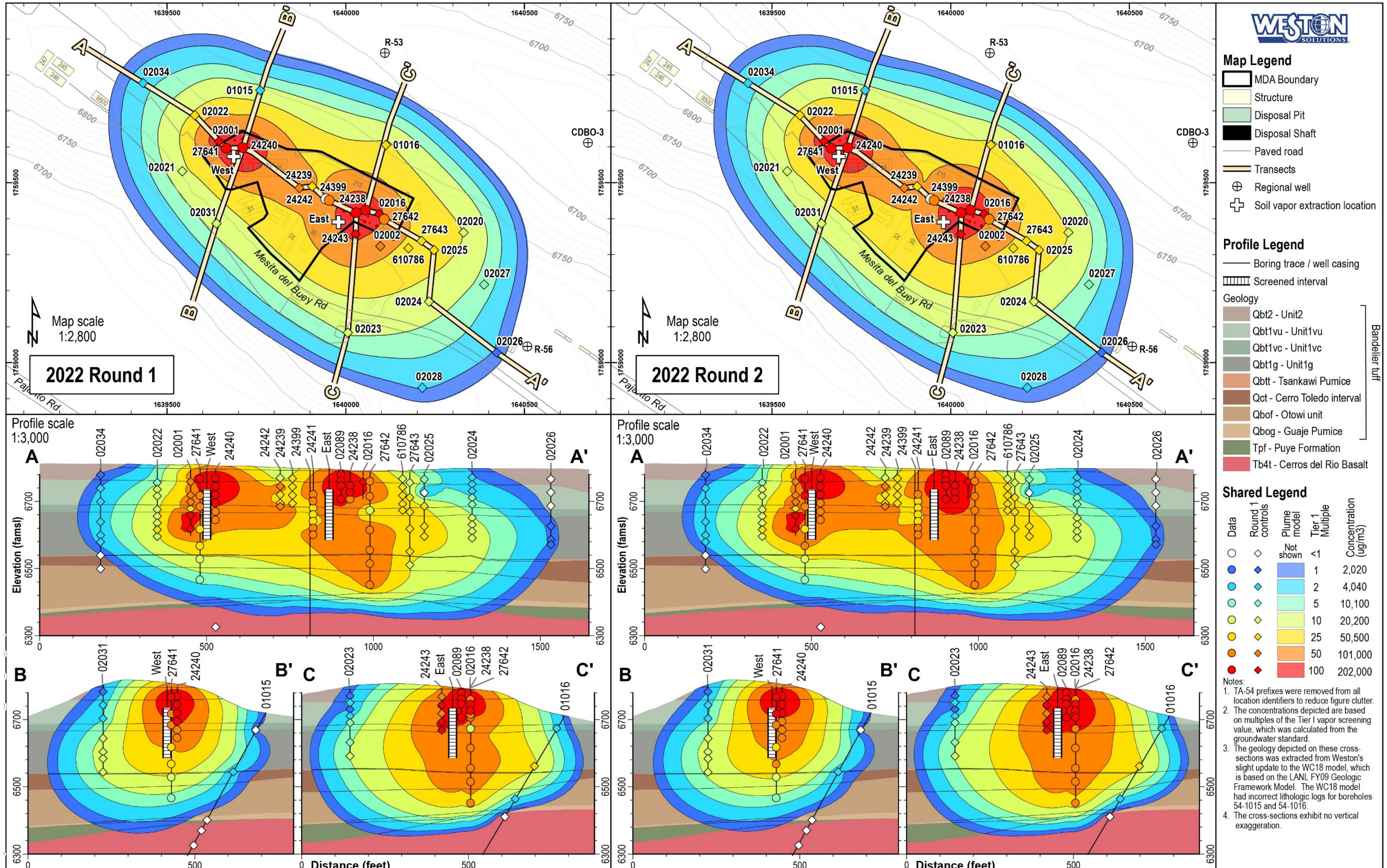


Figure D-2.0-1 Comparison of the 2022 MDA L TCE data and interpolated plumes

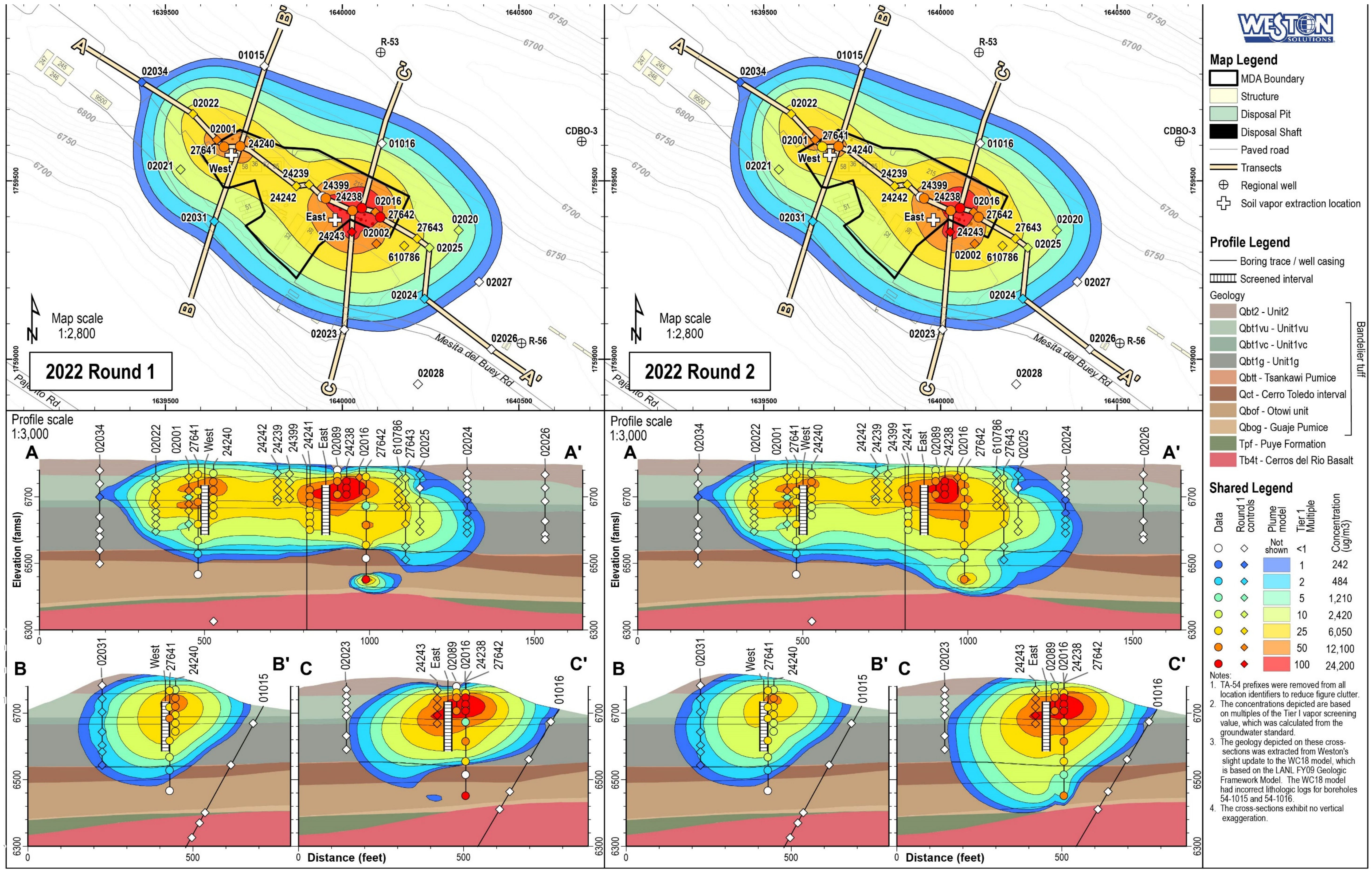


Figure D-2.0-2 Comparison of the 2022 1,2-DCA data and interpolated plumes

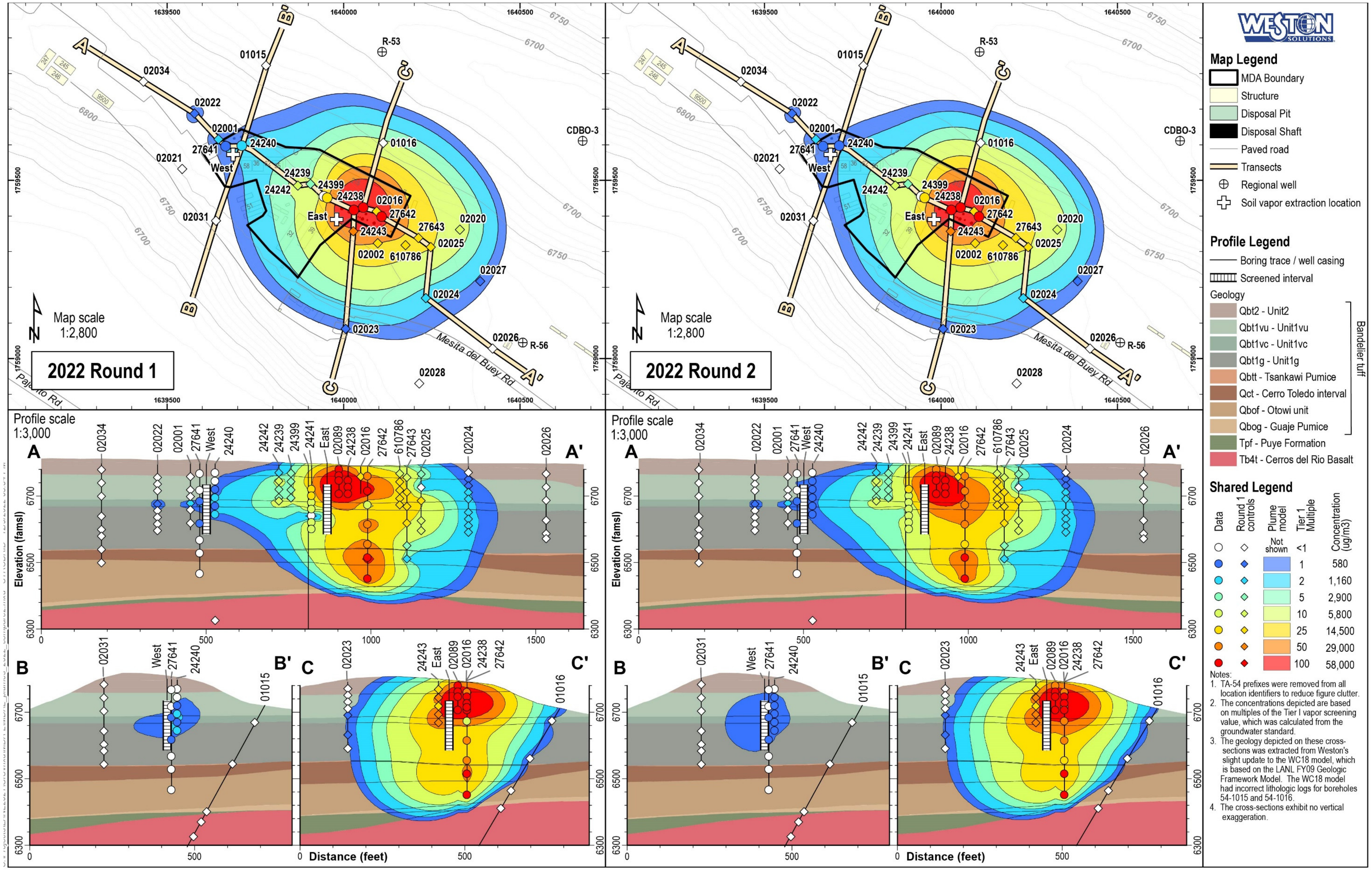


Figure D-2.0-3 Comparison of the 2022 1,2-DCP data and interpolated plumes

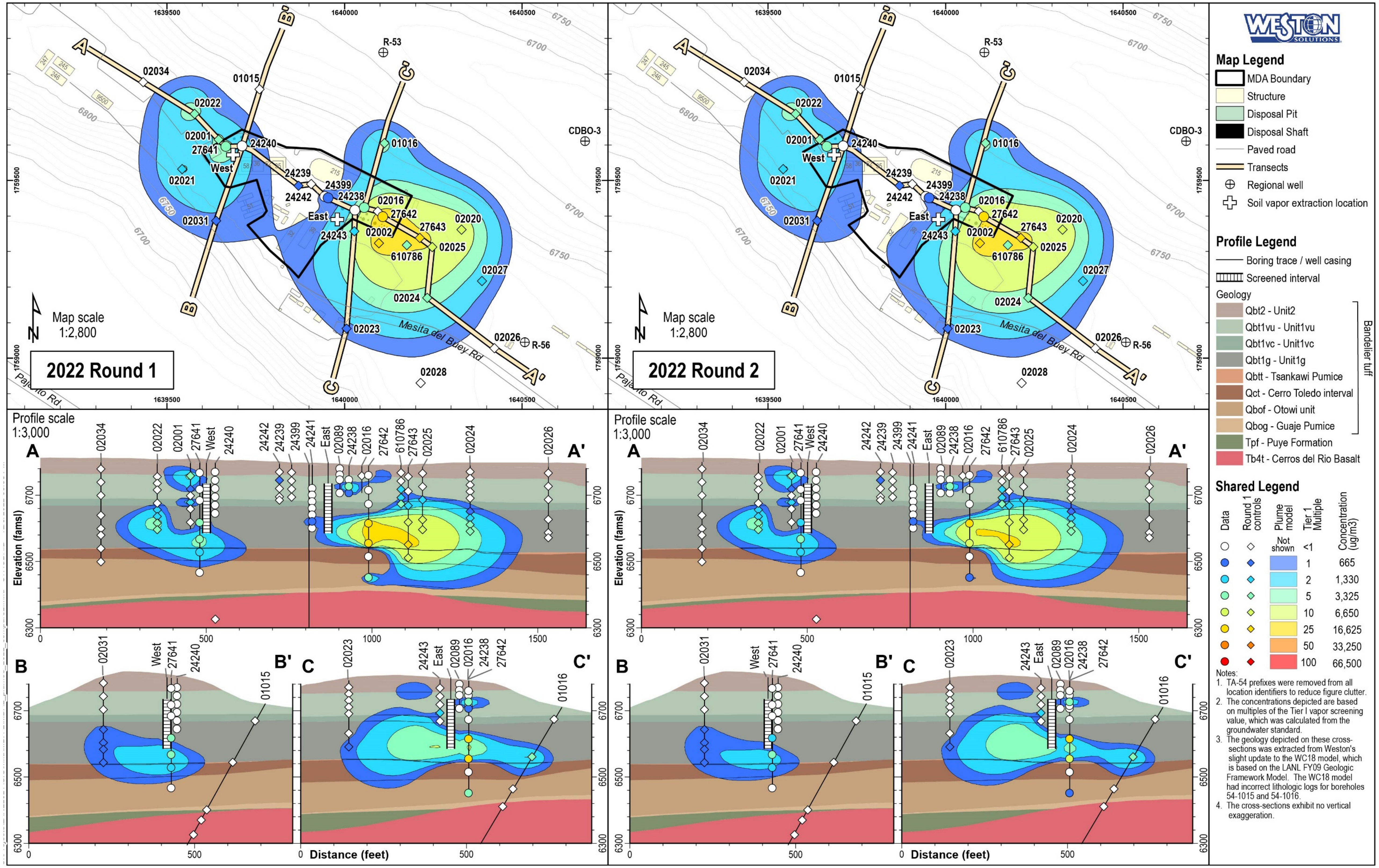


Figure D-2.0-4 Comparison of the 2022 methylene chloride data and interpolated plumes

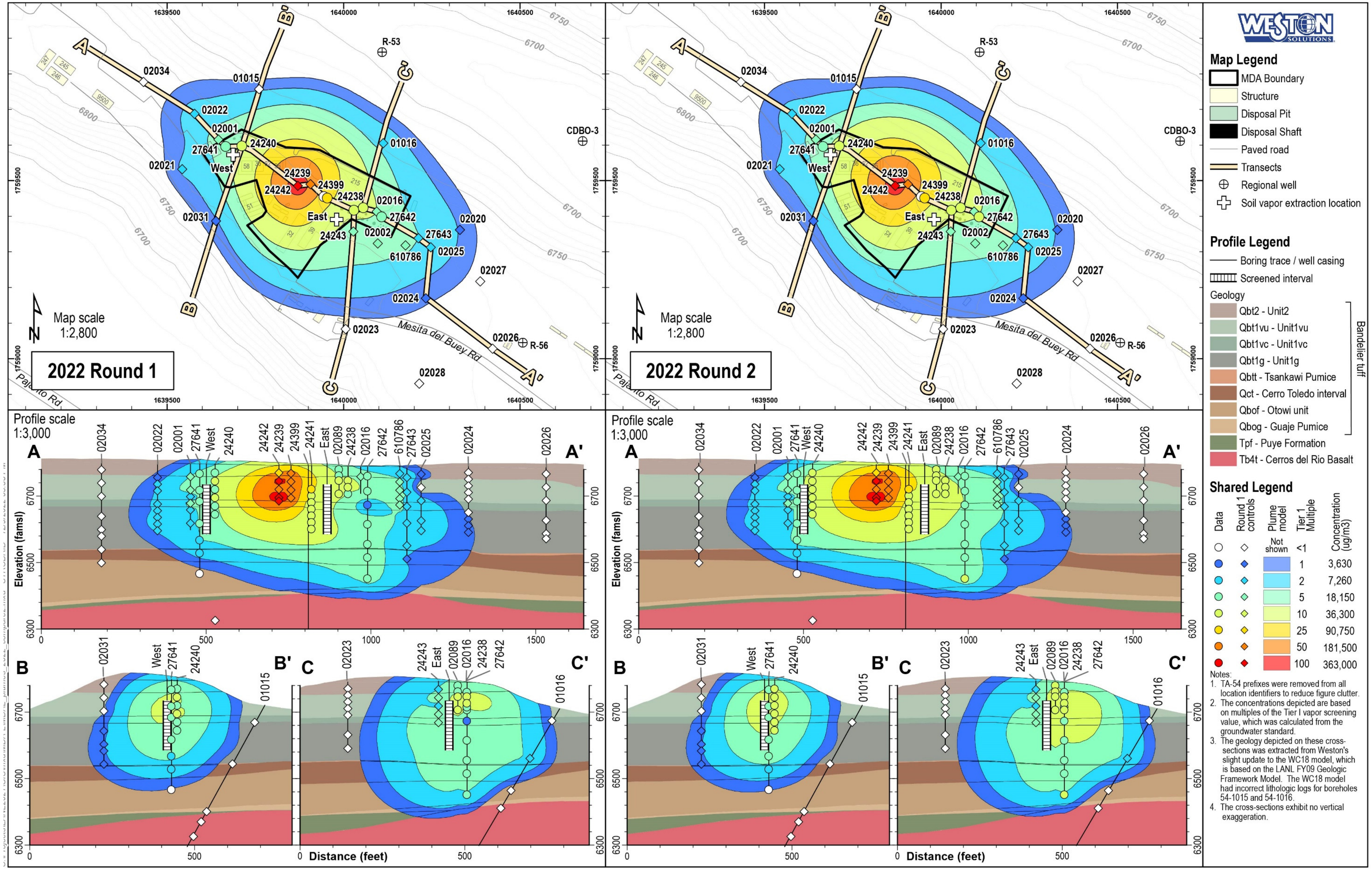


Figure D-2.0-5 Comparison of the 2022 PCE data and interpolated plumes

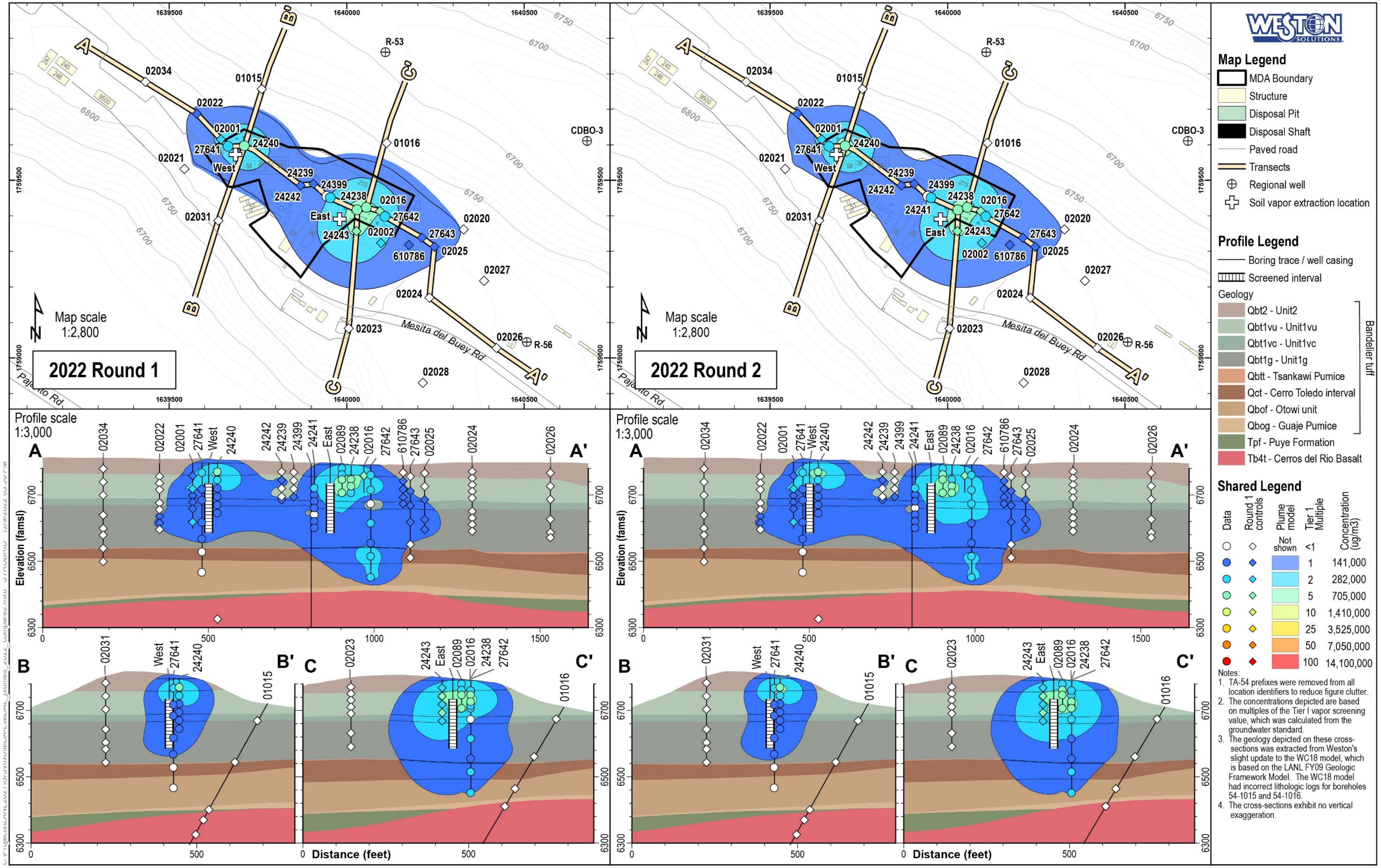


Figure D-2.0-6 Comparison of the 2022 1,1,1-TCA data and interpolated plumes

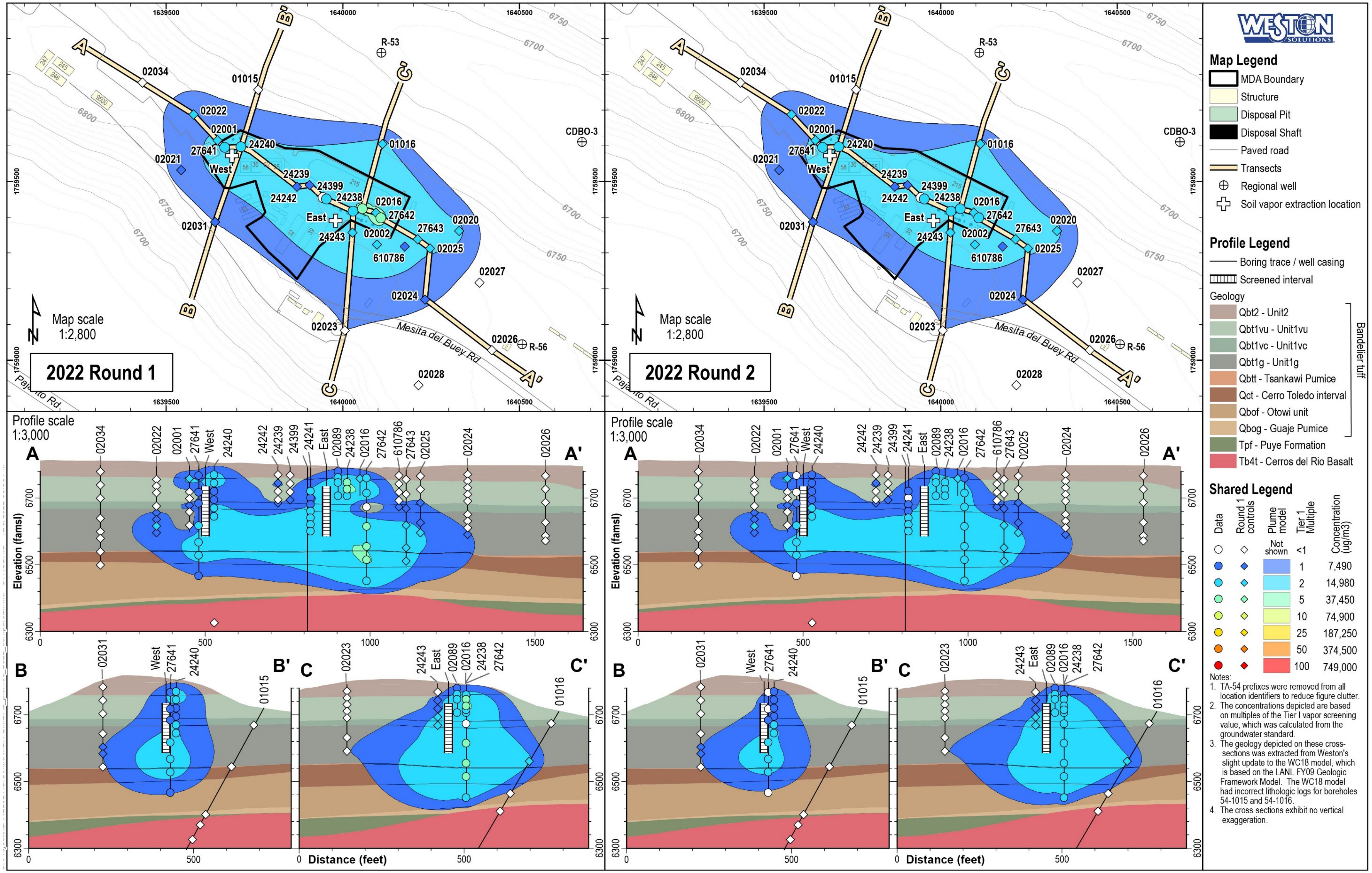


Figure D-2.0-7 Comparison of the 2022 1,1-DCE data and interpolated plumes

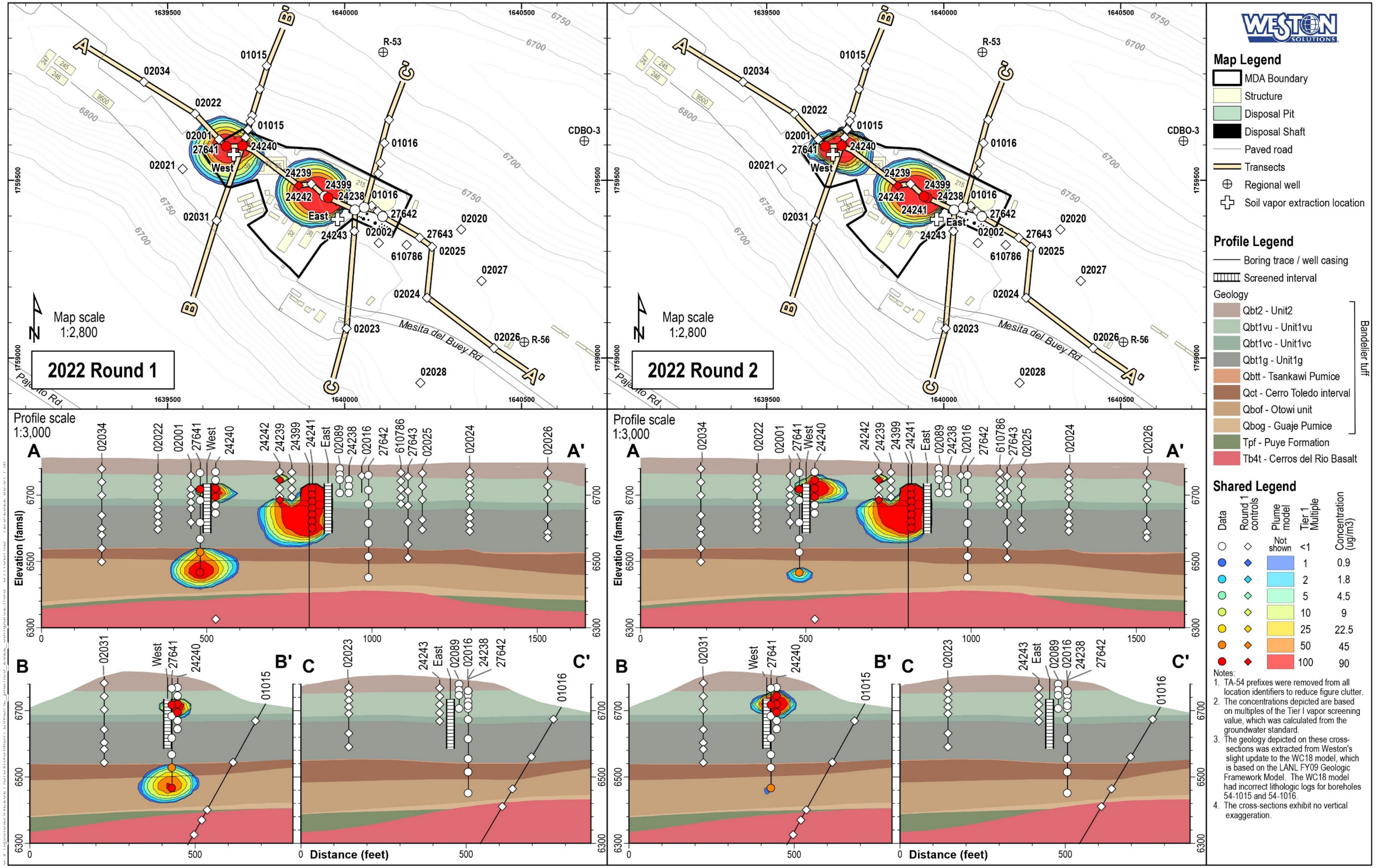


Figure D-2.0-8 Comparison of the 2022 1,4-dioxane data and interpolated plumes

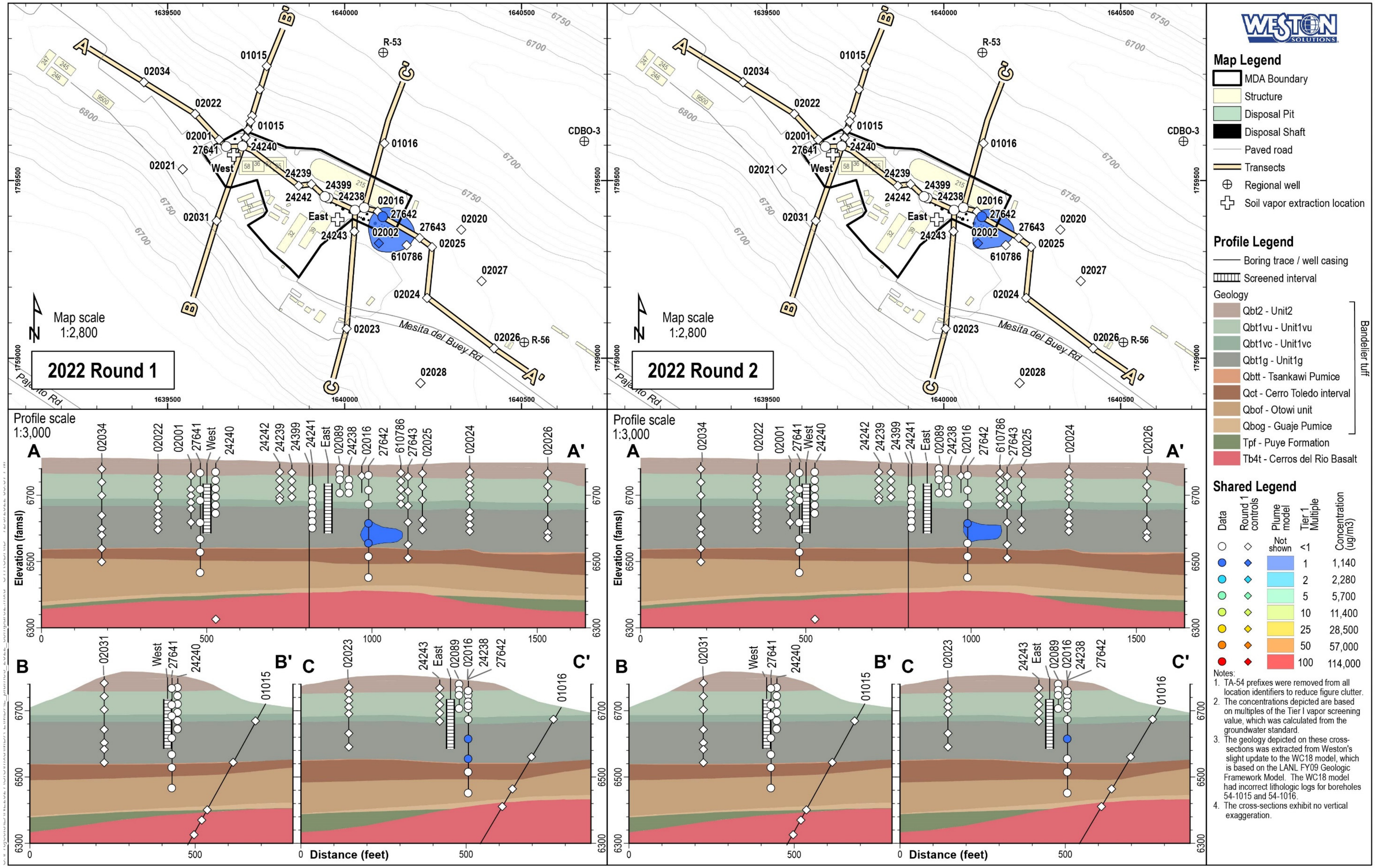


Figure D-2.0-9 Comparison of the 2022 benzene data and interpolated plumes

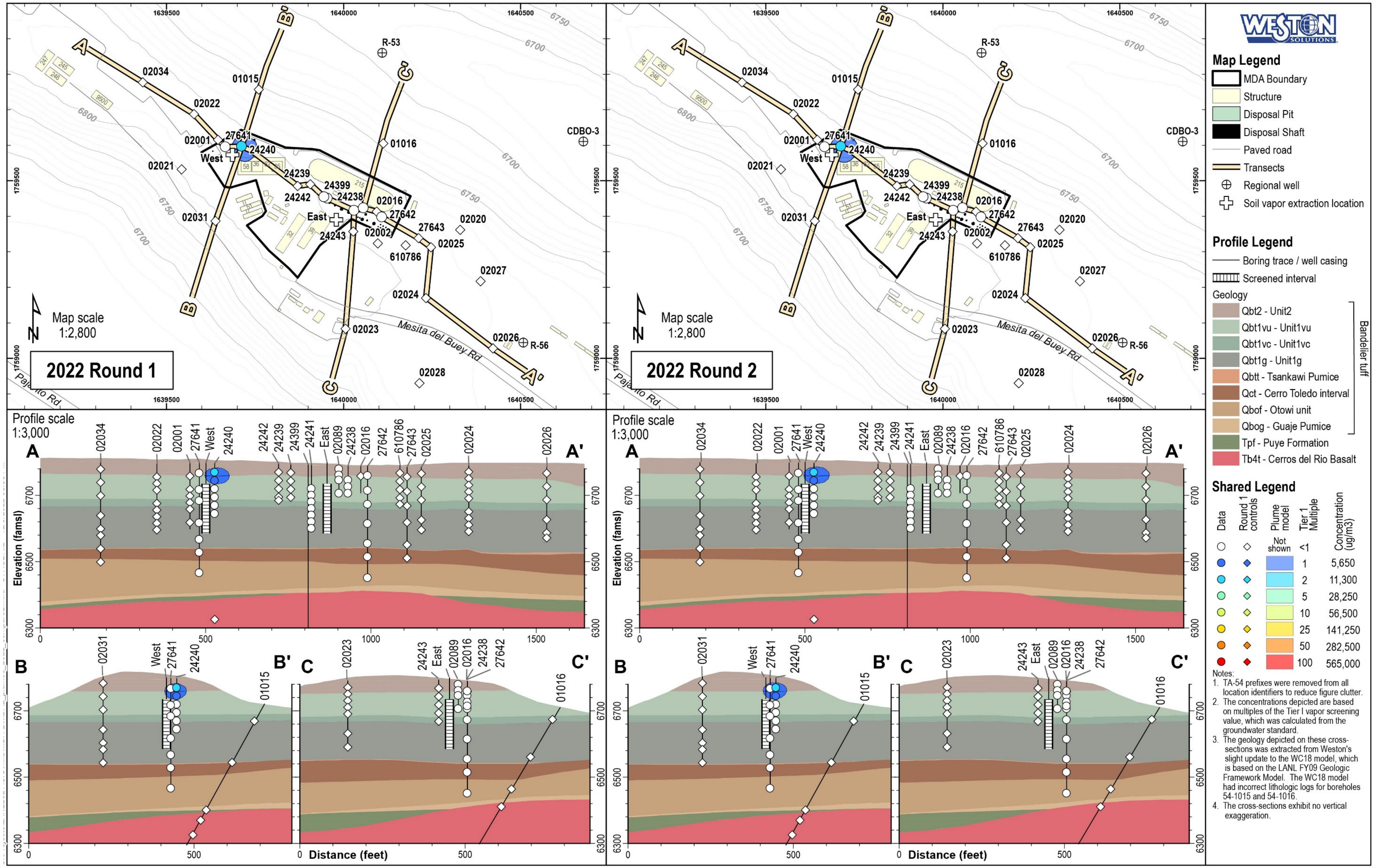


Figure D-2.0-10 Comparison of the 2022 carbon tetrachloride data and interpolated plumes

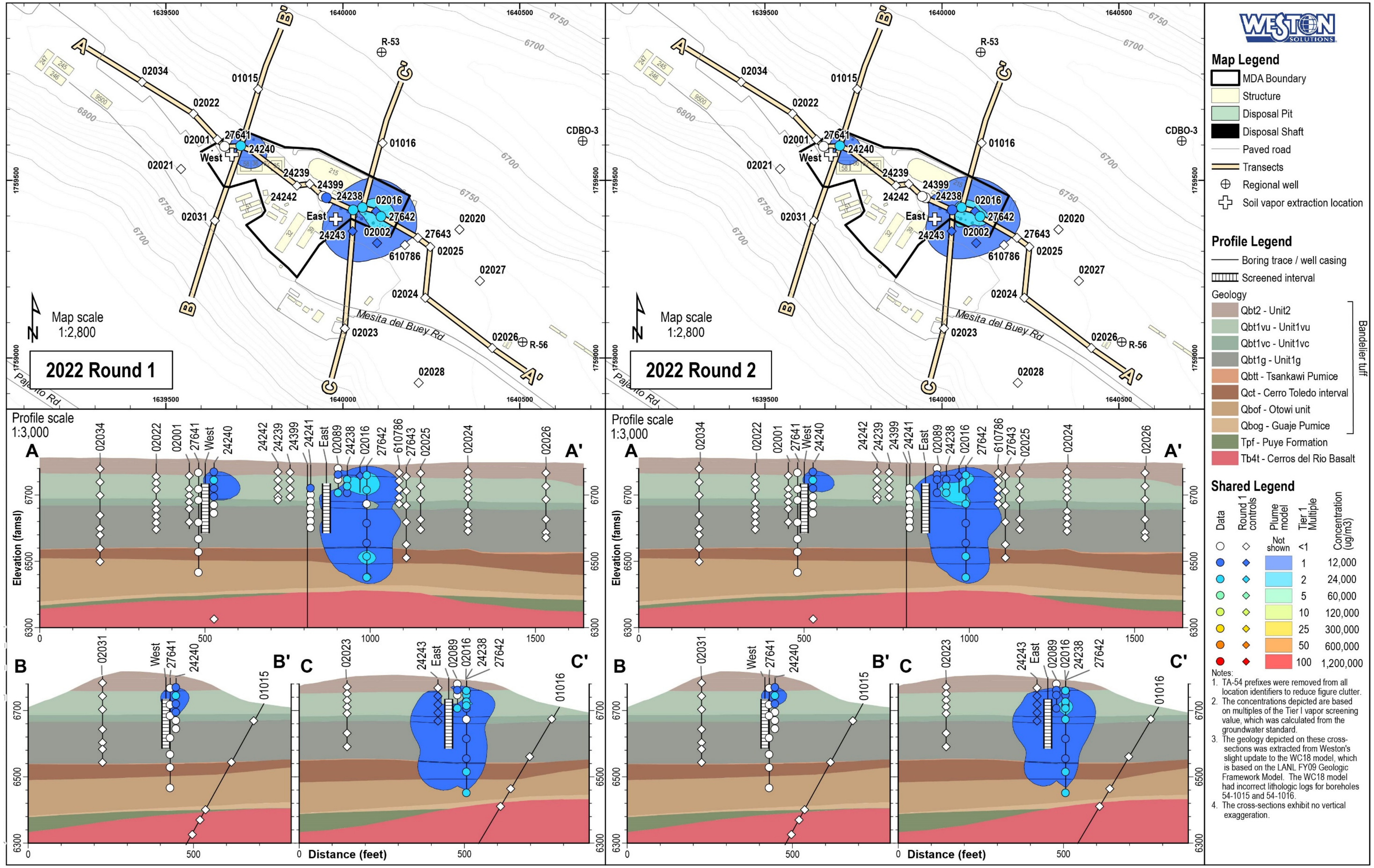


Figure D-2.0-11 Comparison of the 2022 chloroform data and interpolated plumes

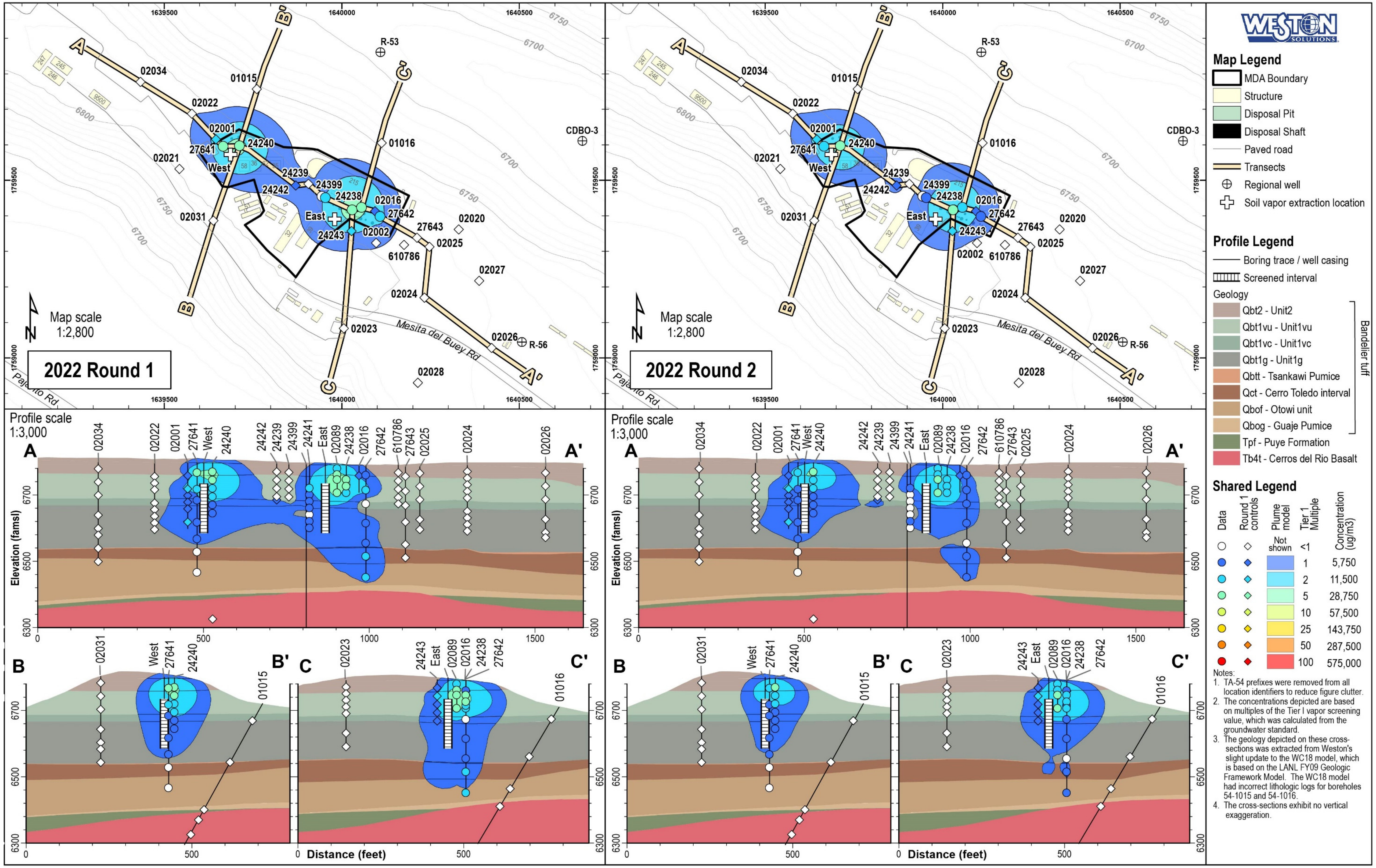


Figure D-2.0-12 Comparison of the 2022 1,1-DCA data and interpolated plumes

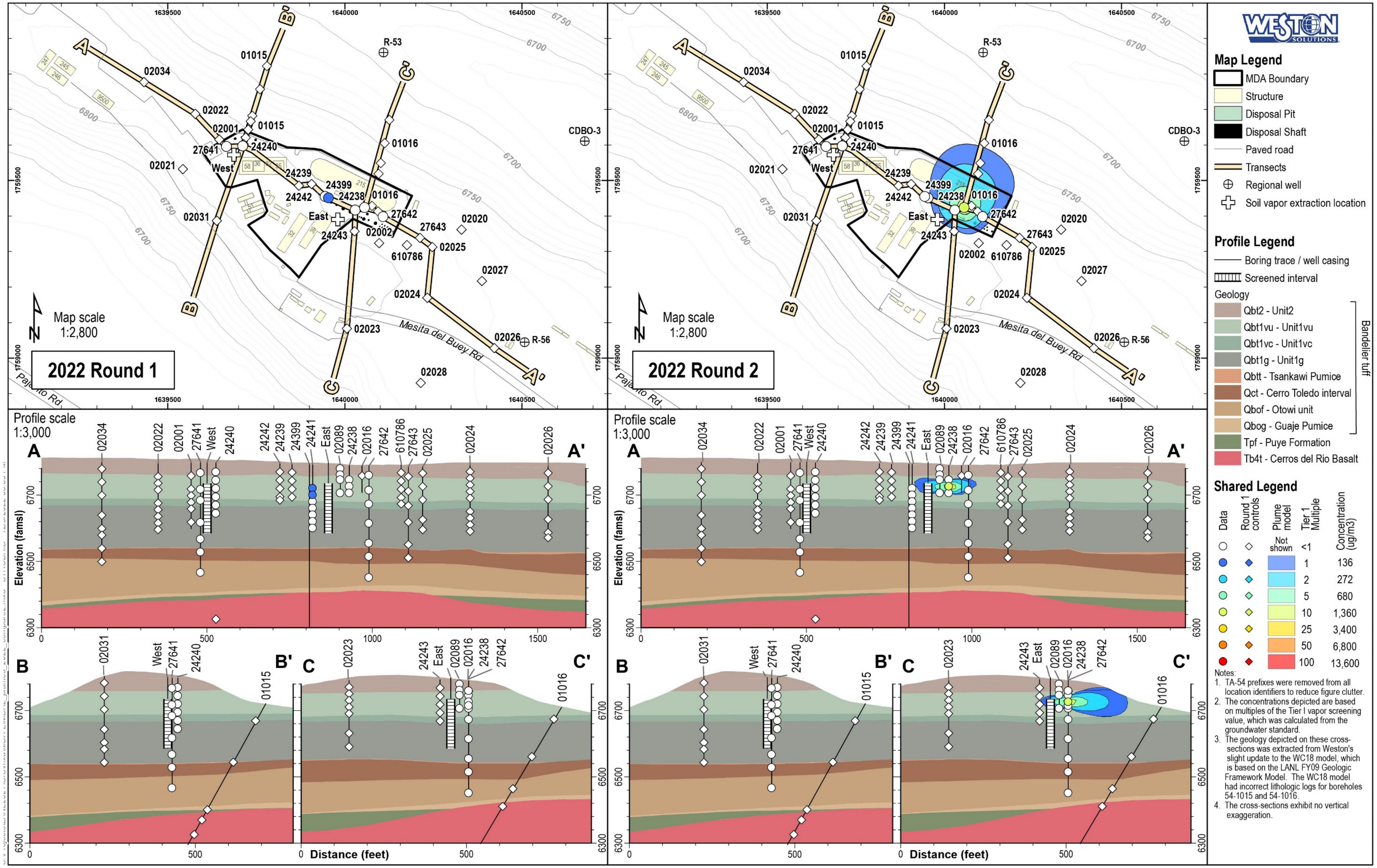


Figure D-2.0-13 Comparison of the 2022 2-propanol data and interpolated plumes

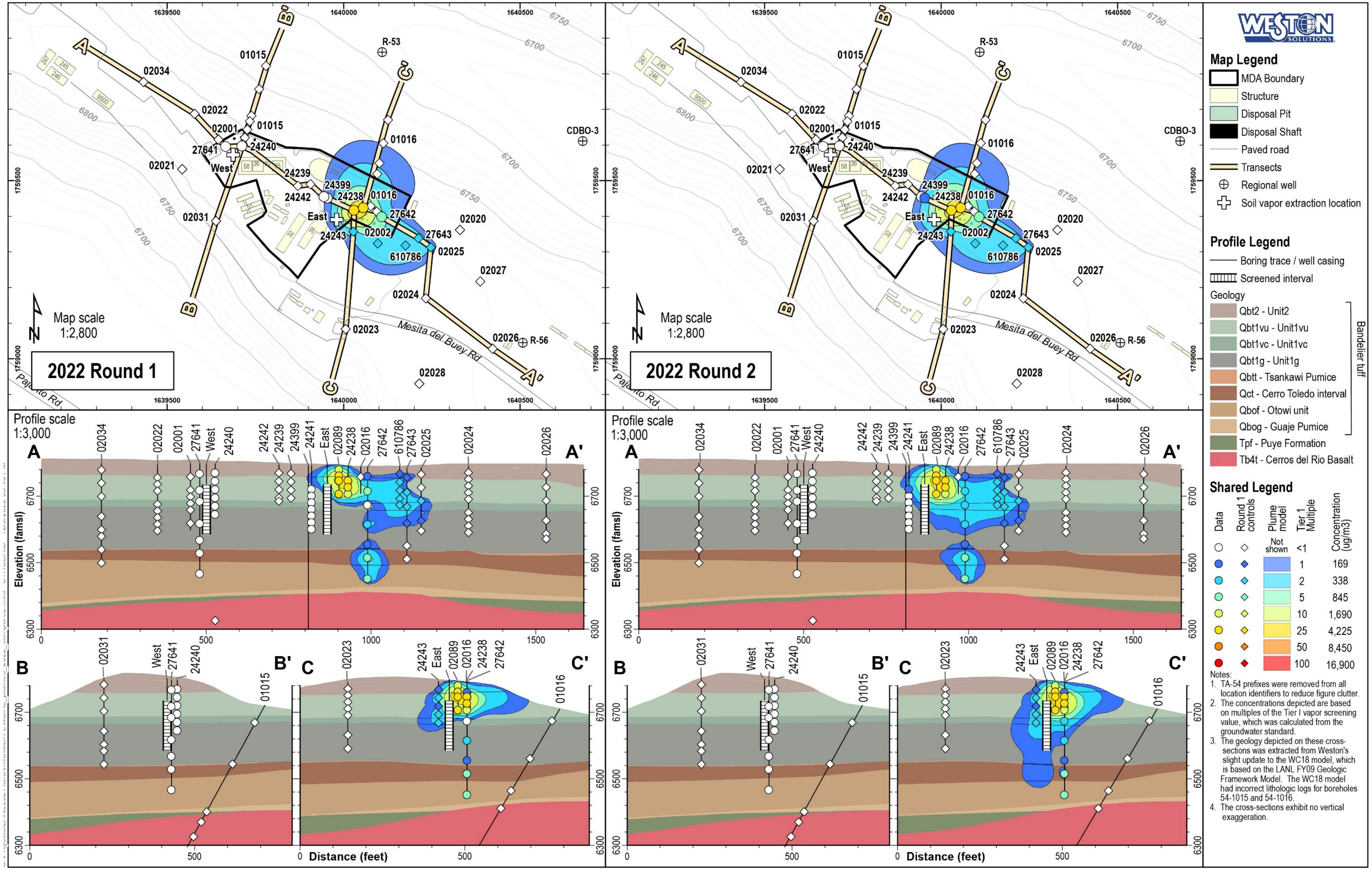


Figure D-2.0-14 Comparison of the 2022 1,1,2-TCA data and interpolated plumes

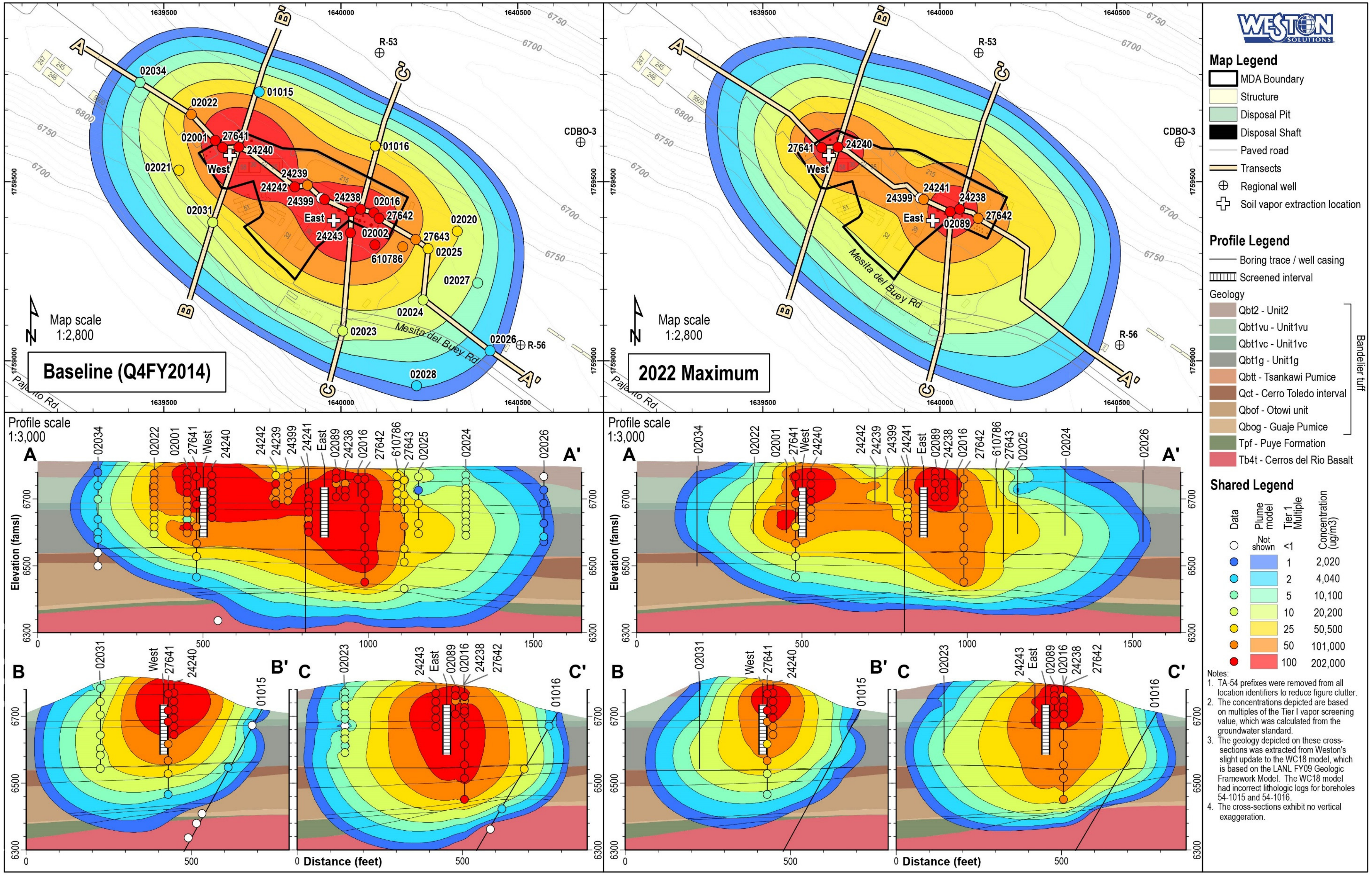
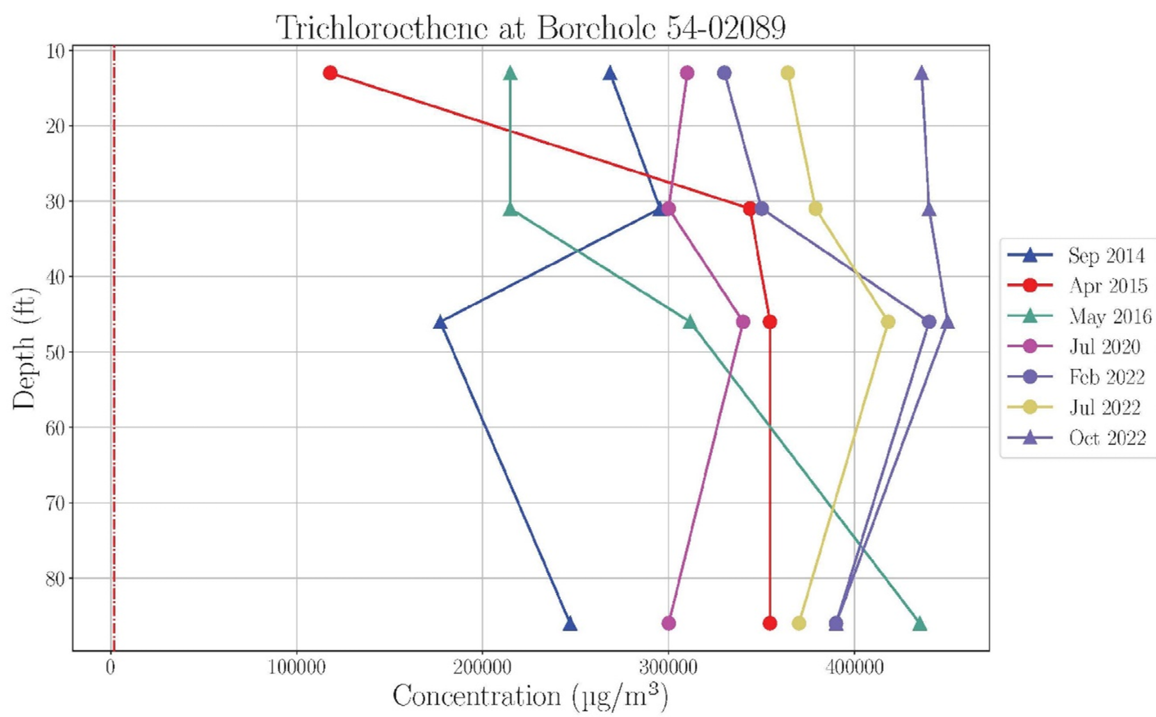
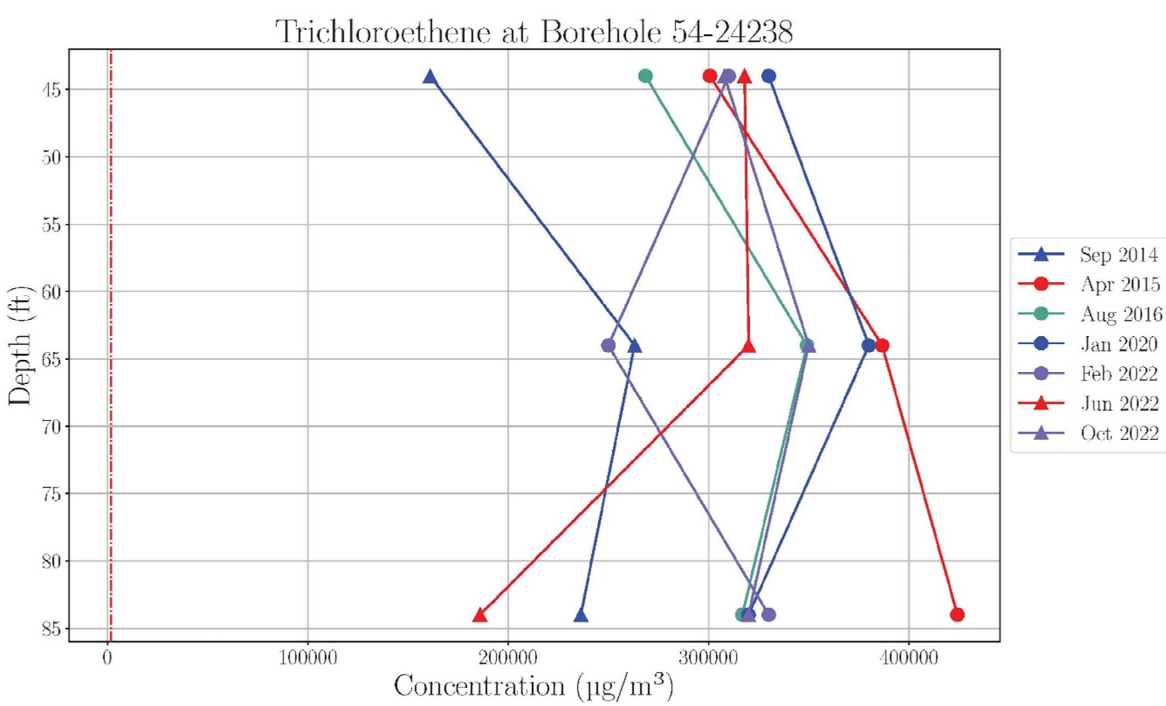


Figure D-3.0-1 Comparison of the maximum 2022 MDA L TCE data and interpolated plume with the FY 2014 Quarter 4 pre-SVE baseline



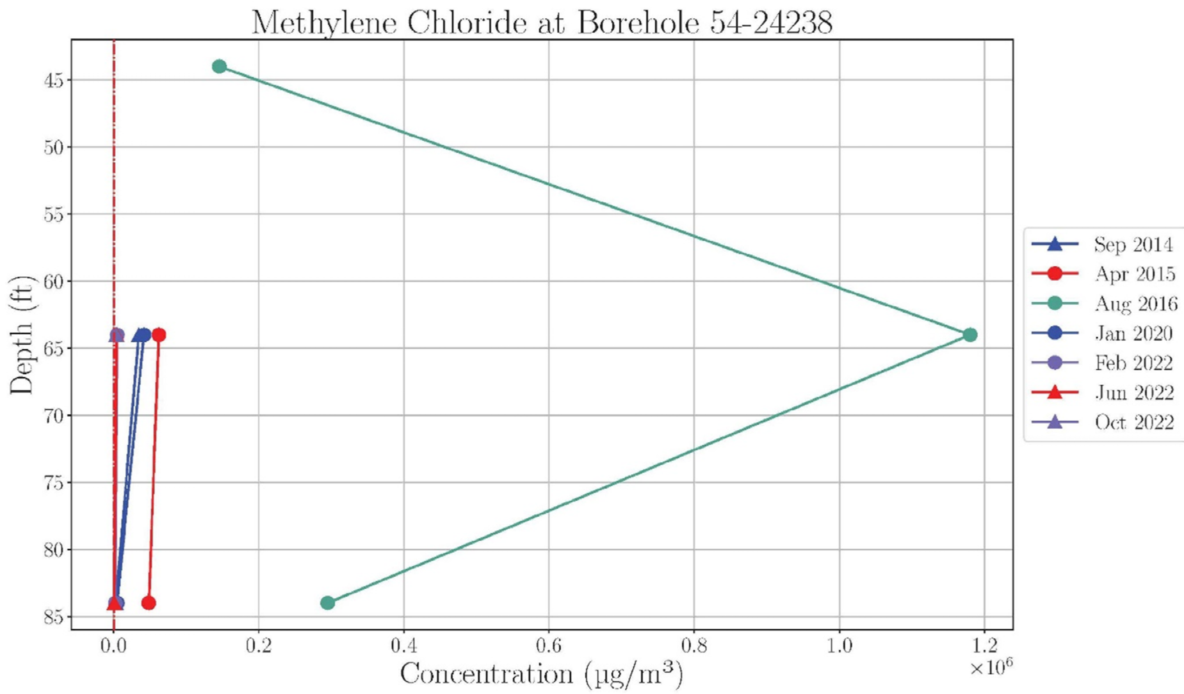
Note: Dashed red line is the 2020-µg/m^3 Tier I pore-gas SL for TCE.

Figure D-4.1-1 TCE data in 54-02089 eastside sentry well



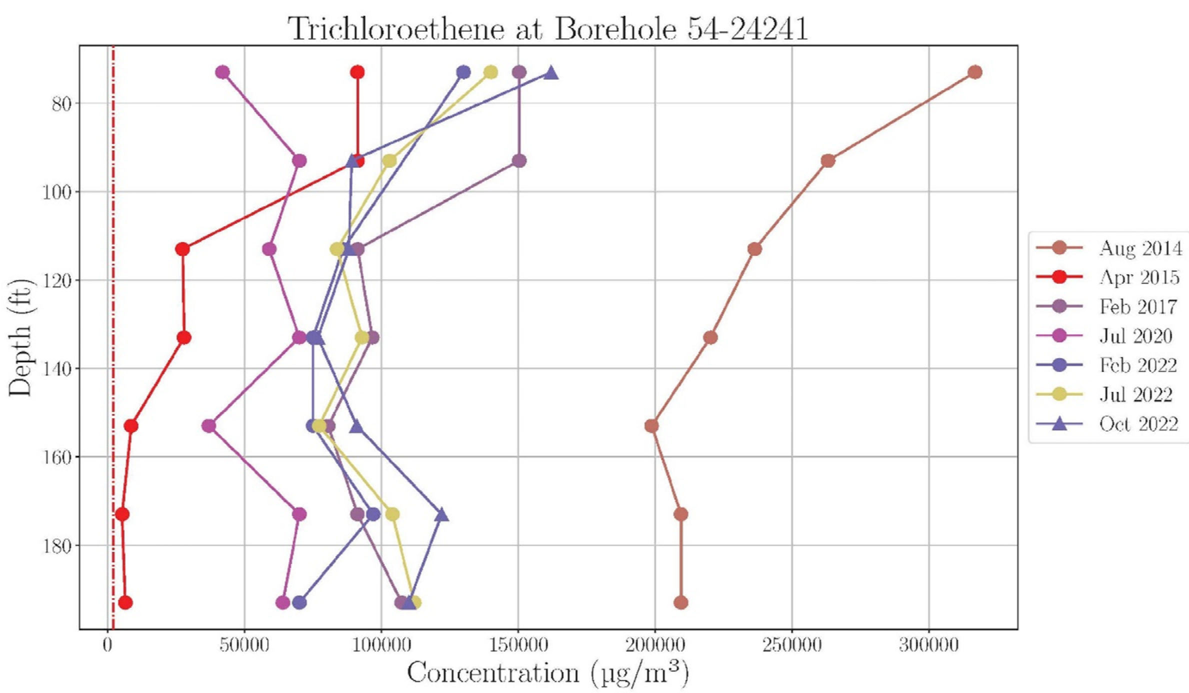
Note: Dashed red line is the 2020-µg/m^3 Tier I pore-gas SL for TCE.

Figure D-4.1-2 TCE in 54-24238 eastside sentry well



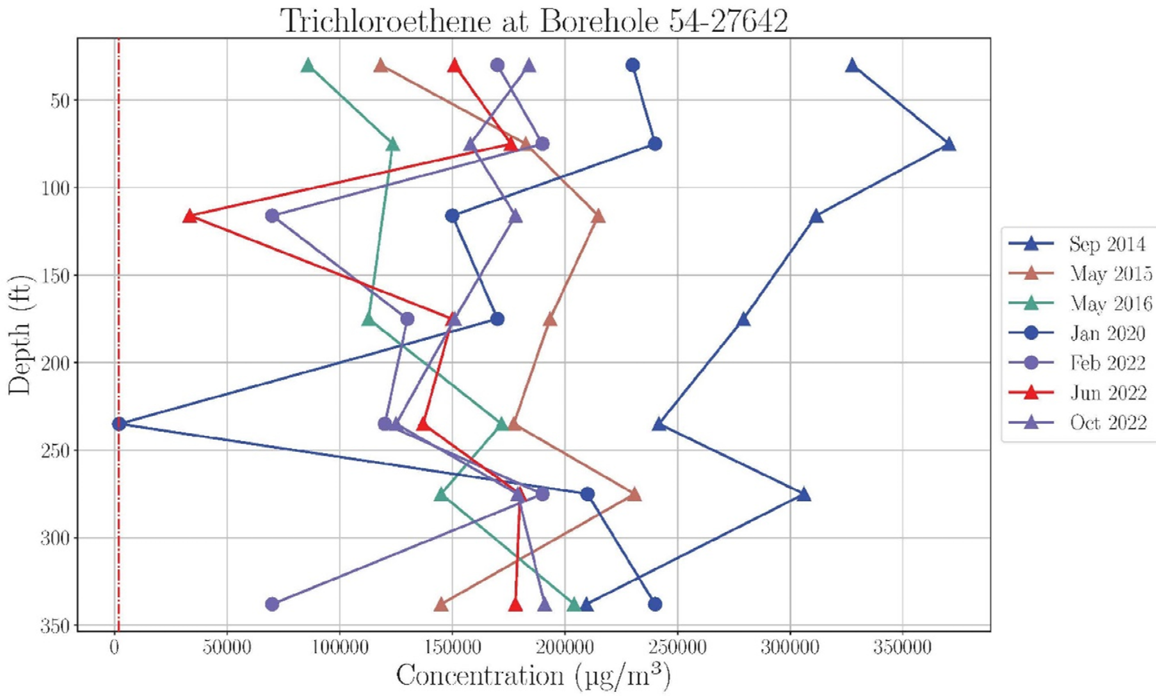
Note: Dashed red line is the 665-µg/m^3 Tier I pore-gas SL for methylene chloride.

Figure D-4.1-3 Methylene chloride in 54-24238 eastside sentry well



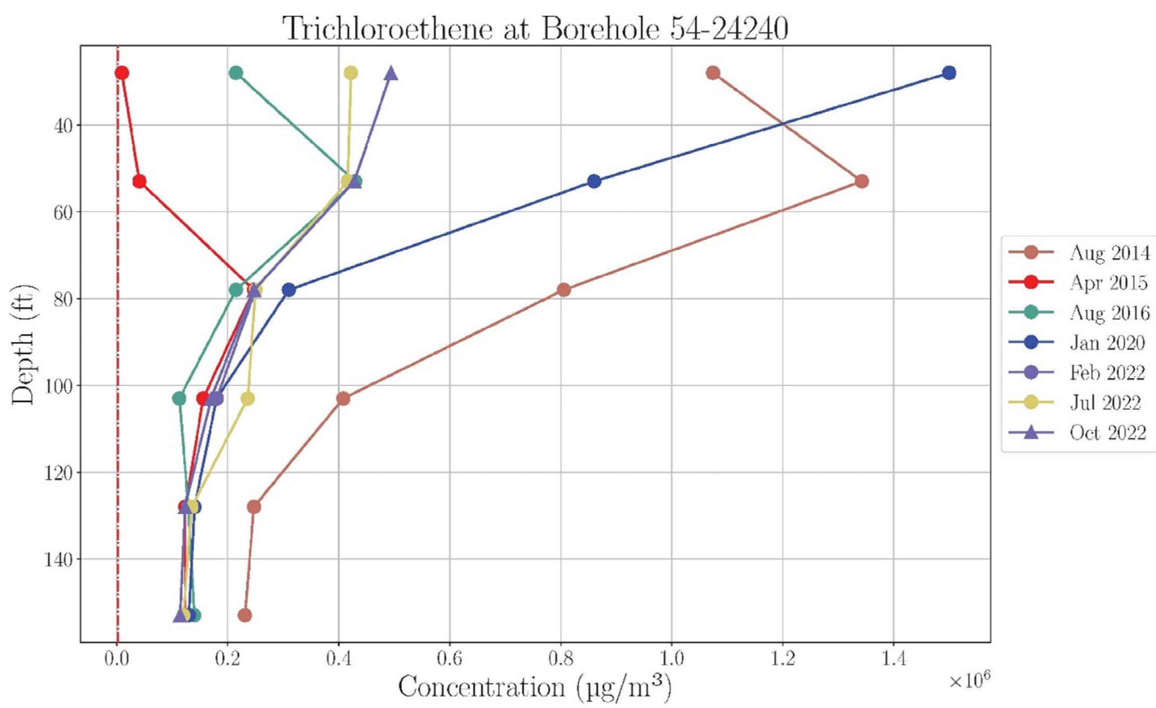
Note: Dashed red line is the 2020-µg/m^3 Tier I pore-gas SL for TCE.

Figure D-4.1-4 TCE in 54-24241 eastside sentry well



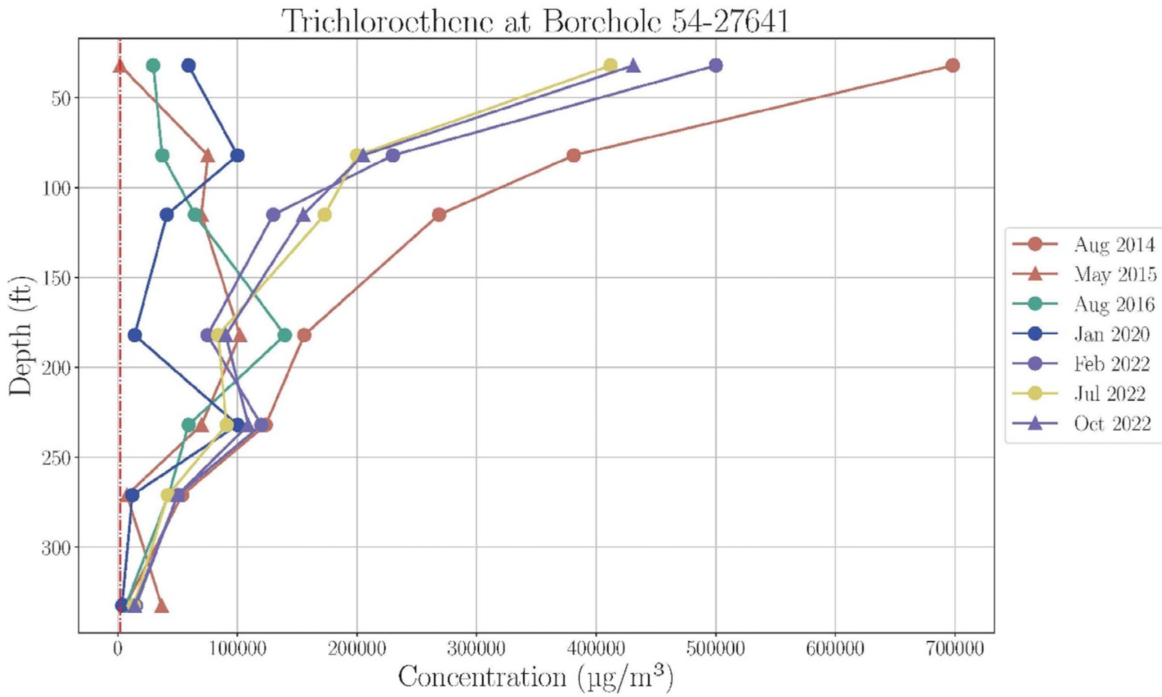
Note: Dashed red line is the 2020-µg/m³ Tier I pore-gas SL for TCE.

Figure D-4.1-5 TCE in 54-27642 eastside sentry well



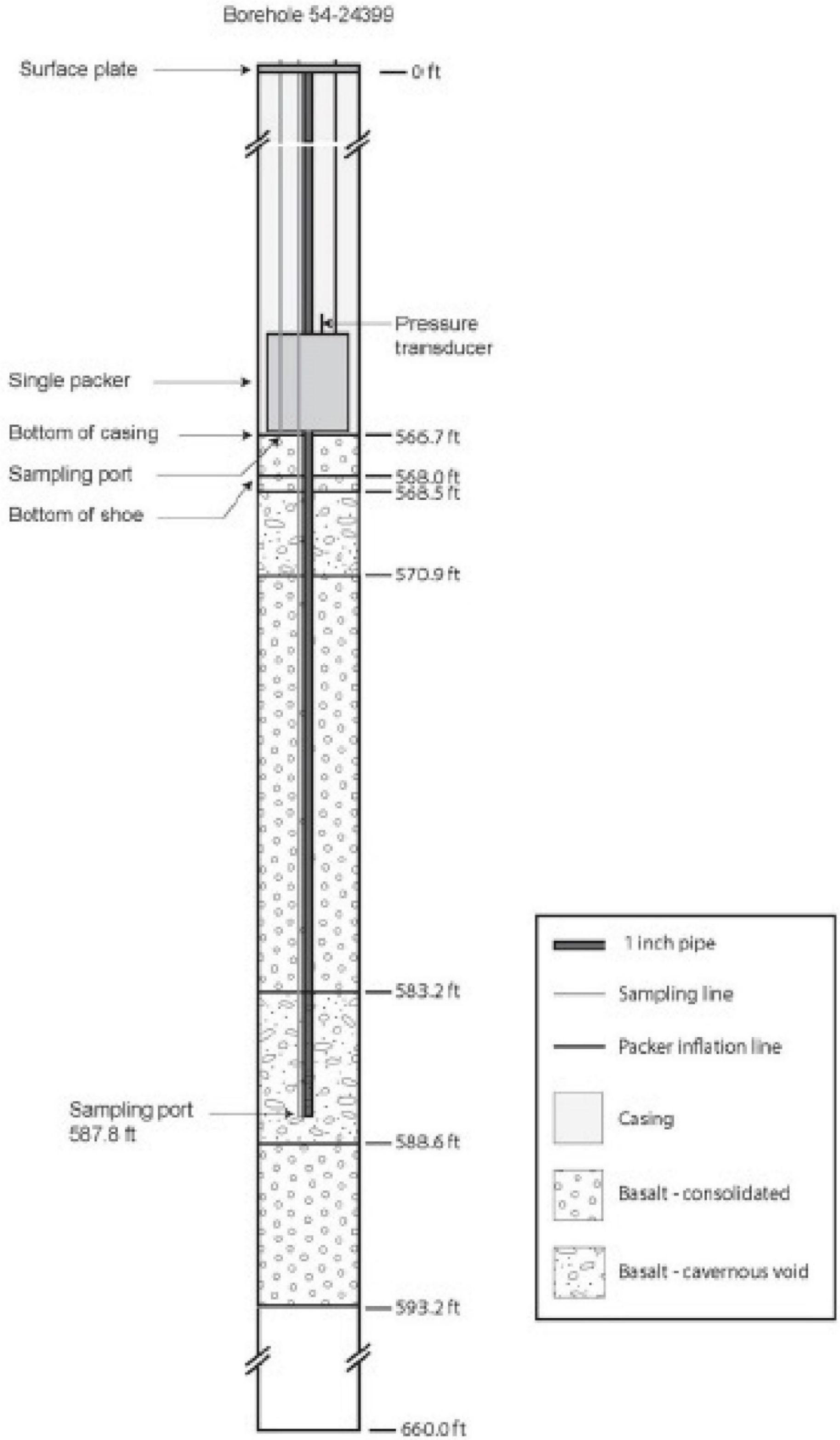
Note: Dashed red line is the 2020-µg/m³ Tier I pore-gas SL for TCE.

Figure D-4.2-1 TCE in 54-24240 westside sentry well



Note: Dashed red line is the 2020-μg/m³ Tier I pore-gas SL for TCE.

Figure D-4.2-2 TCE in 54-27641 westside sentry well



Note: Dashed red line is the 2020-µg/m^3 Tier I pore-gas SL for TCE.

Figure D-4.3-1 Borehole 54-24399 completion schematic

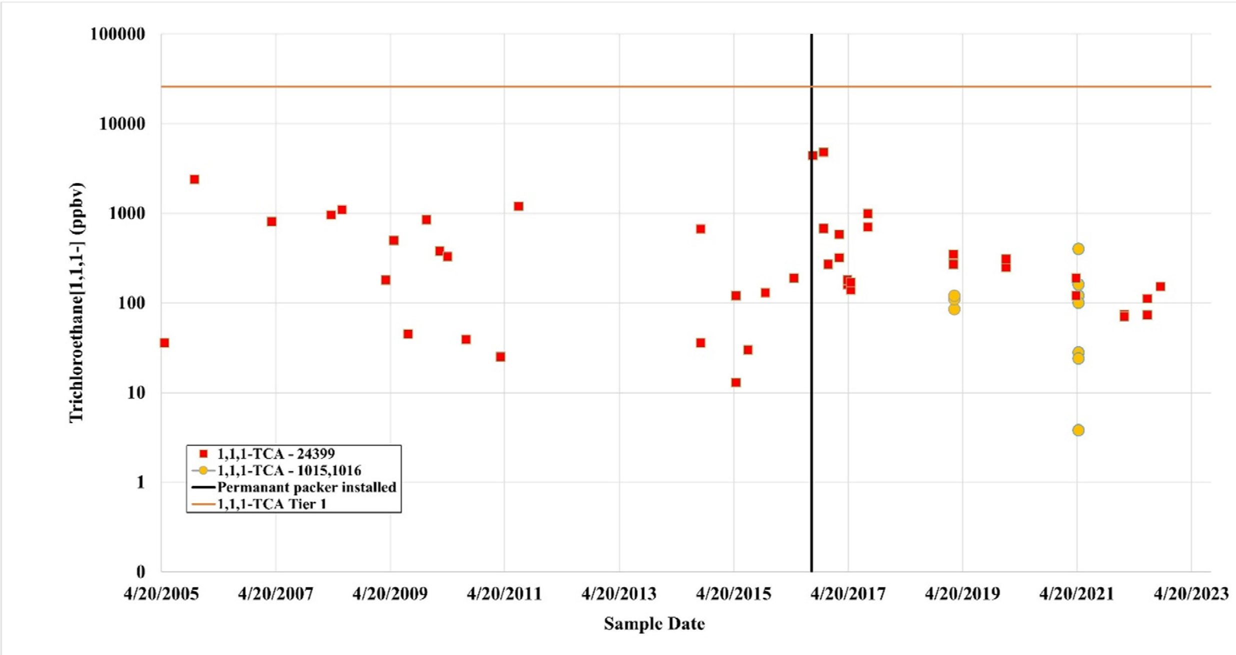


Figure D-4.3-2 TCA[1,1,1-] concentrations in borehole 54-24399

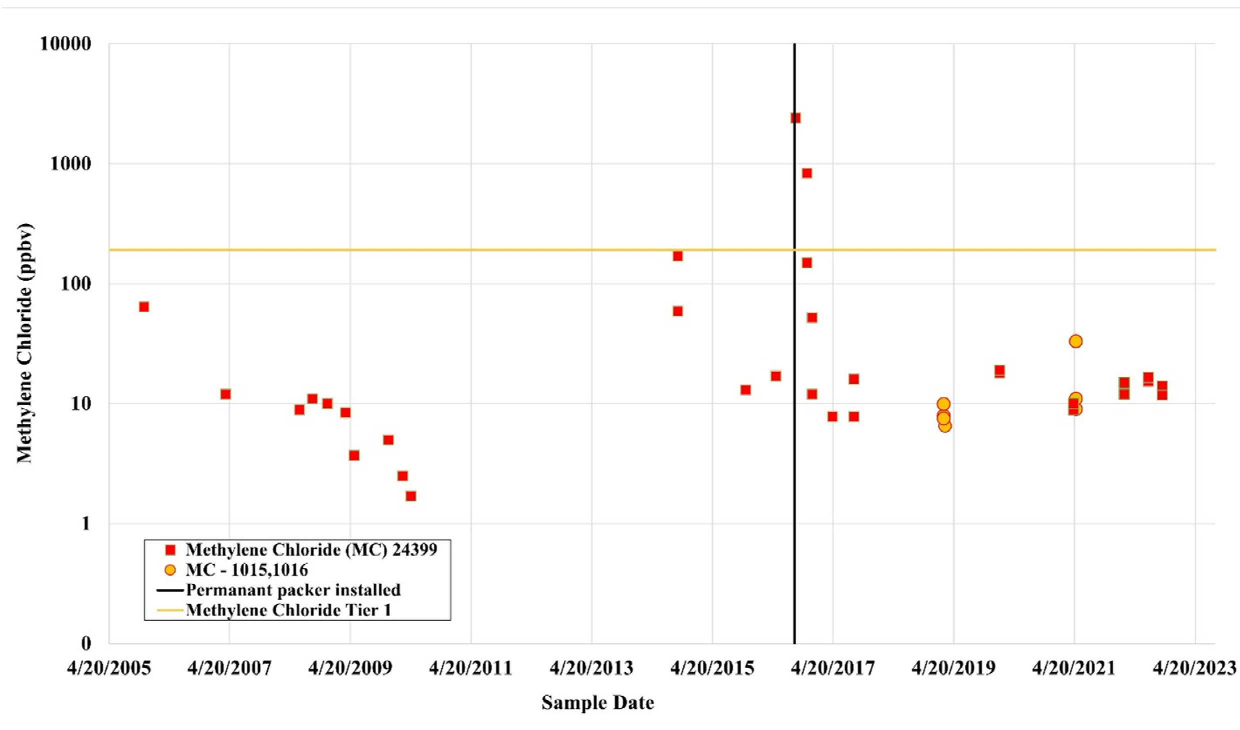


Figure D-4.3-3 Methylene chloride concentrations in borehole 54-24399

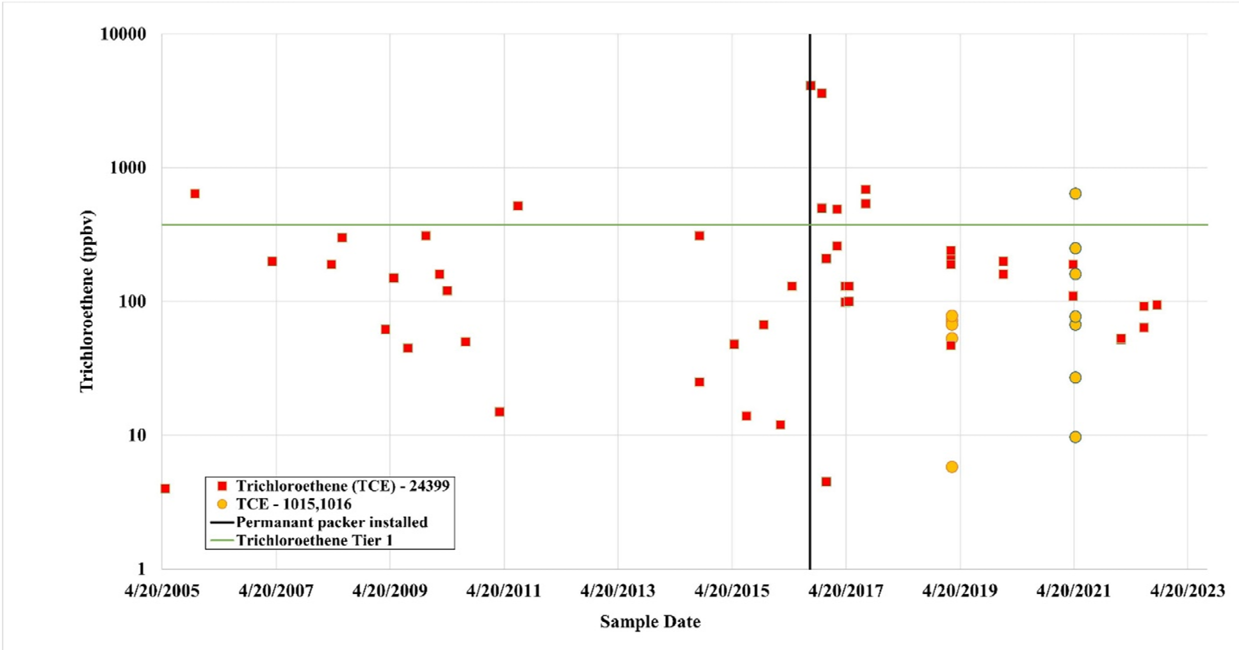


Figure D-4.3-4 TCE concentrations in borehole 54-24399

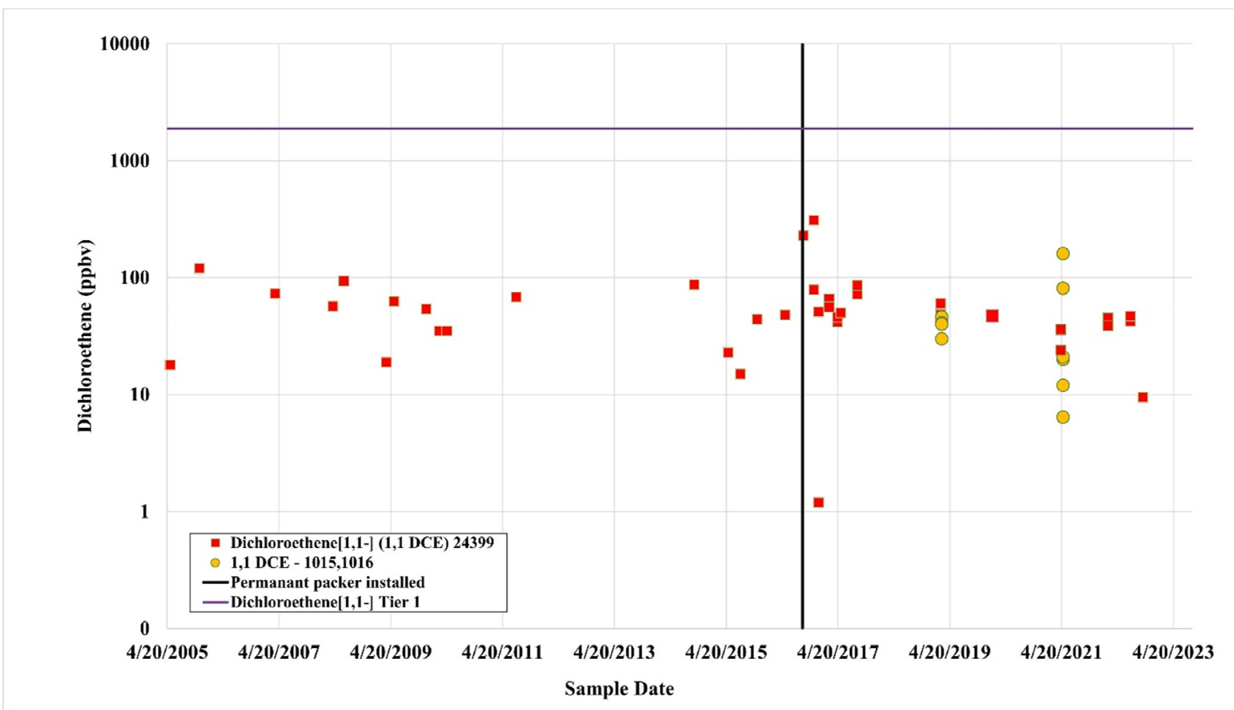


Figure D-4.3-5 DCE[1,1-] concentrations in borehole 54-24399

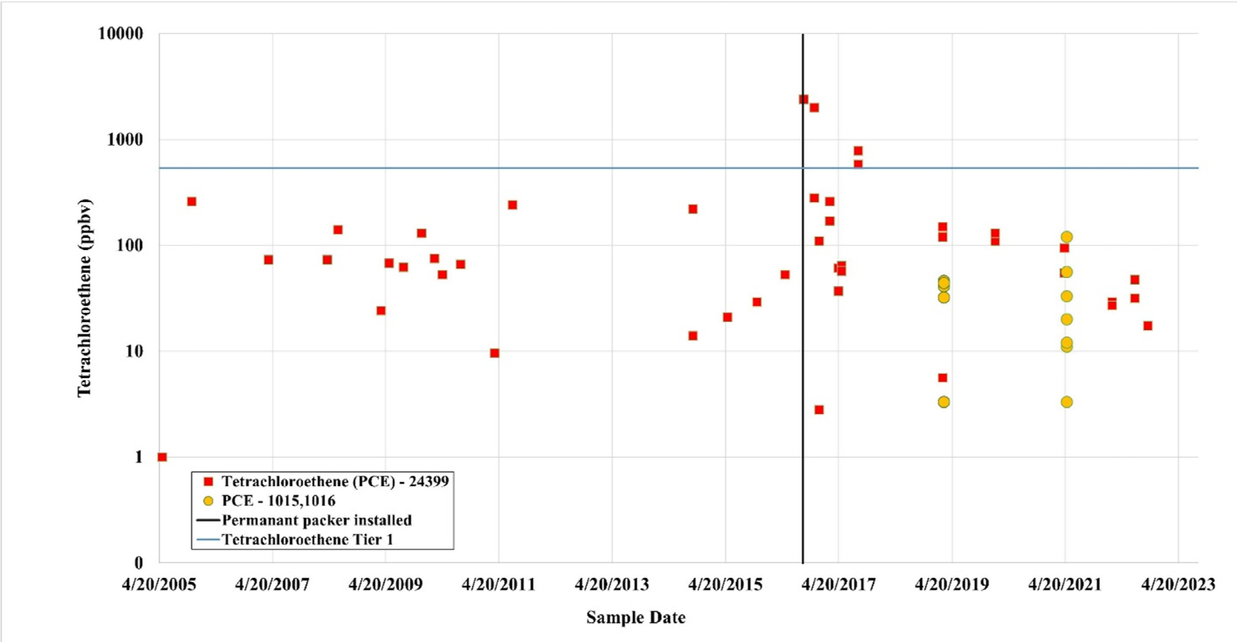


Figure D-4.3-6 PCE concentrations in borehole 54-24399

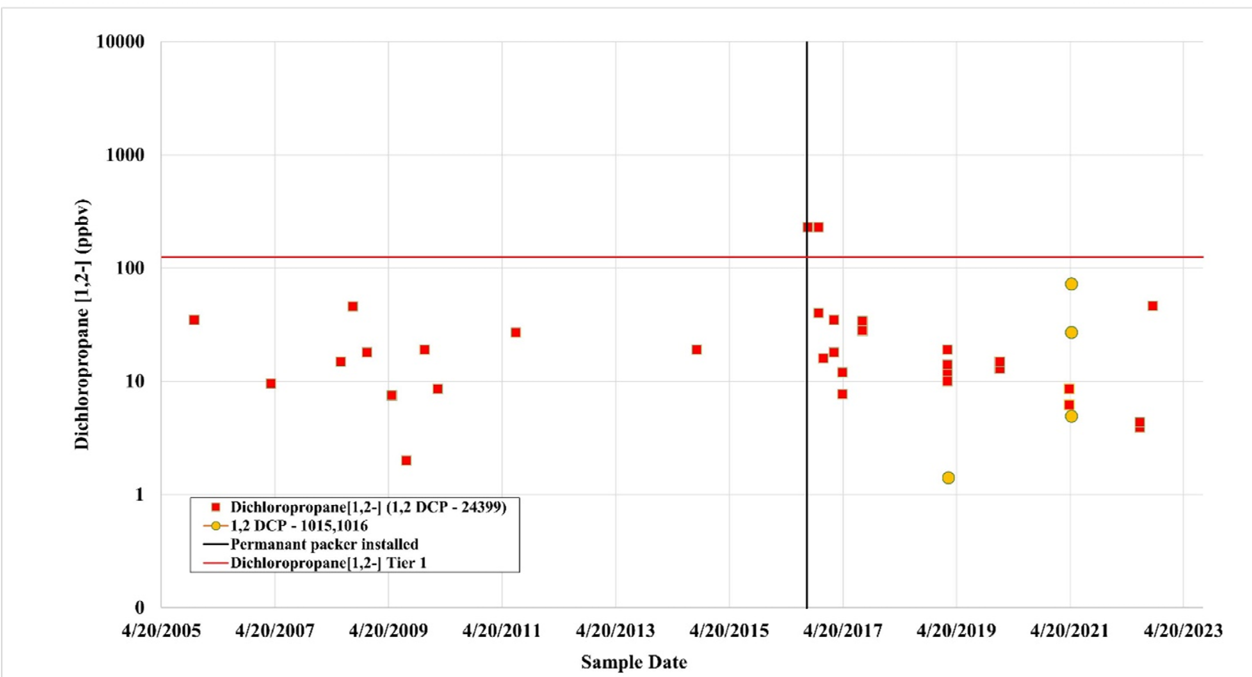


Figure D-4.3-7 DCP[1,2-] concentrations in borehole 54-24399

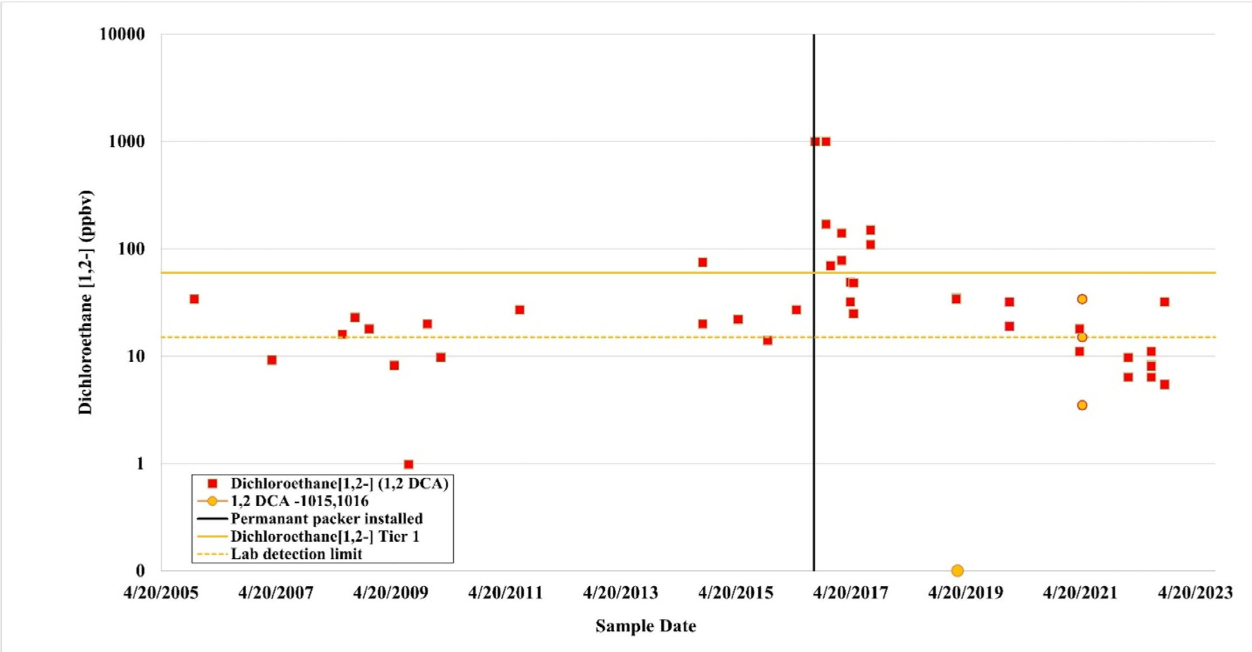


Figure D-4.3-8 **DCA[1,2-] concentrations in borehole 54-24399**

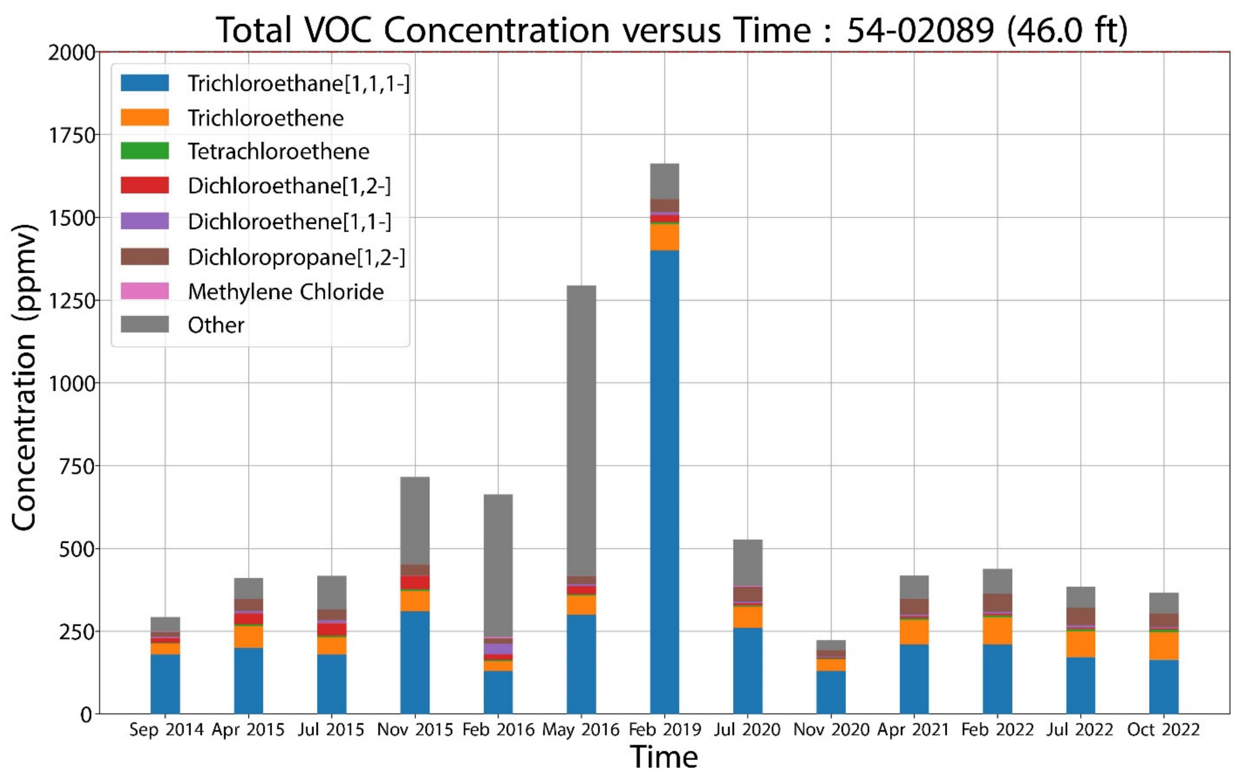
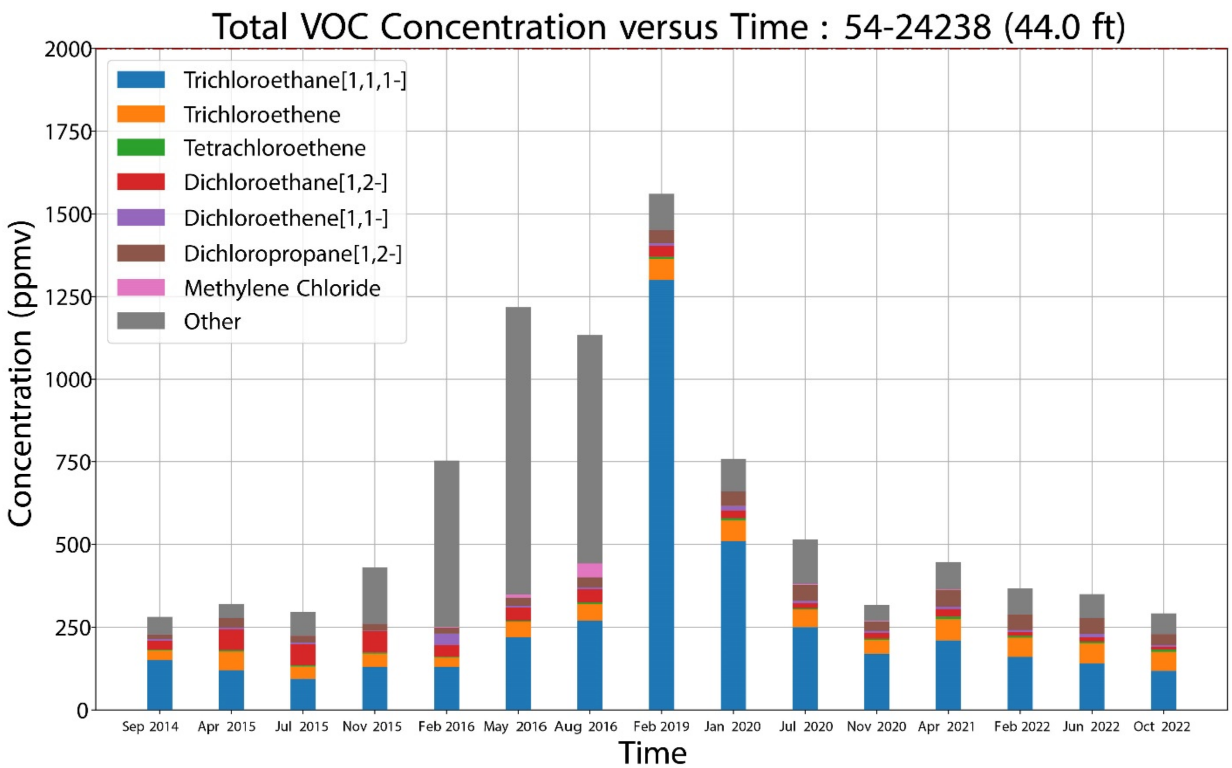


Figure D-5.0-1 **Total VOC concentrations in borehole 54-02089 at 46 ft bgs. The proposed SVE trigger value of 2000 ppmv total VOC is at the top of the graph.**



Note: Dashed red line is the 2020-µg/m^3 Tier I pore-gas SL for TCE.

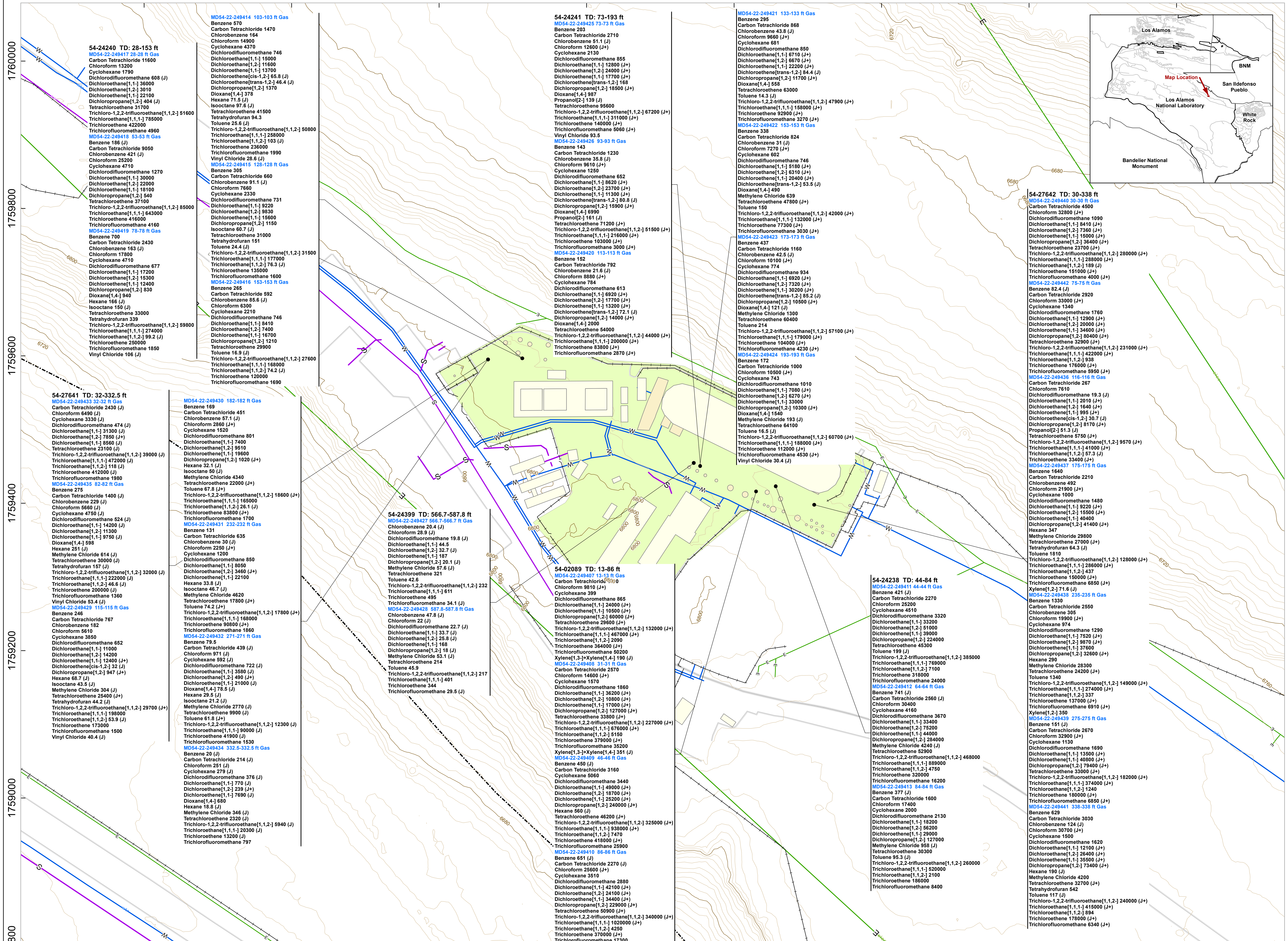
Figure D-5.0-2 Total VOC concentrations in borehole 54-24238 at 43 ft bgs. The proposed SVE trigger value of 2000 ppmv total VOC is at the top of the graph.

Table D-1.0-1
Sentry Boreholes at MDA L

Sentry Borehole	East, West, or Deep	Deepest Port (ft bgs)	Possible Increased Leakage Detected
54-02089	East	86	Yes (all depths)
54-24238	East	84	Yes (all depths)
54-24240	West	153	Yes (28 ft)
54-24241	East	193	No
54-24399	Deep	587.7	No
54-27641	West	332.5	No
54-27642	East	338	Yes (30 ft)

Appendix E

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



- Sampling location
- Paved road
- Fence
- TA boundary line
- Index contour, 40-ft interval
- Terrain contour, 5-ft interval
- Sewer line
- Electric line
- Water line
- MDA L
- Structure
- Waste disposal pits and shafts

Plate 1

First Round 2022 VOC Pore Gas Detected Results at MDA L

New Mexico State Plane Coordinate System Central Zone (3002)
North American Datum, 1983 (NAD 83)

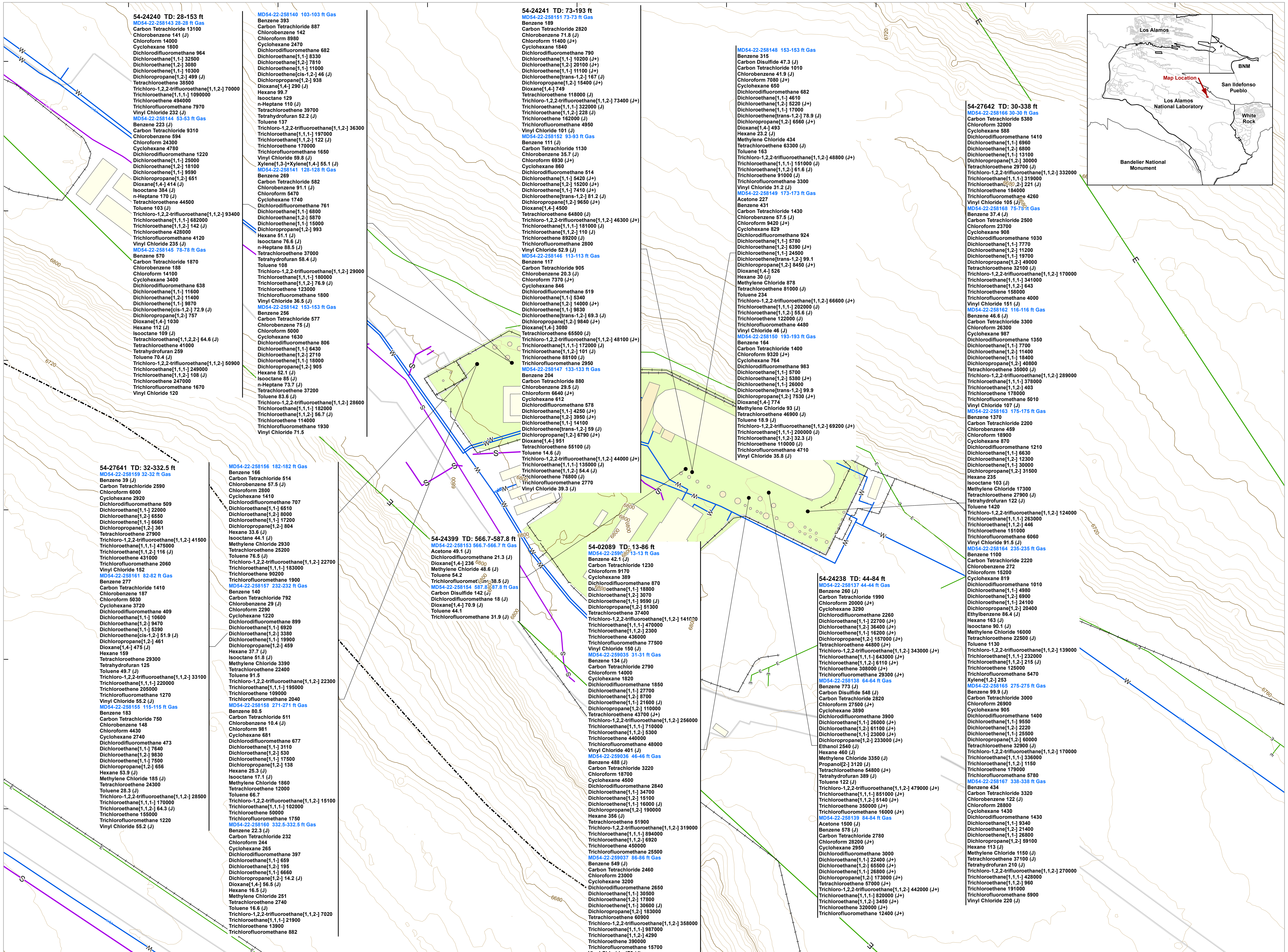
US Survey Ft

GIS: Tyson Wood, twood@adelanteconsulting.com
Date: 20-February-2019
Last Opened: Wednesday, January 4, 2023

File: MDA_L_PMR_Plate_Round_1

DISCLAIMER: This map was created for work processes associated with LLCC. All other uses for this map should be confirmed with N3B staff.

0 75 150 300
Feet



- Sampling location
- Paved road
- Fence
- TA boundary line
- Index contour, 40-ft interval
- Terrain contour, 5-ft interval
- Sewer line
- Electric line
- Water line
- MDA L
- Structure
- Waste disposal pits and shafts

Plate 2

Second Round 2022 VOC Pore Gas Detected Results at MDA L

New Mexico State Plane Coordinate System Central Zone (3002)
North American Datum, 1983 (NAD 83)

US Survey Ft

GIS: Tyson Wood, twood@adelanteconsulting.com
Date: 20-February-2019
Last Opened: Wednesday, January 4, 2023

File: MDA_L_PMR_Plate_Round_2

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0 75 150 300
Feet