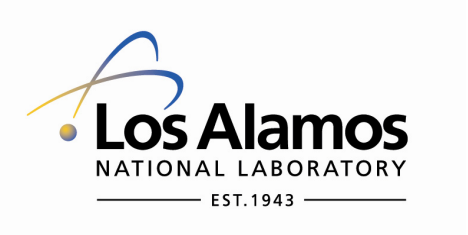
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Supplemental Remedy Completion Report for Upper Los Alamos Canyon Aggregate Area, Former Technical Area 32



Prepared by the Environmental Programs Directorate

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EP2012-0306

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December 2012

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EXECUTIVE SUMMARY

This supplemental remedy completion report presents the results of additional investigation and assessments performed at Solid Waste Management Units (SWMUs) 32-002(a) and 32-002(b1) at former Technical Area 32 (TA-32) in the Upper Los Alamos Canyon Aggregate Area at Los Alamos National Laboratory (the Laboratory). The results augment the information previously presented in Revision 1 of the remedy completion report for TA-32 sites within the Upper Los Alamos Canyon Aggregate Area.

The objective of the additional investigation and assessments is to expedite corrective action complete status for sites within former TA-32 that are located on property currently owned by the Los Alamos School Board. Attainment of corrective action complete status for these sites is necessary to facilitate commercial development of the site by Los Alamos County. These sites were previously remediated and investigated as part of an accelerated corrective action (ACA) that was reported in the previous remedy completion report. Based on the results of the ACA, SWMUs 32-002(a) and 32-002(b) [which has subsequently been divided into SWMUs 32-002(b1) and 32-002(b2)] could not be recommended for corrective action complete. The investigation and assessments described in this report were performed to address the issues preventing attainment of corrective action complete status for these sites or a portion of the original site.

The additional investigation and assessment for SWMU 32-002(a) included additional sampling to complete the determination of the vertical extent of contamination for this site. Human health and ecological risk-screening assessments were also performed. SWMU 32-002(b1) is a new SWMU consisting of the portion of former SWMU 32-002(b), located on property owned by the Los Alamos School Board. The additional assessment for this site included evaluating potential human health and ecological risks using existing data collected at former SWMU 32-002(b) that are now associated with SWMU 32-002(b1).

The results of the additional investigation and assessments show the nature and extent of contamination are defined for both sites; neither site poses an unacceptable human health risk or dose under the industrial scenario, and neither site poses an unacceptable risk to ecological receptors. The industrial scenario was evaluated because it is appropriate for the current and planned land use, which involves the development of the former TA-32 area by Los Alamos County. Consistent with the use of the industrial scenario, SWMUs 32-002(a) and 32-002(b1) are recommended for corrective action complete with controls. Further evaluation of the SWMUs and areas of concern within former TA-32 may be performed in the future with the objective of supporting a determination of corrective action complete without controls. At that time, the Laboratory will submit the results of additional risk evaluations supporting corrective action complete without controls to the New Mexico Environment Department, along with the appropriate site recommendations.

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1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility owned by the U.S. Department of Energy (DOE) and managed by Los Alamos National Security, LLC (LANS). The Laboratory is located in north-central New Mexico, approximately 60 mi northeast of Albuquerque and 20 mi northwest of Santa Fe. The Laboratory site covers 36 mi^2 of the Pajarito Plateau, which consists of a series of fingerlike mesas separated by deep canyons that contain perennial and intermittent streams running from west to east. Mesa tops range in elevation from approximately 6200 to 7800 ft.

The Laboratory is participating in a national effort by DOE to clean up sites and facilities formerly involved in weapons research and development. The Laboratory's goal is to ensure that past operations do not threaten human or environmental health and safety in and around Los Alamos County. To achieve this goal, the Laboratory is currently investigating sites potentially contaminated by past operations; the sites under investigation are designated as solid waste management units (SWMUs) or areas of concern (AOCs).

This report is a supplement to Revision 1 of the remedy completion report for the Upper Los Alamos Canyon Aggregate Area, which is associated with former Technical Area 32 (TA-32) (LANL 2011, 111806.23). Revision 1 of the report described the accelerated corrective action (ACA) activities conducted in 2010 to complete the remediation and investigation of two SWMUs [32-002(a) and 32-002(b)] and two AOCs (32-003 and 32-004) associated with former TA-32. Figure 1.0-1 shows the location of Upper Los Alamos Canyon Aggregate Area and former TA-32 with respect to the Laboratory.

The SWMUs addressed in this supplemental remedy completion report are potentially contaminated with both hazardous and radioactive components. The New Mexico Environment Department (NMED), pursuant to the New Mexico Hazardous Waste Act, regulates cleanup of hazardous wastes and hazardous components of mixed waste. DOE regulates cleanup of radioactive contamination, pursuant to DOE Order 458.1, Administrative Change 2, Radiation Protection of the Public and the Environment, and DOE Order 435.1, Radioactive Waste Management. Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily levels (SALs) for radionuclide COPCs were deriv

1.1 Purpose of Supplemental Remedy Completion Report

Portions of former TA-32 are located on property currently owned by Los Alamos County and the Los Alamos School Board. The two SWMUs and two AOCs addressed in the remedy completion report (LANL 2011, 111806.23) are located both on Los Alamos School Board property and on DOE property. The 2010 ACA was performed to accelerate investigation and remediation of the former TA-32 sites in advance of the remainder of the Upper Los Alamos Canyon Aggregate Area sites, thereby allowing Los Alamos County to proceed with development of former TA-32. The remedy completion report presented the following conclusions with respect to the two SWMUs and two AOCs:

- SWMU 32-002(a)—The vertical extent of contamination was not defined at several locations for several inorganic chemicals. Because extent of contamination was not defined, risk evaluations were not performed.
- SWMU 32-002(b)—The nature and extent of contamination were defined, and the site posed no unacceptable human health risk under the industrial, construction worker, recreational, and residential scenarios. The site potentially posed risk to ecological receptors from contamination on the DOE-owned portion of the site.

- AOC 32-003—The nature and extent of contamination were defined, and the site posed no unacceptable human health risk under the industrial, construction worker, recreational, and residential scenarios. The site posed no unacceptable risk to ecological receptors.
- AOC 32-004—The nature and extent of contamination were defined, and the site posed no unacceptable human health risk under the industrial, construction worker, and recreational scenarios. The site posed no unacceptable risk to ecological receptors.

Based on the conclusions of the remedy completion report, no additional investigation or remediation activities were necessary at AOCs 32-003 and 32-004. Additional sampling was necessary to define the vertical extent at SWMU 32-002(a), and additional characterization of contamination potentially presenting an ecological risk was needed for SWMU 32-002(b). The additional sampling and characterization were performed in 2011 as part of the ongoing Upper Los Alamos Canyon Aggregate Area Phase II investigations. Additional sampling performed at SWMU 32-002(a) indicated that the vertical extent of contamination was defined for this site. The additional sampling performed at SWMU 32-002(b) indicated additional remediation activities may be needed on the DOE-owned portion of the site. To expedite completion of corrective actions on the portion of SWMU 32-002(b) located on property owned by the Los Alamos School Board, DOE and LANS submitted a permit modification request to NMED to split SWMU 32-002(b) into two new SWMUs, one on the Los Alamos School Board property [designated as SWMU 32-002(b1)] and one on DOE property [designated as SWMU 32-002(b2)] (DOE 2012, 232356). Corrective actions at SWMU 32-002(b2) will be completed at a later date and reported in the Phase II investigation report for Upper Los Alamos Canyon Aggregate Area.

This supplemental remedy completion report updates the previous remedy completion report (LANL 2011, 111806.23) to present and evaluate the extent of contamination using additional sampling results and to assess risk at SWMU 32-002(a) and to evaluate the nature and extent of contamination and risk at the new SWMU 32-002(b1). Because no additional investigation activities are needed at AOCs 32-003 or 32-004, they are not included in this supplemental report.

The Revision 1 of the remedy completion report for Upper Los Alamos Canyon Aggregate Area, former TA-32 (LANL 2011, 111806.23) presents the results of an ACA that was performed in accordance with an approved ACA work plan (LANL 2009, 108332; NMED 2010, 108455). As directed by Section VII.F.4 of Compliance Order on Consent (the Consent Order), the ACA results were presented in a remedy completion report. Pursuant to Section VII.E.6.a of the Consent Order, the remedy completion report contained registered professional engineer and owner-operator certifications. The additional investigation activities at SWMU 32-002(a) described in this report were specified in an approved Phase II investigation work plan (LANL 2010, 110860; NMED 2011, 111674) and not in an ACA work plan. Therefore, the certification requirements of Consent Order Section VII.E.6.a are not applicable to this supplemental remedy completion report. The results for SWMU 32-002(b1) presented in this report were previously reported in the certified remedy completion report for former TA-32 (LANL 2011, 111806.23).

1.2 Document Organization

Section 2 of this report presents the site description and operational history for each site. Section 3 presents the regulatory criteria and target cleanup levels for the sites. The supplemental investigation activities for each site are presented in section 4, along with analytical results and risk-screening results. Sections 5 and 6 present conclusions and recommendations, respectively, based on the results presented in this supplemental report and the previous remedy completion report (LANL 2011, 111806.23). The references cited in this supplemental report and the map data sources are listed in section 7.

Appendix A contains a list of acronyms and abbreviations used in this report, a metric conversion table, and a data qualifier definition table. Appendix B summarizes the field methods used during the additional sampling and characterization performed in 2011 at SWMU 32-002(a). Appendix C provides the analytical results of the samples collected during the supplemental investigation activities at SWMU 32-002(a) as well as the samples collected from previous investigations that are evaluated in this report. Appendix D presents the analytical program implemented for chemical analysis and data quality control of samples collected during the supplemental investigation activities at SWMU 32-002(a). Appendix E presents the box plots and the results of statistical tests for SWMU 32-002(b1). Appendix F presents the risk-screening assessments for SWMUs 32-002(a) and 32-002(b1). Appendix G describes the storage and disposal of investigation-derived waste (IDW) from the additional sampling and characterization performed in 2011 at SWMU 32-002(a).

1.3 Data Review

Data discussed in this supplemental report are the analytical results from samples collected during the additional investigation conducted at SWMU 32-002(a) and the investigations described in Revision 1 of the remedy completion report (LANL 2011, 111806.23). Samples were shipped through the Sample Management Office to off-site contract laboratories for analyses and are accompanied by full chain-of-custody and quality documentation. The resulting data are decision-level data and are used to determine the nature and extent of contamination, calculate exposure point concentrations, and conduct risk-screening assessments. Analytical data packages, sample collection logs, and chain-of-custody forms for all samples collected at SWMUs 32-002(a) and 32-002(b1) are provided in Appendix C (on DVD included with this document). The data obtained in 2011 at SWMU 32-002(a) and during previous investigations at SWMUs 32-002(a) and 32-002(b1) are also provided in Appendix C. The analytical methods used and the data-quality assessments, including assignment of data qualifiers, for the additional investigation samples at SWMU 32-002(a) are presented in Appendix D. The data qualifiers are defined in Appendix A.

1.3.1 Identification of Chemicals of Potential Concern

Inorganic chemicals of potential concern (COPCs) are identified by comparing site data with background values (BVs) (LANL 1998, 059730) or are based on detection status if no BVs are available. Organic chemicals are identified as COPCs based on detection status. Radionuclides are identified as COPCs based on comparisons to BVs or fallout values (FVs) or are based on detection status if no BVs or FVs are available.

Media associated with samples evaluated in this report include soil (all soil horizons, designated by the media code SOIL) and Bandelier Tuff (media codes QBT3 and QBT4). For inorganic chemicals, data are evaluated by sample media to facilitate the comparison with media-specific background data. Background data are generally available for soil, sediment, and tuff (LANL 1998, 059730). However, some analytes (e.g., nitrate, perchlorate, and hexavalent chromium) have no BVs. A BV may be either a calculated value from the background data set (upper tolerance limit or the 95% upper confidence bound on the 95th quantile) or a detection limit (DL). When a BV is based on a DL, there is no corresponding background data set for that analyte/media combination.

To identify inorganic COPCs, the first step is to compare the sample result with the BV, if available. If sample results are above BVs and sufficient data are available (10 or more sample results), statistical tests are used to compare the site sample data with the background data set for the appropriate media, if available. If statistical tests cannot be performed because of insufficient data (less than 10 samples) or a high percentage of nondetects, the sample results are compared with the BV and/or the maximum background concentration of the chemical in the appropriate media. If sample results are above the BV

and/or maximum background concentration, the chemical is identified as a COPC. The same evaluation is performed using sample DLs when a constituent is not detected but has DLs above the BV. If no BV is available, detected inorganic chemicals are identified as COPCs.

Radionuclides are identified as COPCs based on comparisons to BVs for naturally occurring radionuclides or to FVs for fallout radionuclides. Isotopic thorium and isotopic uranium are naturally occurring radionuclides. Americium-241, cesium-137, plutonium-238, plutonium-239/240, strontium-90, and tritium are fallout radionuclides. FVs apply to surface soil (0 to 1 ft below ground surface [bgs]), so fallout radionuclides detected below 1 ft bgs are identified as COPCs. Fallout radionuclides in tuff are also identified as COPCs based on detection status.

The FV for tritium in surface soil (LANL 1998, 059730) is in units of picocuries per milliliter. When this FV is used, sample percent moisture must be used to convert sample tritium data from picocuries per gram, as provided by analytical laboratories, to the corresponding values in units of picocuries per milliliter. Because sample percent moisture historically has been determined using a variety of methods that were often undocumented, the Laboratory has adopted the conservative approach of identifying tritium in soil as a COPC based on detection status.

1.3.2 Overview of Statistical Methods

A variety of statistical methods may be applied to each of the data sets but generally include distributional comparisons and box plots comparing site data with background data. In cases where no background data are available, fewer than 10 samples were analyzed for a specific constituent, or more than 80% of the site samples and background samples are nondetects, statistical tests are not valid. In such cases, COPC identification is based on detection status, direct comparison to the BV or FV (if one is available), and subsequent comparison to the maximum background concentration if it is greater than the BV or FV. If no BV or FV is available, the constituent is identified as a COPC if it is detected in any samples at the site.

Comparisons between site data sets and the Laboratory background data sets are performed using statistical methods. All comparisons begin with a simple comparison of site-specific data to media-specific BVs or FVs (LANL 1998, 059730). The BV/FV comparisons are followed, when appropriate, by statistical tests that evaluate potential differences between the distributions. These tests are used for testing hypotheses about data from two potentially different distributions (e.g., a test of the hypothesis that site concentrations are different from background levels).

Nonparametric tests that are most commonly performed include the two-sample Wilcoxon Rank Sum test (the Wilcoxon test), the Gehan test (modification of the Wilcoxon test), and the quantile test (Gehan 1965, 055611; Gilbert and Simpson 1990, 055612). The Gehan test is best suited for assessing complete shifts in distributions, and accounts for nondetected concentrations at multiple DLs in a statistically robust manner. If the data have no nondetected concentrations, the Gehan test is equivalent to the Wilcoxon test. The quantile test is better suited for assessing shifts of a subset of the data. Most types of differences between distributions can be identified. Occasionally, if the differences between two distributions appear to occur far into the tails, the slippage test might be performed. This test evaluates the potential for some of the site data to be greater than the maximum concentration in the background data set if, in fact, the site data and background data came from the same distribution.

Observed significance levels (p-values) are obtained from the Gehan, quantile, or slippage tests. If a p-value is less than a specified probability (e.g., 0.05, a nominal significance level), then there is some reason to suspect that a difference exists between the distributions. If the p-value is greater than 0.05, no difference is indicated. The standard set of tests is run whenever the detection rate for both the site data

set and the Laboratory background data set is greater than 50%; if there are fewer than 50% detections in either set, then the Gehan test is not applicable. If all sample data are nondetects, statistical tests are not performed.

Paired tests are used to test whether site data are different from background. Specifically, the Gehan test (or the Wilcoxon Rank Sum test if all sample results are detects) is the preferred initial test. If the result of the Gehan test indicates that the site data are not different from background (i.e., $p > 0.05$), the quantile test is performed. Site data must pass (i.e., $p > 0.05$) both tests to eliminate an inorganic chemical as a COPC. If the p-value from either the Gehan (or Wilcoxon) or the quantile test is less than 0.05, the constituent is identified as a COPC for the specific medium tested. If the Gehan test is not applicable because either the site or background data set includes more than 50% nondetects, the quantile test is performed first. If the p-value from the quantile test is >0.05, the slippage test is performed next. Again, the p-value from both tests must be >0.05 to eliminate an inorganic chemical as a COPC. If the p-value from the first test is <0.05, indicating the site data are different from background, the second test does not need to be performed, and the inorganic chemical is identified as a COPC. Results of statistical tests performed for SWMU 32-002(b1) are presented in Appendix E. Statistical tests performed for SWMU 32-002(a) are presented in the Upper Los Alamos Canyon Aggregate Area investigation report (LANL 2010, 108528).

Box plots provide a visual representation of the data and may identify the presence of outliers or other anomalous data that might affect statistical results and interpretations. The plots allow a visual comparison between site and background concentration distributions. The plots are generally used in conjunction with the statistical tests (distributional comparisons) described above. A box plot consists of a box, a line across the box, whiskers (lines extended beyond the box and terminated with a short perpendicular line), and points outside the whiskers. The box area of the plot is the region between the 25th percentile and the 75th percentile of the data, which is the interquartile range or middle half of the data. The horizontal line within the box represents the median (50th percentile) of the data. The whiskers give an interval of 1.5 times the interquartile range, outside of which data may be evaluated for their potential to be outliers. The concentrations of individual samples are plotted as points overlaying the box plot. When a data set contains both detected and nondetected concentrations reported as DLs, the detected concentrations are plotted as Xs, and the nondetected concentrations are plotted as Os. The medium-specific BV is also illustrated by a dashed line in each box plot. Box plots for SWMU 32-002(b1) are presented in Appendix E. Box plots for SWMU 32-002(a) are presented in the Upper Los Alamos Canyon Aggregate Area investigation report (LANL 2010, 108528).

2.0 BACKGROUND

Former TA-32 was occupied by the medical research facility from 1944 to 1953 when operations were moved to TA-43 as the research group expanded. All the Laboratory structures at former TA-32 have been removed. Currently, the mesa-top portion of former TA-32 is owned by Los Alamos County and the Los Alamos School Board. The area was used by Los Alamos County to store equipment and materials for road work and maintenance but is currently being developed.

Two sites are addressed in this supplemental report: two septic systems that served former buildings 32-01 and 32-02 [SWMUs 32-002(a) and 32-002(b1)]. These two sites are shown on Plate 1.

2.1 SWMU 32-002(a)

2.1.1 Site Description and Operational History

SWMU 32-002(a) is a former septic system that served former building 32-01 (Plate 1). In 1944, the septic system was installed south of building 32-01 on the edge of Los Alamos Canyon. The septic system consisted of a wood-frame tank (former structure 32-07) measuring 4 ft × 8 ft × 4 ft, an influent line from building 32-01, and an outlet drainline that discharged to the edge of Los Alamos Canyon. Former building 32-01 operated as a research laboratory from 1944 to 1954. Research activities involved plutonium-238, plutonium-239, americium-241, and carbon-14. Inorganic and organic chemicals also may have been used at the facility. Because no industrial waste line served former TA-32, it is possible chemical and radioactive wastes were disposed of in sinks and drains connected to the SWMU 32-002(a) septic system. Former TA-32 was decommissioned in 1954. The septic tank was removed before 1996 (LANL 1996, 059178), but no historical records are available documenting the removal date or disposition of the tank. The drainlines were removed during a 1996 voluntary corrective action (LANL 1996, 059178).

2.1.2 Summary of Previous Investigations

Historical investigation and remediation activities conducted at SWMU 32-002(a) are presented in Revision 1 of the remedy completion report (LANL 2011, 111806.23). Revision 1 concluded that further investigation was needed to define the vertical extent of inorganic chemicals at SMWU 32-002(a) as follows:

- aluminum, barium, beryllium, copper, lead, and nickel at sampling location 00-603582
- aluminum, barium, and copper at sampling location 00-603585
- chromium and nickel at sampling location 32-06372

Additional sampling to address the data needs was proposed in the Phase II investigation work plan for the Upper Los Alamos Canyon Aggregate Area (LANL 2010, 110860). NMED approved the Phase II investigation work plan with modifications (NMED 2011, 111674). NMED's approval requested that the Laboratory also analyze samples from locations 00-603582 and 00-603585 for chromium and nickel to define the vertical extent at nearby locations 00-603586, 00-603588, and 00-603596.

2.2 SWMU 32-002(b1)

2.2.1 Site Description and Operational History

SWMU 32-002(b1) is part of a former septic system that served former buildings 32-01 and 32-02 (Plate 1). SWMU 32-002(b1) is the portion of the former septic system that is located on property currently owned by the Los Alamos School Board. The remainder of the septic system is located on property owned by DOE and is designated as SMWU 32-002(b2). The septic system was installed directly northwest and slightly upgradient of the SWMU 32-002(a) septic tank, near the edge of Los Alamos Canyon. This system was installed when the SWMU 32-002(a) septic system could no longer meet the usage requirement of the laboratory (building 32-01) and consisted of a reinforced concrete tank (former structure 32-08) measuring 9 ft × 5 ft × 6 ft with an outlet drainline that discharged to an outfall at the edge of Los Alamos Canyon. The influent line from the SWMU 32-002(a) septic system was diverted to the former SWMU 32-002(b) septic system, which also received effluent from former building 32-02, the medical research annex. The outfall was located at the edge of Los Alamos Canyon, approximately 15 ft southwest of the SWMU 32-002(a) outfall. The septic tank was removed in 1988, and the influent drainline was removed in 1996.

Research activities in former building 32-01 involved radionuclides. Inorganic and organic chemicals may also have been used. Because no industrial waste line served former TA-32, it is possible chemical and radioactive wastes may have been disposed of in sinks and drains connected to the septic system at SWMU 32-002(b1).

2.2.2 Summary of Previous Investigations

Former SWMU 32-002(b) was split into two new SWMUs [32-002(b1) and 32-002(b2)] in December 2012 to expedite completion of corrective actions on the portion of the site owned by the Los Alamos School Board (DOE 2012, 232356). Previous investigations, therefore, were performed for SWMU 32-002(b) and included collection of samples on both Los Alamos School Board and DOE property. Historical investigation and remediation activities conducted at SWMU 32-002(b) are presented in Revision 1 of the remedy completion report (LANL 2011, 111806.23). Revision 1 concluded that further evaluation is needed at SWMU 32-002(b) because elevated mercury concentrations were detected in the 1996 samples, resulting in an potential ecological risk for the earthworm as well as concentrations in excess of the residential soil screening level (SSL). These locations, which are on DOE property, were resampled to confirm the presence of mercury at elevated levels. The subsequent sampling performed at SWMU 32-002(b) indicates additional sampling and remediation activities will be needed on the DOE-owned portion of the site [SWMU 32-002(b2)]. Corrective actions at SWMU 32-002(b2) will be completed at a later date and reported in the Phase II investigation report for Upper Los Alamos Canyon Aggregate Area.

3.0 REGULATORY CRITERIA AND TARGET CLEANUP LEVELS

3.1 Current and Future Land Use

Former TA-32 is located within the Los Alamos townsite. Los Alamos County and the Los Alamos School Board own the mesa-top portion of former TA-32. The area was recently used by Los Alamos County to store equipment and materials for road work and maintenance. The County demolished all structures at the site in 2010 and is currently developing the area for commercial use. The industrial scenario is applicable to this property currently and for the foreseeable future.

DOE owns the land south of the mesa top. The location of the TA-32 SWMUs and AOCs is within the boundary of the Laboratory in current TA-41. Based on the location of these sites within an active TA, the industrial scenario is also applicable currently and for the foreseeable future.

3.2 Screening Levels and Cleanup Standards

The industrial SSLs from NMED guidance (NMED 2012, 219971) were used for human health risk-screening levels for nonradionuclide COPCs. The SSLs are based on a target hazard quotient (HQ) of 1 or a target cancer risk of 1×10^{-5} (NMED 2012, 219971). For COPCs for which no NMED value is available, U.S. Environmental Protection Agency (EPA) regional screening levels (available at http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm) were used. The EPA screening levels for carcinogens were multiplied by 10 to adjust to the NMED target cancer risk of 1×10^{-5}. Exposure parameters used to calculate the SSLs are presented in Appendix F, Table F-4.1-1.

Screening action levels (SALs) for radionuclide COPCs were derived using the residual radioactive (RESRAD) model, Version 6.5 (LANL 2009, 107655). The radionuclide SALs are based on a 15 mrem/yr dose per DOE guidance (Soden 2000, 067489). Exposure parameters used to calculate the SALs are

provided in Appendix F, Table F-4.1-2. The industrial SSLs and SALs are included in the analytical data tables for each site.

The ecological risk-screening assessments (Appendix F) were conducted using ecological screening levels (ESLs) obtained from the ECORISK Database, Version 3.1 (LANL 2012, 226667). The ESLs are based on similar species and are derived from experimentally determined no observed adverse effect levels, lowest observed adverse effect levels (LOAELs), or doses determined lethal to 50% of the test population. Information relevant to the calculation of ESLs, including concentration equations, dose equations, bioconcentration factors, transfer factors, and toxicity reference values, are presented in the ECORISK Database, Version 3.1 (LANL 2012, 226667).

3.3 Cleanup Goals

As specified in Section VIII.B.1 of the Consent Order, SSLs will be used as soil cleanup levels unless they are determined to be impracticable or values do not exist for the current and reasonably foreseeable future land use. Screening assessments compare COPC concentrations for each site with SSLs depending on the current and foreseeable future land use at each site.

The cleanup goals specified in Section VIII of the Consent Order are a target cancer risk of 1×10^{-5} and a hazard index (HI) of 1. For radionuclides, the target dose is 15 mrem/yr based on DOE guidance (Soden 2000, 067489).

4.0 SUPPLEMENTAL SITE INVESTIGATION ACTIVITIES

Supplemental investigation activities included collection of samples at SWMU 32-002(a) needed to define the vertical extent of contamination. As described in section 2.1.2, this sampling was proposed in the Phase II investigation work plan for Upper Los Alamos Canyon Aggregate Area (LANL 2010, 110860) and was performed in June 2011. During field screening, no organic vapors were detected above ambient air, and no radiological screening results exceeded twice the daily site background levels. Field-screening results for samples collected at SWMU 32-002(a) were recorded in the sample collection logs (SCLs) and are presented in Table 4.0-1. No changes to sampling or other activities occurred based on field-screening results. Appendix B summarizes the field methods used during the supplemental investigation sampling conducted at SWMU 32-002(a). Analytical results, data reports, SCLs, and chain-of-custody (COC) forms for all samples associated with SWMU 32-002(a) are provided in Appendix C (on DVD). The analytical program for the additional samples is summarized in Appendix D.

SWMU 32-002(b1) was created in December 2012 when former SWMU 32-002(b) was split into two new SWMUs. SWMU 32-002(b1) consists of that portion of former SWMU 32-002(b) located on property currently owned by the Los Alamos School Board. As described in section 2.2.2, previous investigations were conducted at former SWMU 32-002(b). The investigation of SWMU 32-002(b1), therefore, consists of evaluating the data previously collected for SWMU 32-002(b) from sampling locations located on Los Alamos School Board property to define the nature and extent of contamination and to evaluate potential risk and dose for SWMU 32-002(b1).

No additional sampling was performed at SWMU 32-002(b1). Appendixes B, C, and D of Revision 1 of the remedy completion report (LANL 2011, 111806.23) include the field methods, analytical results, data reports, SCLs, COC forms, and the analytical program for SWMU 32-002(b), which includes the data now associated with SWMU 32-002(b1) and evaluated in this supplemental remedy completion report. Analytical results, data reports, SCLs, and COC forms associated with SWMU 32-002(b1) are provided in Appendix C (on DVD).

4.1 SWMU 32-002(a)

4.1.1 Sampling Activities

In 2011, six subsurface samples were collected from three existing sampling locations (00-603582, 00-603585, and 32-06372) to define the vertical extent of aluminum, barium, beryllium, chromium, copper, lead, and/or nickel at these locations. Two samples were collected at each location at deeper depths. Samples from location 00-603582 were analyzed for aluminum, barium, beryllium, chromium, copper, lead, and nickel. Samples from location 00-603585 were analyzed for aluminum, barium, chromium, copper, and nickel. Samples from location 32-06372 were analyzed for chromium and nickel.

Sampling results from location 00-603585 are also used to define the vertical extent of nickel and chromium at nearby locations 00-603586, 00-603588, and 00-603596, which are within approximately 10 ft of location 00-603585.

4.1.2 Sample Analytical Results

The samples collected in 1996, 2008, 2010, and 2011 and the analyses requested are presented in Table 4.1-1. The samples were collected from depths ranging from 0 to 15 ft bgs. Plate 1 shows the sampling locations.

Inorganic Chemicals

Table 4.1-2 presents the results of inorganic chemicals above BVs, detected inorganic chemicals that have no BVs, and nondetected inorganic chemicals with DLs above BVs. Plate 2 shows the sampling locations and inorganic chemicals detected or detected above BVs.

The six samples collected in 2011 were analyzed for the metals identified above. Barium, beryllium, copper, lead, and nickel were detected above BVs in one or both of the samples collected at location 00-603582 in 2011 (Table 4.1-2). The results indicated that none of the inorganic chemicals were detected above BVs at locations 00-603585 and 32-06372 (Table 4.1-2).

Organic Chemicals

Table 4.1-3 presents the results of the detected organic chemicals. Plate 3 shows the sampling locations and the detected organic chemicals.

Because the nature and extent of organic chemicals are defined at SWMU 32-002(a) (LANL 2010, 111806.23, pp. F-190), the samples collected in 2011 were not analyzed for organic chemicals.

Radionuclides

Table 4.1-4 presents the results of the radionuclides detected or detected above BVs/FVs. The sampling locations and the radionuclides detected or detected above BVs/FVs are shown on Plate 4.

Because the nature and extent of radionuclides are defined at SWMU 32-002(a) (LANL 2010, 108528, pp. F-190–F-191), the samples collected in 2011 were not analyzed for radionuclides.

Summary of COPCs at SWMU 32-002(a)

Inorganic chemicals detected above BVs or that had DLs above BVs in the samples collected in 2011 do not change the inorganic COPCs identified in Revision 1 of the remedy completion report (LANL 2011, 111806.23, p. 11). The inorganic COPCs are antimony, barium, beryllium, cadmium, chromium, copper, total cyanide, lead, mercury, nickel, nitrate, perchlorate, selenium, silver, sodium, thallium, and zinc.

The organic COPCs are identified in Revision 1 of the remedy completion report (LANL 2011, 111806.23, p. 11) and include acenaphthene; acetone; anthracene; Aroclor-1260; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; bis(2-ethylhexyl)phthalate; butylbenzylphthalate; carbazole; chrysene; dibenz(a,h)anthracene; dibenzofuran; dichlorodifluoromethane; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; methylene chloride; naphthalene; phenanthrene; pyrene; trichlorofluoromethane; and dioxins and furans, including 1,2,3,4,6,7,8-heptachlorodibenzodioxin; total heptachlorodibenzodioxins; 1,2,3,4,6,7,8-heptachlorodibenzofuran; 1,2,3,4,7,8,9-heptachlorodibenzofuran; total heptachlorodibenzofurans; 1,2,3,4,7,8-hexachlorodibenzodioxin; 1,2,3,6,7,8-hexachlorodibenzodioxin; 1,2,3,7,8,9-hexachlorodibenzodioxin; total hexachlorodibenzodioxins; 1,2,3,4,7,8-hexachlorodibenzofuran; 1,2,3,6,7,8-hexachlorodibenzofuran; 2,3,4,6,7,8-hexachlorodibenzofuran; total hexachlorodibenzofurans; 1,2,3,4,6,7,8,9-octachlorodibenzodioxin; 1,2,3,4,6,7,8,9-octachlorodibenzofuran; 1,2,3,7,8-pentachlorodibenzodioxin; total pentachlorodibenzodioxins; 1,2,3,7,8-pentachlorodibenzofuran; 2,3,4,7,8-pentachlorodibenzofuran; total pentachlorodibenzofurans; total tetrachlorodibenzodioxins; 2,3,7,8-tetrachlorodibenzofuran; and total tetrachlorodibenzofurans.

The radionuclide COPCs are identified in Revision 1 of the remedy completion report and include cesium-137, plutonium-238, plutonium-239/240, tritium, and uranium-235/236 (LANL 2011, 111806.23, p. 11).

4.1.3 Nature and Extent of Contamination

Inorganic Chemicals

Revision 1 of the remedy completion report indicated the nature and extent of inorganic chemicals were defined, except for the vertical extent of aluminum, barium, beryllium, chromium, copper, lead, and/or nickel at six locations. As specified in the approved Phase II investigation work plan for Upper Los Alamos Canyon Aggregate Area (LANL 2010, 110860; NMED 2011, 111674), deeper samples were collected at three existing locations (00-603582, 00-603585, and 32-06372) to define the vertical extent of aluminum, barium, beryllium, chromium, copper, lead, and/or nickel at these and three other locations.

Based on the results of previous investigations, the vertical extent of aluminum was not defined at locations 00-603582 and 00-603585. Aluminum was not detected above the Qbt 2,3,4 BV in the deeper samples collected in 2011 at locations 00-603582 and 00-603585. Therefore, the vertical extent of aluminum is defined at locations 00-603582 and 00-603585.

Based on the results of previous investigations, the vertical extent of barium was not defined at locations 00-603582 and 00-603585. Concentrations of barium in 2011 samples decreased with depth at location 00-603582. Barium was not detected above the Qbt 2,3,4 BV in 2011 samples at location 00-603585. Therefore, the vertical extent of barium is defined at locations 00-603582 and 00-603585.

Based on the results of previous investigations, the vertical extent of beryllium was not defined at location 00-603582. Concentrations of beryllium decreased with depth in 2011 samples at location 00-603582. Therefore, the vertical extent of beryllium is defined at location 00-603582.

Based on the results of previous investigations, the vertical extent of chromium was not defined at locations 00-603582, 00-603585, 00-603586, 00-603588, 00-603596, and 32-06372. Chromium was not detected above the Qbt 2,3,4 BV in 2011 samples at locations 00-603582, 00-603585, and 32-06372. Locations 00-603586, 00-603588, and 00-603596 are sited within approximately 10 ft of location 00-603585, and the 2011 results from location 00-603585 are used to define vertical extent at these locations. Therefore, the vertical extent of chromium is defined at locations 00-603582, 00-603585, 00-603586, 00-603588, 00-603596, and 32-006372.

Based on the results of previous investigations, the vertical extent of copper was not defined at locations 00-603582 and 00-603585. Concentrations of copper decreased with depth in 2011 samples at location 00-603582, and copper was not detected above the Qbt 2,3,4 BV in 2011 samples at location 00-603585. Therefore, the vertical extent of copper is defined at locations 00-603582 and 00-603585.

Based on the results of previous investigations, the vertical extent of lead was not defined at location 00-603582. Concentrations of lead decreased with depth in 2011 samples at location 00-603582. Therefore, the vertical extent of lead is defined at location 00-603582.

Based on the results of previous investigations, the vertical extent of nickel was not defined at locations 00-603582, 00-603585, 00-603586, 00-603588, 00-603596, and 32-06372. Concentrations of nickel decreased with depth in 2011 samples at location 00-603582. Nickel was not detected above the Qbt 2,3,4 BV in 2011 samples at locations 00-603585 and 32-06372. Locations 00-603586, 00-603588, and 00-603596 are sited within approximately 10 ft of location 00-603585, and the 2011 results from location 00-603585 are used to define vertical extent at these locations. Therefore, the vertical extent of nickel is defined at locations 00-603582, 00-603585, 00-603586, 00-603588, 00-603596, and 32-06372.

Organic Chemicals

Based on the results of the 2008–2009 Upper Los Alamos Canyon Aggregate Area investigation, the nature and extent of organic chemicals are defined for SWMU 32-002(a) (LANL 2010, 108528, p. F-190). No additional evaluation of organic chemicals was performed as part of the additional sampling at SWMU 32-002(a).

Radionuclides

Based on the results of the 2008–2009 Upper Los Alamos Canyon Aggregate Area investigation, nature and extent of radionuclides are defined for SWMU 32-002(a) (LANL 2010, 108528, p. F-191). No additional evaluation of radionuclides was performed as part of the additional sampling at SWMU 32-002(a).

4.1.4 Summary of Human Health Risk Screening

The human health risk-screening assessments are presented in section F-4.2.1 in Appendix F.

Industrial Scenario

The total excess cancer risk is approximately 2×10^{-7}, which is less than the NMED target cancer risk level of 1×10^{-5}. The HI is approximately 0.08, which is less than the NMED target HI of 1. The total dose is approximately 1 mrem/yr, which is less than the DOE target dose limit of 15 mrem/yr.

Based on the risk-screening assessment results, no potential unacceptable risks or dose exists at SWMU 32-002(a) for the industrial scenario.

4.1.5 Summary of Ecological Risk Screening

The ecological risk-screening assessments are presented in sections F-5.3 and F-5.4 in Appendix F.

No potential ecological risks exist for any receptor at SWMU 32-002(a) based on minimum ESL comparisons, HI analyses, potential effects to populations (individuals for threatened and endangered [T&E] species), and LOAEL analysis.

4.2 SWMU 32-002(b1)

4.2.1 Sampling Activities

No additional samples were collected at SWMU 32-002(b1) in 2011. The samples previously collected for former SWMU 32-002(b) from locations on property owned by the Los Alamos School Board are used to evaluate the nature and extent of contamination and potential risk at SWMU 32-002(b1).

4.2.3 Sample Analytical Results

The samples collected in 1996, 2008, and 2010 and the analyses requested are presented in Table 4.2-1. The samples were collected from depths ranging from 3.5 to 10 ft bgs. Plate 1 shows the sampling locations.

Inorganic Chemicals

Table 4.2-2 presents the results of inorganic chemicals above BVs, detected inorganic chemicals that have no BVs, and nondetected inorganic chemicals that have DLs above BVs. Plate 5 shows the sampling locations and inorganic chemicals detected or detected above BVs.

Organic Chemicals

Table 4.2-3 presents the results of the detected organic chemicals. Plate 6 shows the sampling locations and the detected organic chemicals.

Radionuclides

Table 4.2-4 presents the results of the radionuclides detected or detected above BVs/FVs. The sampling locations and the radionuclides detected or detected above BVs/FVs are shown on Plate 4.

Summary of COPCs at SWMU 32-002(b1)

The inorganic COPCs previously identified in Revision 1 of the remedy completion report are antimony, arsenic, barium, chromium, copper, total cyanide, lead, mercury, nickel, nitrate, selenium, silver, thallium, and zinc (LANL 2011, 111806.23, pp. 14–17). These COPCs were reevaluated to determine if background comparisons and statistical analyses would add or eliminate COPCs for SWMU 32-002(b1). Arsenic had no concentrations above the Qbt 2,3,4 BV in the samples at SWMU 32-002(b1). Cyanide had DLs slightly above the Qbt 2,3,4 BV in two samples (0.59 mg/kg and 0.58 mg/kg compared with 0.5 mg/kg), and no other DLs were above the BV. The results of the Gehan and the quantile tests indicate the site data are not different from background for zinc. Based on this analysis, arsenic, cyanide, and zinc are not COPCs at SWMU 32-002(b1). The results of statistical comparisons of site data to background data and box plots for inorganic chemicals are provided in Appendix E.

The organic COPCs previously identified in Revision1 of the Upper Los Alamos Canyon Aggregate Area Investigation Report (LANL 2010, 108528, p. F-198) are Aroclor-1260; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; benzoic acid; bis(2-ethylhexyl)phthalate; butylbenzylphthalate; chrysene; dibenz(a,h)anthracene; di-n-butylphthalate; fluoranthene; indeno(1,2,3-cd)pyrene; methylene chloride; phenanthrene; pyrene; tetrachloroethane; trichlorofluoromethane; and dioxins and furans (1,2,3,4,6,7,8-heptachlorodibenzodioxin; total heptachlorodibenzodioxins; 1,2,3,4,6,7,8-heptachlorodibenzofuran; 1,2,3,4,7,8,9-heptachlorodibenzofuran; 1,2,3,7,8,9-hexachlorodibenzofuran; total heptachlorodibenzofurans; 1,2,3,4,7,8-hexachlorodibenzodioxin; 1,2,3,6,7,8-hexachlorodibenzodioxin; 1,2,3,7,8,9-hexachlorodibenzodioxin; total hexachlorodibenzodioxins; 1,2,3,4,7,8-hexachlorodibenzofuran; 1,2,3,6,7,8-hexachlorodibenzofuran; 2,3,4,6,7,8-hexachlorodibenzofuran; total hexachlorodibenzofurans; 1,2,3,4,6,7,8,9-octachlorodibenzodioxin; 1,2,3,4,6,7,8,9-octachlorodibenzofuran; 1,2,3,7,8-pentachlorodibenzodioxin; total pentachlorodibenzodioxins; 1,2,3,7,8-pentachlorodibenzofuran; 2,3,4,7,8-pentachlorodibenzofuran; total pentachlorodibenzofurans; total tetrachlorodibenzofurans). A reevaluation of the data indicated that dibenz(a,h)anthracene; 1,2,3,7,8,9-hexachlorodibenzofuran; 1,2,3,7,8-pentachlorodibenzodioxin; total pentachlorodibenzodioxins; 1,2,3,7,8-pentachlorodibenzofuran; and tetrachloroethane were not detected at SWMU 32-002(b1) and therefore are not COPCs for this site.

The radionuclide COPCs previously identified in Revision1 of the Upper Los Alamos Canyon Aggregate Area Investigation Report (LANL 2010, 108528, p. F-198–F-199) are americium-241, cesium-137, plutonium-239/240, strontium-90, tritium, uranium-234, uranium-235, and uranium-238. A reevaluation of the data indicated that americium-241, cesium-137, strontium-90, uranium-234, uranium-235, and uranium-238 were not detected or detected above BV at SWMU 32-002(b1) and therefore are not COPCs for this site.

4.2.4 Nature and Extent of Contamination

Inorganic Chemicals

Based on the information presented in Revision 1 of the remedy completion report , the nature and extent of inorganic chemicals are defined at former SWMU 32-002(b) (LANL 2011, 111806.23, pp. 17–18). Because the footprint of SWMU 32-002(b1) lies entirely within the footprint of former SWMU 32-002(b), the nature and extent of inorganic chemicals are also defined for SWMU 32-002(b1). No additional evaluation of extent of inorganic chemicals was performed at SWMU 32-002(b1) for this supplemental remedy completion report.

Organic Chemicals

Based on the results of the 2008–2009 Upper Los Alamos Canyon Aggregate Area investigation, the nature and extent of organic chemicals are defined at former SWMU 32-002(b) (LANL 2010, 108528, p. F-198). Because the footprint of SWMU 32-002(b1) lies entirely within the footprint of former SWMU 32-002(b), the nature and extent of organic chemicals are also defined for SWMU 32-002(b1). No additional evaluation of extent of organic chemicals was performed at SWMU 32-002(b1) for this supplemental remedy completion report.

Radionuclides

Based on the results of the 2008–2009 Upper Los Alamos Canyon Aggregate Area investigation, the nature and extent of radionuclides are defined for former SWMU 32-002(b) (LANL 2010, 108528, p. F-199). Because the footprint of SWMU 32-002(b1) lies entirely within the footprint of former SWMU 32-002(b), the nature and extent of radionuclides are also defined for SWMU 32-002(b1). No additional evaluation of extent of radionuclides was performed at SWMU 32-002(b1) for this supplemental remedy completion report.

4.2.5 Summary of Human Health Risk Screening

The human health risk-screening assessments are presented in section F-4.2.2 in Appendix F.

Industrial Scenario

SWMU 32-002(b1) consists of a drainline located below the ground surface, which was part of a former septic system. No samples were collected from 0 to 1 ft bgs within this SWMU (samples were collected from 3.5 to 10 ft bgs), so no complete exposure pathways exist for the industrial scenario, and a risk-screening assessment was not performed. As a result, no potential exposure and unacceptable risk or dose related to the industrial scenario exist.

4.2.6 Summary of Ecological Risk Screening

The ecological risk-screening assessments are presented in sections F-5.3 and F-5.4 in Appendix F.

No potential ecological risks exist for any receptor at SWMU 32-002(b1) based on minimum ESL comparisons, HI analyses, potential effects to populations (individuals for T&E species), and LOAEL analysis.

5.0 CONCLUSIONS

5.1 Summary of Nature and Extent of Contamination

The nature and extent of inorganic chemicals, organic chemicals, and radionuclides are defined for SWMU 32-002(a) and 32-002(b1).

5.2 Summary of Risk-Screening Assessments

5.2.1 Human Health

The human health risk-screening assessments indicated no potential unacceptable risks or doses from COPCs under the industrial scenario at SWMUs 32-002(a) and 32-002(b1).

The total excess cancer risk was equivalent to the NMED target risk level of 2×10^{-7} (NMED 2012, 219971) for the industrial scenario at SWMU 32-002(a). The HI was 0.08 for SWMU 32-002(a), which is less than the NMED target HI of 1 (NMED 21012, 219971). The dose was below the DOE target dose of 15 mrem/yr at SWMU 32-002(a). The total equivalent risk was approximately 1×10^{-5} for the industrial scenario.

For SWMU 32-002(b1), no samples were collected from 0 to 1 ft bgs because the drainline is below the ground surface (samples were collected from 3.5 to 10 ft bgs). Therefore, there is no exposure to COPCs at the surface, and no potential risk or dose to an industrial worker.

The Laboratory's as low as reasonably achievable (ALARA) program description states that quantitative ALARA evaluations are not necessary for Laboratory activities that have a potential for annual public exposure less than a 3-mrem total effective dose equivalent individual dose ("Los Alamos National Laboratory Environmental ALARA Program," PD410, p. 7, effective November 8, 2008). The calculated radiation dose for the industrial scenario at SWMU 32-002(a) was 1 mrem/yr. There is no industrial dose for SWMU 32-002(b1) because there is no exposure at 0 to 1 ft bgs. Therefore, radiation exposures to the under the industrial scenario at SWMUs 32-002(a) and 32-002(b1) are ALARA.

5.2.2 Ecology

No potential ecological risks were found to any receptor at SWMUs 32-002(a) and 32-002(b1) based on minimum ESL comparisons, HI analyses, potential effects to populations (individuals for T&E species), and LOAEL analyses. These lines of evidence support the conclusion that no potential ecological risks exist at SWMUs 32-002(a) and 32-002(b1) at former TA-32.

6.0 RECOMMENDATIONS

The determination of site status is based on the evaluation of nature and extent and the results of the risk-screening assessments. Depending on the decision scenario used, the sites are recommended as corrective actions complete either with or without controls or for additional action. The residential scenario is the only scenario under which corrective action complete without controls is applicable. Other scenarios (i.e., industrial, recreational, and construction worker) result in corrective action complete with controls. The additional investigation and assessments described in this report were performed with the objective of attaining corrective action complete status for SWMUs 32-002(a) and 32-002(b1) to allow commercial development of property within former TA-32, now owned by the Los Alamos School Board. The appropriate scenario for this proposed land use is industrial. As a result, the industrial scenario was the only scenario evaluated for human health. Based on the results of the extent sampling at SWMU 32-002(a) and the results of the risk-screening assessment for the industrial scenario and ecological risk at both sites, the Laboratory recommends corrective action complete with controls for SWMUs 32-002(a) and 32-002(b1).

Further evaluation of the SWMUs and AOCs within former TA-32 may be performed in the future with the objective of supporting a determination of corrective action complete without controls. At that time, the

Laboratory will submit the results of additional risk evaluations supporting corrective action complete without controls to NMED, along with the appropriate site recommendations.

7.0 REFERENCES AND MAP DATA SOURCES

7.1 References

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

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

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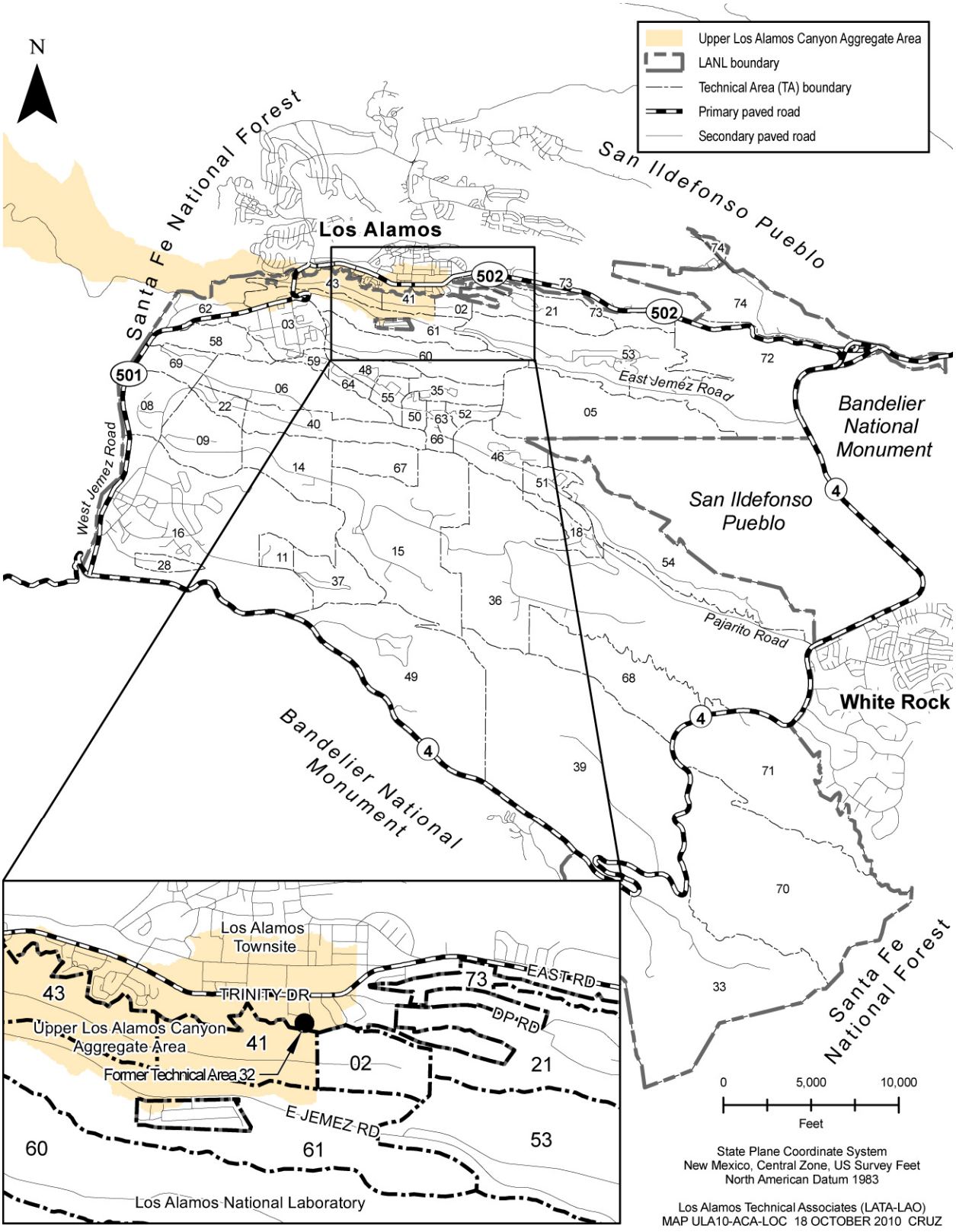


Figure 1.0-1 Location of former TA-32 within the Upper Los Alamos Canyon Aggregate Area

Table 4.0-1
Field-Screening Results for Samples Collected in 2011

SMWU	Location ID	Depth (ft)	Sample ID	PID (ppm)	Alpha (dpm*)	Beta/Gamma (dpm)
32-002(a)	00-603582	9–10	RE32-11-4459	0	39.8	1708
32-002(a)	00-603582	14–15	RE32-11-4460	0	39.8	1708
32-002(a)	00-603585	6–7	RE32-11-4462	0	39.8	1708
32-002(a)	00-603585	9–10	RE32-11-4463	0	39.8	1708
32-002(a)	32-06372	6–7	RE32-11-4465	0	39.8	1708
32-002(a)	32-06372	9–10	RE32-11-4466	0	39.8	1708

Note: Readings are field measurements.
*dpm = Disintegrations per minute.

Table 4.1-1
Samples Collected and Analyses Requested at SWMU 32-002(a)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Nitrate	Dioxins/Furans	Gamma-Emitting Radionuclides	Tritium	Isotopic Plutonium	Isotopic Uranium	TAL Metals	PCBs	Perchlorate	Strontium-90	SVOCs	VOCs	Cyanide (Total)
RE00-08-15140	00-603580	2–3	QBT3	08-1997	08-1997	08-1996	08-1997	08-1997	08-1997	08-1997	08-1997	08-1997	08-1997	08-1997	08-1997	08-1997	08-1997
RE00-08-15141	00-603580	4–5	QBT3	08-1997	08-1997	08-1996	08-1997	08-1997	08-1997	08-1997	08-1997	08-1997	08-1997	08-1997	08-1997	08-1997	08-1997
RE32-10-11452	00-603580	6–7	QBT3	—[a]	—	—	—	—	—	—	10-1962	—	—	—	—	—	—
RE00-08-15142	00-603581	3–4	QBT3	08-2009	08-2008	08-2006	08-2009	08-2009	08-2009	08-2009	08-2008	08-2007	08-2008	08-2009	08-2007	08-2007	08-2008
RE00-08-15143	00-603581	5–6	QBT3	08-2009	08-2008	08-2006	08-2009	08-2009	08-2009	08-2009	08-2008	08-2007	08-2008	08-2009	08-2007	08-2007	08-2008
RE32-10-11457	00-603581	7–8	QBT3	—	—	—	—	—	—	—	10-1989	—	—	—	—	—	—
RE00-08-15144	00-603582	4–5	QBT3	08-2009	08-2008	08-2006	08-2009	08-2009	08-2009	08-2009	08-2008	08-2007	08-2008	08-2009	08-2007	08-2007	08-2008
RE00-08-15145	00-603582	6–7	QBT3	08-2009	08-2008	08-2006	08-2009	08-2009	08-2009	08-2009	08-2008	08-2007	08-2008	08-2009	08-2007	08-2007	08-2008
RE32-10-11455	00-603582	7–8	QBT3	—	—	—	—	—	—	—	10-1989	—	—	—	—	—	—
RE32-11-4459	00-603582	9-10	QBT3	—	—	—	—	—	—	—	11-2754[b]	—	—	—	—	—	—
RE32-11-4460	00-603582	14-15	QBT3	—	—	—	—	—	—	—	11-2754[b]	—	—	—	—	—	—
RE00-08-15146	00-603583	6.5–7.5	QBT3	08-2009	08-2008	08-2006	08-2009	08-2009	08-2009	08-2009	08-2008	08-2007	08-2008	08-2009	08-2007	08-2007	08-2008
RE00-08-15147	00-603583	8.5–9.5	QBT3	08-2009	08-2008	08-2006	08-2009	08-2009	08-2009	08-2009	08-2008	08-2007	08-2008	08-2009	08-2007	08-2007	08-2008
RE32-10-11458	00-603583	10–11	QBT3	—	—	—	—	—	—	—	10-1989	—	—	—	—	—	—
RE00-08-15148	00-603584	1.5–2.5	QBT3	09-15	09-14	09-12	09-15	09-15	09-15	09-15	09-14	09-13	09-14	09-15	09-13	09-13	09-14
RE00-08-15149	00-603584	3.5–4.5	QBT3	09-15	09-14	09-12	09-15	09-15	09-15	09-15	09-14	09-13	09-14	09-15	09-13	09-13	09-14
RE00-08-15150	00-603585	0–1	QBT3	09-15	09-14	09-12	09-15	09-15	09-15	09-15	09-14	09-13	09-14	09-15	09-13	09-13	09-14
RE00-08-15151	00-603585	2–3	QBT3	09-15	09-14	09-12	09-15	09-15	09-15	09-15	09-14	09-13	09-14	09-15	09-13	09-13	09-14
RE32-10-11459	00-603585	3–4	QBT3	—	—	—	—	—	—	—	10-2112	—	—	—	—	—	—
RE32-10-11460	00-603585	4–5	QBT3	—	—	—	—	—	—	—	10-2112	—	—	—	—	—	—
RE32-11-4462	00-603585	6-7	QBT3	—	—	—	—	—	—	—	11-2754[c]	—	—	—	—	—	—
RE32-11-4463	00-603585	9-10	QBT3	—	—	—	—	—	—	—	11-2754[c]	—	—	—	—	—	—
RE00-08-15152	00-603586	0–1	QBT3	09-15	09-14	09-12	09-15	09-15	09-15	09-15	09-14	09-13	09-14	09-15	09-13	09-13	09-14
RE00-08-15153	00-603586	2–3	QBT3	09-15	09-14	09-12	09-15	09-15	09-15	09-15	09-14	09-13	09-14	09-15	09-13	09-13	09-14
RE00-08-15154	00-603587	0–1	QBT3	09-15	09-14	09-12	09-15	09-15	09-15	09-15	09-14	09-13	09-14	09-15	09-13	09-13	09-14
RE00-08-15155	00-603587	2–3	QBT3	09-15	09-14	09-12	09-15	09-15	09-15	09-15	09-14	09-13	09-14	09-15	09-13	09-13	09-14
RE00-08-15156	00-603588	0–1	QBT3	09-15	09-14	09-12	09-15	09-15	09-15	09-15	09-14	09-13	09-14	09-15	09-13	09-13	09-14
RE00-08-15157	00-603588	2–3	QBT3	09-15	09-14	09-12	09-15	09-15	09-15	09-15	09-14	09-13	09-14	09-15	09-13	09-13	09-14
RE00-08-15181	00-603596	1.25–2.25	QBT3	09-4	09-4	09-3	09-4	09-4	09-4	09-4	09-4	09-4	09-4	09-4	09-4	09-4	09-4
RE00-08-15182	00-603596	3.25–4.25	QBT3	09-4	09-4	09-3	09-4	09-4	09-4	09-4	09-4	09-4	09-4	09-4	09-4	09-4	09-4
0132-96-0751	32-06353	0–0.5	QBT3	—	—	—	2069	—	2069	2069	2068	—	—	—	—	—	—
0132-96-0610	32-06367	4–4.17	QBT4	—	—	—	2019	2019	2019	2019	2018	—	—	—	2017	2017	—
RE32-10-11453	32-06367	5–6	QBT3	—	—	—	—	—	—	—	10-1962	—	—	—	—	—	—
0132-96-0601	32-06368	4.5–4.67	QBT4	—	—	—	2019	2019	2019	2019	2018	—	—	—	2017	2017	—

Table 4.1-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Nitrate	Dioxins/Furans	Gamma-Emitting Radionuclides	Tritium	Isotopic Plutonium	Isotopic Uranium	TAL Metals	PCBs	Perchlorate	Strontium-90	SVOCs	VOCs	Cyanide (Total)
RE32-10-11456	32-06368	5–6	QBT3	—	—	—	—	—	—	—	10-1989	—	—	—	—	—	—
0132-96-0602	32-06369	4.5–4.67	QBT4	—	—	—	2019	2019	2019	2019	2018	—	—	—	2017	2017	—
0132-96-0604	32-06370	5–5.25	QBT4	—	—	—	2023	2023	2023	2023	2022	—	—	—	2021	2021	—
RE32-10-11454	32-06370	1–2	SOIL	—	—	—	—	—	—	—	10-1962	—	—	—	—	—	—
RE32-10-11461	32-06370	5–6	SOIL	—	—	—	—	—	—	—	10-2382	—	—	—	—	—	—
0132-96-0606	32-06371	5–5.25	QBT4	—	—	—	2023	2023	2023	2023	2022	—	—	—	2021	2021	—
0132-96-0607	32-06372	3–3.25	QBT4	—	—	—	2027	2027	2027	2027	2026	—	—	—	2025	2025	—
RE32-10-11451	32-06372	4–5	QBT3	—	—	—	—	—	—	—	10-1962	—	—	—	—	—	—
RE32-11-4465	32-06372	6-7	QBT3	—	—	—	—	—	—	—	11-2754[d]	—	—	—	—	—	—
RE32-11-4466	32-06372	9-10	QBT3	—	—	—	—	—	—	—	11-2754[d]	—	—	—	—	—	—
RE32-10-11445	32-06373	2–3	SOIL	—	—	—	—	—	—	—	10-2252	—	—	—	—	—	—
RE32-10-11446	32-06373	4–5	SOIL	—	—	—	—	—	—	—	10-2252	—	—	—	—	—	—
0132-96-0608	32-06374	2–2.25	SOIL	—	—	—	2027	2027	2027	2027	2026	—	—	—	2025	2025	—
0132-96-0609	32-06375	3.5–4.5	SOIL	—	—	—	2038	2038	2038	2038	2037	—	—	—	2036	2036	—
0132-96-0616	32-06380	2.5–3	SOIL	—	—	—	2057	2057	2057	2057	2055	—	—	—	2054	2054	—
RE32-10-11449	32-611241	1.5–2	SOIL	—	—	—	—	—	—	—	10-2252	—	—	—	—	—	—
RE32-10-11450	32-611242	1.5–2	SOIL	—	—	—	—	—	—	—	10-2252	—	—	—	—	—	—

Note: Numbers in analyte columns are request numbers.

[a] — = Analysis not requested.

[b] Samples analyzed for aluminum, barium, beryllium, chromium, copper, lead, and nickel.

[c] Samples analyzed for aluminum, barium, chromium, copper, and nickel.

[d] Samples analyzed or chromium and nickel.

Table 4.1-2
Inorganic Chemicals above BVs at SWMU 32-002(a)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Cyanide (Total)	Lead	Magnesium	Manganese	Mercury	Nickel	Nitrate	Perchlorate	Selenium	Silver	Sodium	Thallium	Zinc
Qbt 2,3,4 BV[a]				**7340**	**0.5**	**46**	**1.21**	**1.63**	**2200**	**7.14**	**3.14**	**4.66**	**0.5**	**11.2**	**1690**	**482**	**0.1**	**6.58**	**na[b]**	**na**	**0.3**	**1**	**2770**	**1.1**	**63.5**
Soil BV[a]				**29200**	**0.83**	**295**	**1.83**	**0.4**	**6120**	**19.3**	**8.64**	**14.7**	**na**	**22.3**	**4610**	**671**	**0.1**	**15.4**	**na**	**na**	**1.52**	**1**	**915**	**0.73**	**48.8**
Industrial SSL[c]				**1130000**	**454**	**223000**	**2260**	**897**	**na**	**63.1[d]**	**300[e]**	**45400**	**681**	**800**	**na**	**26700**	**341**	**22500**	**1820000**	**795**	**5680**	**5680**	**na**	**11.4**	**341000**
RE00-08-15140	00-603580	2–3	QBT3	—[f]	—	—	—	—	—	10.5 (J)	—	—	0.54 (UJ)	—	—	—	—	6.9 (J+)	0.89	—	0.54 (UJ)	—	—	—	—
RE00-08-15141	00-603580	4–5	QBT3	—	—	—	—	—	—	18.7 (J+)	—	—	0.54 (UJ)	—	—	—	—	10.2	1.2	—	0.39 (U)	—	—	—	—
RE32-10-11452	00-603580	6–7	QBT3	—	1.06 (U)	—	—	—	—	8.8 (J)	—	—	NA[g]	—	—	—	—	—	NA	NA	1.07 (U)	—	—	—	—
RE00-08-15142	00-603581	3–4	QBT3	—	—	—	—	—	—	11.2 (J)	—	—	0.59 (U)	—	—	—	—	8.6 (J)	2.5	—	—	—	—	—	—
RE00-08-15143	00-603581	5–6	QBT3	—	—	—	—	—	—	18 (J+)	—	—	0.54 (U)	—	—	—	—	10 (J)	1.7	—	—	—	—	—	—
RE32-10-11457	00-603581	7–8	QBT3	—	1.02 (UJ)	—	—	—	—	15.6	—	—	NA	—	—	—	—	—	NA	NA	1.06 (U)	—	—	—	—
RE00-08-15144	00-603582	4–5	QBT3	—	—	—	—	—	—	—	—	—	0.59 (U)	—	—	—	—	—	4.2	—	—	—	—	—	—
RE00-08-15145	00-603582	6–7	QBT3	—	—	138 (J)	—	—	—	9.2 (J)	—	4.7 (J)	0.58 (U)	18.4 (J)	—	—	—	7.1 (J)	6.6	—	—	—	—	—	—
RE32-10-11455	00-603582	7–8	QBT3	9230	1.16 (UJ)	409	2.14	—	—	8.74	—	7.34	NA	20.8	2010 (J+)	—	—	9.86	NA	NA	1.18 (U)	—	—	—	—
RE32-11-4459	00-603582	9-10	QBT3	6120	NA	96.6	1.6	NA	NA	4.75	NA	6.16	NA	31.9	NA	NA	NA	13.7	NA	NA	NA	NA	NA	NA	NA
RE32-11-4460	00-603582	14-15	QBT3	1980	NA	14.4	0.61	NA	NA	3.17	NA	1.99	NA	13.9	NA	NA	NA	2.05	NA	NA	NA	NA	NA	NA	NA
RE00-08-15146	00-603583	6.5–7.5	QBT3	—	—	—	—	—	—	18.4 (J)	—	5.3 (J)	—	—	—	—	—	11.3	0.32	—	—	—	—	—	—
RE00-08-15147	00-603583	8.5–9.5	QBT3	—	—	—	—	—	—	29.4 (J+)	—	—	0.52 (U)	—	—	—	—	14.6 (J)	—	—	—	—	—	—	—
RE32-10-11458	00-603583	10–11	QBT3	—	1.11 (UJ)	—	—	—	—	—	—	—	NA	—	—	—	—	—	NA	NA	1.09 (U)	—	—	—	—
RE00-08-15148	00-603584	1.5–2.5	QBT3	—	0.51 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0024	—	—	—	—	—
RE00-08-15149	00-603584	3.5–4.5	QBT3	—	0.51 (U)	—	—	—	—	10.5 (J)	—	—	—	—	—	—	—	7	0.14 (J)	0.0074	—	—	—	—	—
RE00-08-15150	00-603585	0–1	QBT3	—	0.88 (U)	55	—	—	—	—	—	—	—	21.6	—	—	0.169 (J)	—	0.57	—	—	—	—	—	102
RE00-08-15151	00-603585	2–3	QBT3	7450 (J)	—	73.1	1.4 (J)	—	3850 (J)	8.1 (U)	—	8.2 (J)	—	—	2140 (J)	—	—	11 (J)	—	0.0027	0.9	—	—	—	—
RE32-10-11459	00-603585	3–4	QBT3	—	1.01 (U)	71.1	—	—	—	7.63	—	5.59	NA	—	—	—	—	—	NA	NA	0.672 (J-)	—	—	—	—
RE32-10-11460	00-603585	4–5	QBT3	10300	1.1 (U)	110	1.3	—	2960	12.9	—	9.49	NA	—	2570 (J+)	—	—	9.23	NA	NA	1.13 (UJ)	—	—	1.13 (U)	—
RE32-11-4462	00-603585	6-7	QBT3	2680 (J+)	NA	44.8	NA	NA	NA	2.74	NA	4.12	NA	NA	NA	NA	NA	3.12	NA	NA	NA	NA	NA	NA	NA
RE32-11-4463	00-603585	9-10	QBT3	1750 (J+)	NA	21.1	NA	NA	NA	3.44	NA	2.8	NA	NA	NA	NA	NA	1.75	NA	NA	NA	NA	NA	NA	NA
RE00-08-15152	00-603586	0–1	QBT3	—	0.54 (U)	53	—	—	2350 (J)	—	—	5.2 (J)	—	14.5	—	—	0.114 (J)	6.6	0.71	0.0036	—	—	—	—	—
RE00-08-15153	00-603586	2–3	QBT3	—	0.51 (U)	—	—	—	—	10.8 (J)	—	—	—	—	—	—	—	8.4	—	0.0072	—	—	—	—	—
RE00-08-15154	00-603587	0–1	QBT3	—	—	48.8	—	—	2700	—	—	6.6	—	22.1	—	—	0.316 (J)	—	3.2	—	—	—	—	—	—
RE00-08-15155	00-603587	2–3	QBT3	—	0.51 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	0.43	0.0027	0.51 (U)	—	—	—	—
RE00-08-15156	00-603588	0–1	QBT3	—	—	—	—	—	—	—	—	—	—	25.6	—	—	0.241 (J)	—	0.89	0.0031	—	—	—	—	—
RE00-08-15157	00-603588	2–3	QBT3	—	0.51 (U)	—	—	—	—	10.8 (J)	—	—	—	—	—	—	—	7.6	0.15 (J)	0.0024	0.34 (J)	—	—	—	—
RE00-08-15181	00-603596	1.25–2.25	QBT3	—	—	55.1	—	—	—	10.3 (J)	—	5.6 (J)	—	13.6	—	—	0.546 (J)	6.9 (J)	0.16 (J)	—	0.34 (J)	—	—	—	—
RE00-08-15182	00-603596	3.25–4.25	QBT3	—	—	—	—	—	—	17.8 (J+)	—	—	—	—	—	—	—	9 (J+)	0.13 (J)	—	—	—	—	—	—

Table 4.1-2 (continued)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Cyanide (Total)	Lead	Magnesium	Manganese	Mercury	Nickel	Nitrate	Perchlorate	Selenium	Silver	Sodium	Thallium	Zinc
Qbt 2, 3, 4 BV[a]				**7340**	**0.5**	**46**	**1.21**	**1.63**	**2200**	**7.14**	**3.14**	**4.66**	**0.5**	**11.2**	**1690**	**482**	**0.1**	**6.58**	**na**	**na**	**0.3**	**1**	**2770**	**1.1**	**63.5**
Soil BV[a]				**29200**	**0.83**	**295**	**1.83**	**0.4**	**6120**	**19.3**	**8.64**	**14.7**	**na**	**22.3**	**4610**	**671**	**0.1**	**15.4**	**na**	**na**	**1.52**	**1**	**915**	**0.73**	**48.8**
Industrial SSL[c]				**1130000**	**454**	**223000**	**2260**	**897**	**na**	**63.1[d]**	**300[e]**	**45400**	**681**	**800**	**na**	**26700**	**341**	**22500**	**1820000**	**795**	**5680**	**5680**	**na**	**11.4**	**341000**
0132-96-0751	32-06353	0–0.5	QBT3	—	10 (UJ)	54	—	—	4700	—	—	7.1	NA	43 (J-)	—	830	0.17	—	NA	NA	1	2 (U)	—	1.3	—
0132-96-0610	32-06367	4–4.17	QBT4	—	11 (U)	61	—	—	—	—	—	—	NA	17	—	—	0.22 (UJ)	—	NA	NA	—	2.2 (U)	—	—	—
RE32-10-11453	32-06367	5–6	QBT3	—	1 (U)	—	—	—	—	—	—	—	NA	—	—	—	—	—	NA	NA	1.01 (U)	—	—	—	—
0132-96-0601	32-06368	4.5–4.67	QBT4	—	11 (U)	59	—	—	—	—	—	—	NA	26	—	—	0.23 (UJ)	—	NA	NA	—	2.3 (U)	—	—	—
RE32-10-11456	32-06368	5–6	QBT3	—	1.06 (UJ)	—	—	—	—	10.4	—	—	NA	—	—	—	—	—	NA	NA	1.09 (U)	—	—	—	—
0132-96-0602	32-06369	4.5–4.67	QBT4	—	11 (U)	71	—	—	—	—	3.3	—	NA	110	—	—	0.11 (UJ)	—	NA	NA	—	2.2 (U)	—	—	—
0132-96-0604	32-06370	5–5.25	QBT4	—	5.43 (U)	54.2	—	—	—	—	—	—	NA	19	—	—	—	—	NA	NA	—	—	—	—	—
RE32-10-11454	32-06370	1–2	SOIL	—	1.15 (U)	—	—	—	—	—	—	—	NA	—	—	—	—	—	NA	NA	—	—	987	—	—
RE32-10-11461	32-06370	5–6	SOIL	—	—	—	—	0.55 (U)	—	—	—	—	NA	—	—	—	—	—	NA	NA	—	—	—	—	—
0132-96-0606	32-06371	5–5.25	QBT4	—	5.12 (U)	—	—	—	—	—	—	—	NA	—	—	—	—	—	NA	NA	—	—	—	—	—
0132-96-0607	32-06372	3–3.25	QBT4	8100	12 (UJ)	140	—	—	2400	—	4.8	7.1	NA	26	—	—	0.12 (U)	—	NA	NA	—	2.4 (U)	4900	—	—
RE32-10-11451	32-06372	4–5	QBT3	—	0.569 (J)	—	—	—	—	15.5 (J)	—	—	NA	—	—	—	—	7.41 (J-)	NA	NA	1.12 (U)	—	—	—	—
RE32-11-4465	32-06372	6-7	QBT3	NA	NA	NA	NA	NA	NA	2.18	NA	NA	NA	NA	NA	NA	NA	1.39	NA	NA	NA	NA	NA	NA	NA
RE32-11-4466	32-06372	9-10	QBT3	NA	NA	NA	NA	NA	NA	3.15	NA	NA	NA	NA	NA	NA	NA	3.39	NA	NA	NA	NA	NA	NA	NA
RE32-10-11445	32-06373	2–3	SOIL	—	1.13 (UJ)	—	—	0.565 (U)	—	—	—	18.4 (J+)	NA	386 (J)	—	—	—	—	NA	NA	—	—	2940	—	—
RE32-10-11446	32-06373	4–5	SOIL	—	1.09 (UJ)	—	—	0.543 (U)	—	—	—	—	NA	50.6 (J)	—	—	—	—	NA	NA	—	—	2290	—	—
0132-96-0608	32-06374	2–2.25	SOIL	—	12 (UJ)	—	—	0.6 (U)	—	—	—	—	NA	24	—	—	1.2	—	NA	NA	—	2.4 (U)	1400	—	69
0132-96-0609	32-06375	3.5–4.5	SOIL	—	11	—	—	0.56 (U)	—	—	—	—	NA	65 (J-)	—	—	0.11 (U)	—	NA	NA	—	2.2 (U)	3500	1.4 (U)	49
0132-96-0616	32-06380	2.5–3	SOIL	—	6.8 (U)	—	—	0.9 (U)	—	—	—	—	NA	—	—	—	—	—	NA	NA	—	1.7 (U)	3210	—	—
RE32-10-11449	32-611241	1.5–2	SOIL	—	1.13 (UJ)	—	—	0.563 (U)	9540 (J)	—	—	—	NA	—	—	—	—	—	NA	NA	—	—	4030	—	—
RE32-10-11450	32-611242	1.5–2	SOIL	—	1.11 (UJ)	—	—	0.555 (U)	—	—	—	30.5 (J+)	NA	—	—	—	—	—	NA	NA	—	—	3060	—	—

Notes: Results are in mg/kg. Data qualifiers are defined in Appendix A. All the data from 2011 are presented regardless of whether concentrations exceeded BVs.

[a] BVs are from LANL (1998, 059730).

[b] na = Not available.

[c] SSLs are from NMED (21012, 219971), unless otherwise noted.

[d] SSLs are for hexavalent chromium.

[e] SSLs are from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[f] — = Not detected or not detected above BV.

[g] NA = Not analyzed.

Table 4.1-3
Organic Chemicals Detected at SWMU 32-002(a)

Sample ID	Location ID	Depth (ft)	Media	Acenaphthene	Acetone	Anthracene	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Bis(2-ethylhexyl)phthalate	Butylbenzylphthalate	Carbazole	Chrysene	Dibenz(a,h)anthracene
Industrial SSL[a]				**36700**	**868000**	**183000**	**8.26**	**23.4**	**2.34**	**23.4**	**18300[b]**	**234**	**1370**	**9100[c]**	**na[d]**	**2340**	**2.34**
RE00-08-15140	00-603580	2–3	QBT3	—[e]	0.0032 (J)	—	—	—	—	—	—	—	0.21 (J)	—	NA[f]	—	—
RE00-08-15141	00-603580	4–5	QBT3	—	—	—	—	—	—	—	—	—	—	—	NA	—	—
RE00-08-15142	00-603581	3–4	QBT3	—	0.0053 (J)	—	—	—	—	—	—	—	—	—	NA	—	—
RE00-08-15143	00-603581	5–6	QBT3	—	0.0031 (J)	—	—	—	—	—	—	—	—	—	NA	—	—
RE00-08-15144	00-603582	4–5	QBT3	—	—	—	0.042	—	—	—	—	—	—	—	NA	—	—
RE00-08-15145	00-603582	6–7	QBT3	—	—	—	—	—	—	—	—	—	—	—	NA	—	—
RE00-08-15146	00-603583	6.5–7.5	QBT3	—	0.0027 (J)	—	0.099	—	—	—	—	—	0.056 (J)	—	NA	—	—
RE00-08-15147	00-603583	8.5–9.5	QBT3	—	—	—	—	—	—	—	—	—	0.34	—	NA	—	—
RE00-08-15148	00-603584	1.5–2.5	QBT3	—	—	—	—	—	—	—	—	—	—	—	NA	—	—
RE00-08-15149	00-603584	3.5–4.5	QBT3	—	—	—	—	—	—	—	—	—	—	0.055 (J)	NA	—	—
RE00-08-15150	00-603585	0–1	QBT3	—	—	—	—	—	—	—	—	—	—	—	NA	—	—
RE00-08-15151	00-603585	2–3	QBT3	—	—	—	—	—	—	—	—	—	—	—	NA	—	—
RE00-08-15152	00-603586	0–1	QBT3	—	—	—	—	—	—	—	—	—	—	—	NA	—	—
RE00-08-15153	00-603586	2–3	QBT3	—	—	—	—	—	—	—	—	—	—	—	NA	—	—
RE00-08-15154	00-603587	0–1	QBT3	—	—	—	—	—	—	—	—	—	—	—	NA	0.042 (J)	—
RE00-08-15155	00-603587	2–3	QBT3	—	—	—	—	—	—	—	—	—	—	0.034 (J)	NA	—	—
RE00-08-15156	00-603588	0–1	QBT3	—	—	—	—	—	—	—	—	—	—	0.038 (J)	NA	—	—
RE00-08-15157	00-603588	2–3	QBT3	—	—	—	—	—	—	—	—	—	—	—	NA	—	—
RE00-08-15181	00-603596	1.25–2.25	QBT3	—	—	—	—	—	—	—	—	—	0.12 (J)	—	NA	—	—
RE00-08-15182	00-603596	3.25–4.25	QBT3	—	—	—	—	—	—	—	—	—	0.44	—	NA	—	—
0132-96-0610	32-06367	4–4.17	QBT4	—	—	0.064 (J)	NA	0.68	0.52	0.81	0.2 (J)	0.31 (J)	—	—	0.049 (J)	0.77	0.073 (J)
0132-96-0601	32-06368	4.5–4.67	QBT4	—	—	—	NA	0.17 (J)	0.14 (J)	0.2 (J)	0.074 (J)	0.075 (J)	—	—	0.06 (J)	0.19 (J)	—
0132-96-0602	32-06369	4.5–4.67	QBT4	—	—	0.11 (J)	NA	0.34 (J)	0.27 (J)	0.4	0.079 (J)	0.17 (J)	—	—	0.085 (J)	0.36 (J)	—
0132-96-0604	32-06370	5–5.25	QBT4	—	—	—	NA	0.053 (J)	—	0.07 (J)	—	—	—	—	—	0.065 (J)	—
0132-96-0606	32-06371	5–5.25	QBT4	0.3 (J)	—	1.5	NA	4.2	3.5	5.5	0.83	2.4	—	—	0.99	3.8	0.39 (J)
0132-96-0607	32-06372	3–3.25	QBT4	—	0.033 (J+)	—	NA	0.25	0.2	0.2	—	—	—	—	NA	0.29	—
0132-96-0608	32-06374	2–2.25	SOIL	—	—	—	NA	—	0.35	0.33	1.2	0.28	—	—	NA	0.34	—
0132-96-0609	32-06375	3.5–4.5	SOIL	—	0.022 (J+)	—	NA	—	—	—	—	—	—	—	NA	—	—
0132-96-0616	32-06380	2.5–3	SOIL	—	—	0.081 (J)	NA	0.73	0.58	0.59	0.33 (J)	0.58	—	—	NA	0.81	—

Table 4.1-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Dibenzofuran	Dichlorodifluoromethane	Fluoranthene	Fluorene	Heptachlorodibenzodioxin [1,2,3,4,6,7,8-]	Heptachlorodibenzodioxins (Total)	Heptachlorodibenzofuran [1,2,3,4,6,7,8-]	Heptachlorodibenzofuran [1,2,3,4,7,8,9-]	Heptachlorodibenzofurans (Total)	Hexachlorodibenzodioxin [1,2,3,4,7,8-]	Hexachlorodibenzodioxin [1,2,3,6,7,8-]
Industrial SSL[a]				**1000[c]**	**798**	**24400**	**24400**	**na**	**na**	**na**	**na**	**na**	**na**	**na**
RE00-08-15140	00-603580	2–3	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15141	00-603580	4–5	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15142	00-603581	3–4	QBT3	—	—	—	—	0.000000862 (J)	0.00000202	—	—	—	—	—
RE00-08-15143	00-603581	5–6	QBT3	—	—	—	—	0.000000566 (J)	0.00000129	—	—	—	—	—
RE00-08-15144	00-603582	4–5	QBT3	—	—	—	—	0.000000999 (J)	0.00000261	—	—	0.00000122 (J)	—	—
RE00-08-15145	00-603582	6–7	QBT3	—	—	—	—	0.000000543 (J)	0.00000124	—	—	—	—	—
RE00-08-15146	00-603583	6.5–7.5	QBT3	—	—	—	—	0.0000377	0.0000792	0.00001 (J)	0.000000877 (J)	0.0000337	0.000000407 (J)	0.00000122 (J)
RE00-08-15147	00-603583	8.5–9.5	QBT3	—	—	—	—	0.0000241	0.0000407	0.00000764 (J)	0.00000051 (J)	0.0000209	—	0.00000084 (J)
RE00-08-15148	00-603584	1.5–2.5	QBT3	—	—	—	—	—	0.000000532	—	—	—	—	—
RE00-08-15149	00-603584	3.5–4.5	QBT3	—	—	—	—	0.000000555 (J)	0.00000125	—	—	—	—	—
RE00-08-15150	00-603585	0–1	QBT3	—	—	0.036 (J)	—	0.000126	0.000255	0.0000428	0.00000168 (J)	0.000125	0.00000129 (J)	0.00000435
RE00-08-15151	00-603585	2–3	QBT3	—	—	—	—	0.00000333	0.00000625	0.000000885 (J)	—	0.00000262	—	—
RE00-08-15152	00-603586	0–1	QBT3	—	—	—	—	0.0000127	0.0000304	0.00000411	—	0.00000993	—	0.000000496 (J)
RE00-08-15153	00-603586	2–3	QBT3	—	—	—	—	—	0.00000026	—	—	—	—	—
RE00-08-15154	00-603587	0–1	QBT3	—	—	0.074 (J)	—	0.000038	0.0000857	0.0000104	0.000000476 (J)	0.0000253	0.000000552 (J)	0.00000135 (J)
RE00-08-15155	00-603587	2–3	QBT3	—	—	—	—	—	0.000000289	—	—	—	—	—
RE00-08-15156	00-603588	0–1	QBT3	—	—	—	—	0.0000348	0.0000719	0.0000115	0.000000352 (J)	0.0000273	0.000000388 (J)	0.00000131 (J)
RE00-08-15157	00-603588	2–3	QBT3	—	—	—	—	0.00000478	0.00000944	0.00000199 (J)	—	0.00000496	—	0.000000191 (J)
RE00-08-15181	00-603596	1.25–2.25	QBT3	—	—	—	—	0.000084	0.000163	0.0000238 (J)	0.0000012 (J)	0.0000749	0.000000763 (J)	0.00000222 (J)
RE00-08-15182	00-603596	3.25–4.25	QBT3	—	—	—	—	0.0000283	0.0000585	0.00000757 (J)	0.000000472 (J)	0.0000269	—	0.000000718 (J)
0132-96-0610	32-06367	4–4.17	QBT4	—	—	1.1	—	NA	NA	NA	NA	NA	NA	NA
0132-96-0601	32-06368	4.5–4.67	QBT4	—	—	0.36 (J)	—	NA	NA	NA	NA	NA	NA	NA
0132-96-0602	32-06369	4.5–4.67	QBT4	—	—	0.61	—	NA	NA	NA	NA	NA	NA	NA
0132-96-0604	32-06370	5–5.25	QBT4	—	—	0.097 (J)	—	NA	NA	NA	NA	NA	NA	NA
0132-96-0606	32-06371	5–5.25	QBT4	0.17 (J)	—	6.1	0.38 (J)	NA	NA	NA	NA	NA	NA	NA
0132-96-0607	32-06372	3–3.25	QBT4	—	NA	0.45	—	NA	NA	NA	NA	NA	NA	NA
0132-96-0608	32-06374	2–2.25	SOIL	—	—	0.2	—	NA	NA	NA	NA	NA	NA	NA
0132-96-0609	32-06375	3.5–4.5	SOIL	—	—	0.4	—	NA	NA	NA	NA	NA	NA	NA
0132-96-0616	32-06380	2.5–3	SOIL	—	0.001 (J)	1.3	—	NA	NA	NA	NA	NA	NA	NA

Table 4.1-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Hexachlorodibenzodioxin [1,2,3,7,8,9-]	Hexachlorodibenzodioxins (Total)	Hexachlorodibenzofuran [1,2,3,4,7,8-]	Hexachlorodibenzofuran [1,2,3,6,7,8-]	Hexachlorodibenzofuran [2,3,4,6,7,8-]	Hexachlorodibenzofurans (Total)	Indeno(1,2,3-cd)pyrene	Methylene Chloride	Naphthalene	Octachlorodibenzodioxin [1,2,3,4,6,7,8,9-]	Octachlorodibenzofuran [1,2,3,4,6,7,8,9-]
Industrial SSL[a]				**na**	**na**	**na**	**na**	**na**	**na**	**23.4**	**4700**	**241**	**na**	**na**
RE00-08-15140	00-603580	2–3	QBT3	—	—	—	—	—	—	—	—	—	0.00000075 (J)	—
RE00-08-15141	00-603580	4–5	QBT3	—	—	—	—	—	—	—	—	—	0.000000588 (J)	—
RE00-08-15142	00-603581	3–4	QBT3	—	—	—	—	—	—	—	0.0059	—	0.00000739	0.00000086 (J)
RE00-08-15143	00-603581	5–6	QBT3	—	—	—	—	—	—	—	0.0074	—	0.00000437 (J)	0.000000398 (J)
RE00-08-15144	00-603582	4–5	QBT3	—	—	0.00000016 (J)	—	—	0.000000545 (J)	—	0.0078	—	0.00000817	0.00000128 (J)
RE00-08-15145	00-603582	6–7	QBT3	—	—	0.000000148 (J)	—	—	—	—	0.0062	—	0.00000421 (J)	0.000000689 (J)
RE00-08-15146	00-603583	6.5–7.5	QBT3	0.00000096 (J)	0.00000694	0.00000062 (J)	—	0.000000432 (J)	0.0000101	—	0.0099	—	0.000337	0.0000386
RE00-08-15147	00-603583	8.5–9.5	QBT3	0.000000741 (J)	0.00000477	0.000000329 (J)	—	0.000000381 (J)	0.00000739	—	0.0049 (J)	—	0.000202	0.0000204
RE00-08-15148	00-603584	1.5–2.5	QBT3	—	—	—	—	—	—	—	—	—	0.00000289 (J)	—
RE00-08-15149	00-603584	3.5–4.5	QBT3	—	—	—	—	—	—	—	—	—	0.00000387 (J)	—
RE00-08-15150	00-603585	0–1	QBT3	0.0000025	0.0000248	0.00000106 (J)	0.000000921 (J)	0.0000013 (J)	0.0000313	—	0.0077	—	0.000985 (J)	0.000177
RE00-08-15151	00-603585	2–3	QBT3	—	0.000000139	—	—	—	0.000000361	—	—	—	0.0000252 (J)	0.00000325 (J)
RE00-08-15152	00-603586	0–1	QBT3	—	0.00000306	0.000000196 (J)	—	0.000000268 (J)	0.00000386	—	—	—	0.000101 (J)	0.00000929
RE00-08-15153	00-603586	2–3	QBT3	—	—	—	—	—	—	—	—	—	0.00000148 (J)	—
RE00-08-15154	00-603587	0–1	QBT3	0.000000924 (J)	0.000011	0.000000497 (J)	0.00000046 (J)	0.000000631 (J)	0.0000112	—	—	—	0.000291 (J)	0.0000211
RE00-08-15155	00-603587	2–3	QBT3	—	—	—	—	—	—	—	—	—	0.0000017 (J)	—
RE00-08-15156	00-603588	0–1	QBT3	0.000000797 (J)	0.00000896	0.000000342 (J)	0.00000036 (J)	0.000000544 (J)	0.0000105	—	0.0063	—	0.000253 (J)	0.0000259
RE00-08-15157	00-603588	2–3	QBT3	—	0.0000011	—	—	—	0.00000121	—	—	—	0.0000362 (J)	0.00000618
RE00-08-15181	00-603596	1.25–2.25	QBT3	0.00000167 (J)	0.0000127	0.000000569 (J)	0.000000386 (J)	0.000000584 (J)	0.0000167	—	—	—	0.00067	0.0000804
RE00-08-15182	00-603596	3.25–4.25	QBT3	0.00000045 (J)	0.00000368	—	—	—	0.00000486 (J)	—	—	—	0.000235	0.0000306
0132-96-0610	32-06367	4–4.17	QBT4	NA	NA	NA	NA	NA	NA	0.23 (J)	—	—	NA	NA
0132-96-0601	32-06368	4.5–4.67	QBT4	NA	NA	NA	NA	NA	NA	0.076 (J)	—	—	NA	NA
0132-96-0602	32-06369	4.5–4.67	QBT4	NA	NA	NA	NA	NA	NA	0.091 (J)	0.003 (J)	—	NA	NA
0132-96-0604	32-06370	5–5.25	QBT4	NA	NA	NA	NA	NA	NA	—	—	—	NA	NA
0132-96-0606	32-06371	5–5.25	QBT4	NA	NA	NA	NA	NA	NA	1	—	0.082 (J)	NA	NA
0132-96-0607	32-06372	3–3.25	QBT4	NA	NA	NA	NA	NA	NA	—	—	—	NA	NA
0132-96-0608	32-06374	2–2.25	SOIL	NA	NA	NA	NA	NA	NA	0.64	—	—	NA	NA
0132-96-0609	32-06375	3.5–4.5	SOIL	NA	NA	NA	NA	NA	NA	—	—	—	NA	NA
0132-96-0616	32-06380	2.5–3	SOIL	NA	NA	NA	NA	NA	NA	0.29 (J)	—	—	NA	NA

Table 4.1-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Pentachlorodibenzodioxin [1,2,3,7,8-]	Pentachlorodibenzodioxins (Total)	Pentachlorodibenzofuran [1,2,3,7,8-]	Pentachlorodibenzofuran [2,3,4,7,8-]	Pentachlorodibenzofurans (Totals)	Phenanthrene	Pyrene	Tetrachlorodibenzodioxins (Total)	Tetrachlorodibenzofuran [2,3,7,8-]	Tetrachlorodibenzofurans (Totals)	Trichlorofluoromethane
Industrial SSL[a]				**na**	**na**	**na**	**na**	**na**	**20500**	**18300**	**na**	**0.00204**	**na**	**6940**
RE00-08-15140	00-603580	2–3	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15141	00-603580	4–5	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15142	00-603581	3–4	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15143	00-603581	5–6	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15144	00-603582	4–5	QBT3	—	—	—	—	0.000000186	—	—	—	—	—	—
RE00-08-15145	00-603582	6–7	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15146	00-603583	6.5–7.5	QBT3	0.000000283 (J)	0.000000605	—	0.000000265 (J)	0.00000303	—	—	—	—	0.000000433	—
RE00-08-15147	00-603583	8.5–9.5	QBT3	0.000000183	0.000000183	—	—	0.00000147	—	—	—	—	0.000000221	—
RE00-08-15148	00-603584	1.5–2.5	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15149	00-603584	3.5–4.5	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15150	00-603585	0–1	QBT3	0.000000625 (J)	0.00000118	0.000000201 (J)	0.000000853 (J)	0.0000106	—	—	0.000000136	0.00000049 (J)	0.00000228	—
RE00-08-15151	00-603585	2–3	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15152	00-603586	0–1	QBT3	—	—	—	—	—	—	—	—	—	0.00000021	—
RE00-08-15153	00-603586	2–3	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15154	00-603587	0–1	QBT3	—	0.000000808	0.000000157 (J)	0.000000461 (J)	0.00000603	0.041 (J)	0.059 (J)	0.000000143	0.000000595	0.00000225	—
RE00-08-15155	00-603587	2–3	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15156	00-603588	0–1	QBT3	—	—	—	0.000000443 (J)	0.00000498	—	—	—	—	0.00000143	—
RE00-08-15157	00-603588	2–3	QBT3	—	—	—	—	0.000000406	—	—	—	—	—	—
RE00-08-15181	00-603596	1.25–2.25	QBT3	—	0.000000174	—	0.000000226 (J)	0.00000286	—	—	—	—	0.000000403	—
RE00-08-15182	00-603596	3.25–4.25	QBT3	—	—	—	—	0.000000398	—	—	—	—	—	—
0132-96-0610	32-06367	4–4.17	QBT4	NA	NA	NA	NA	NA	0.17 (J)	0.79	NA	NA	NA	—
0132-96-0601	32-06368	4.5–4.67	QBT4	NA	NA	NA	NA	NA	0.11 (J)	0.26 (J)	NA	NA	NA	—
0132-96-0602	32-06369	4.5–4.67	QBT4	NA	NA	NA	NA	NA	0.31 (J)	0.47	NA	NA	NA	0.006
0132-96-0604	32-06370	5–5.25	QBT4	NA	NA	NA	NA	NA	0.047 (J)	0.071 (J)	NA	NA	NA	—
0132-96-0606	32-06371	5–5.25	QBT4	NA	NA	NA	NA	NA	3.7	6.6	NA	NA	NA	—
0132-96-0607	32-06372	3–3.25	QBT4	NA	NA	NA	NA	NA	—	0.3	NA	NA	NA	—
0132-96-0608	32-06374	2–2.25	SOIL	NA	NA	NA	NA	NA	—	—	NA	NA	NA	—

Table 4.1-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Pentachlorodibenzodioxin [1,2,3,7,8-]	Pentachlorodibenzodioxins (Total)	Pentachlorodibenzofuran [1,2,3,7,8-]	Pentachlorodibenzofuran [2,3,4,7,8-]	Pentachlorodibenzofurans (Totals)	Phenanthrene	Pyrene	Tetrachlorodibenzodioxins (Total)	Tetrachlorodibenzofuran [2,3,7,8-]	Tetrachlorodibenzofurans (Totals)	Trichlorofluoromethane
Industrial SSL[a]				**na**	**na**	**na**	**na**	**na**	**20500**	**18300**	**na**	**0.00204**	**na**	**6940**
0132-96-0609	32-06375	3.5–4.5	SOIL	NA	NA	NA	NA	NA	—	0.22	NA	NA	NA	—
0132-96-0616	32-06380	2.5–3	SOIL	NA	NA	NA	NA	NA	0.28 (J)	1	NA	NA	NA	—

Notes: Results are in mg/kg. Data qualifiers are defined in Appendix A.

[a] SSLs are from NMED (2012, 219971), unless otherwise noted.

[b] Pyrene used as a surrogate based on structural similarity.

[c] SSLs are from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[d] na = Not available.

[e] — = Not detected.

[f] NA = Not analyzed.

Table 4.1-4
Radionuclides Detected or Detected above BVs/FVs at SWMU 32-002(a)

Sample ID	Location ID	Depth (ft)	Media	Cesium-137	Plutonium-238	Plutonium-239/240	Tritium	Uranium-235/236
Qbt 2, 3, 4 BV[a]				**na[b]**	**na**	**na**	**na**	**0.09**
Soil BV[a,c]				**1.65**	**0.023**	**0.054**	**na**	**0.2**
Industrial SAL[d]				**23**	**240**	**210**	**440000**	**87**
RE00-08-15150	00-603585	0–1	QBT3	0.246	—[e]	—	—	—
RE00-08-15152	00-603586	0–1	QBT3	—	—	0.409	—	—
RE00-08-15154	00-603587	0–1	QBT3	0.405	—	—	—	—
RE00-08-15156	00-603588	0–1	QBT3	0.217	—	—	—	—
0132-96-0751	32-06353	0–0.5	QBT3	1.7	—	0.091	NA[f]	—
0132-96-0602	32-06369	4.5–4.67	QBT4	—	—	0.681	—	—
0132-96-0604	32-06370	5–5.25	QBT4	—	—	0.027	—	—
0132-96-0606	32-06371	5–5.25	QBT4	—	—	2.7	—	—
0132-96-0607	32-06372	3–3.25	QBT4	—	—	—	—	0.126
0132-96-0608	32-06374	2–2.25	SOIL	—	0.079	0.109	—	—
0132-96-0609	32-06375	3.5–4.5	SOIL	—	—	—	0.0998875	—

Notes: Results are in pCi/g.
[a] BVs/FVs are from LANL (1998, 059730).
[b] na = Not available.
[c] FV applies to soil samples collected from 0–1 ft only.
[d] SALs are from LANL (2009, 107655).
[e] — = Not detected or not detected above BV/FV.
[f] NA = Not analyzed.

Table 4.2-1
Samples Collected and Analyses Requested at SWMU 32-002(b1)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Nitrate	Dioxins/Furans	Gamma-Emitting Radionuclides	Tritium	Isotopic Plutonium	Isotopic Uranium	TAL Metals	PCBs	Perchlorate	Strontium-90	SVOCs	VOCs	Cyanide (Total)
RE00-08-15167	00-603589	3.5–4.5	QBT3	08-2011	08-2011	08-2010	08-2011	08-2011	08-2011	08-2011	08-2011	08-2011	08-2011	08-2011	08-2011	08-2011	08-2011
RE00-08-15168	00-603589	5.5–6.5	QBT3	08-2011	08-2011	08-2010	08-2011	08-2011	08-2011	08-2011	08-2011	08-2011	08-2011	08-2011	08-2011	08-2011	08-2011
RE32-10-11437	00-603589	7–8	QBT3	—*	—	—	—	—	—	—	10-1961	—	—	—	—	—	—
RE00-08-15169	00-603590	5.5–6.5	QBT3	08-2026	08-2025	08-2027	08-2026	08-2026	08-2026	08-2026	08-2025	08-2028	08-2025	08-2026	08-2028	08-2028	08-2025
RE00-08-15170	00-603590	7.5–8.5	QBT3	08-2026	08-2025	08-2027	08-2026	08-2026	08-2026	08-2026	08-2025	08-2028	08-2025	08-2026	08-2028	08-2028	08-2025
RE32-10-11442	00-603590	9–10	QBT3	—	—	—	—	—	—	—	10-2113	—	—	—	—	—	—
RE00-08-15171	00-603591	5.5–6.5	QBT3	08-2026	08-2025	08-2027	08-2026	08-2026	08-2026	08-2026	08-2025	08-2028	08-2025	08-2026	08-2028	08-2028	08-2025
RE00-08-15172	00-603591	7.5–8.5	QBT3	08-2026	08-2025	08-2027	08-2026	08-2026	08-2026	08-2026	08-2025	08-2028	08-2025	08-2026	08-2028	08-2028	08-2025
RE32-10-11438	00-603591	9–10	QBT3	—	—	—	—	—	—	—	10-1961	—	—	—	—	—	—
RE00-08-15173	00-603592	3.5–4.5	QBT3	08-2026	08-2025	08-2027	08-2026	08-2026	08-2026	08-2026	08-2025	08-2028	08-2025	08-2026	08-2028	08-2028	08-2025
RE00-08-15174	00-603592	5.5–6.5	QBT3	08-2026	08-2025	08-2027	08-2026	08-2026	08-2026	08-2026	08-2025	08-2028	08-2025	08-2026	08-2028	08-2028	08-2025
RE32-10-11439	00-603592	7–8	QBT3	—	—	—	—	—	—	—	10-2113	—	—	—	—	—	—
0132-96-0611	32-06365	5–5.25	QBT4	—	—	—	2005	2005	2005	2005	2004	—	—	—	2003	2003	—
0132-96-0612	32-06366	4–4.25	QBT4	—	—	—	2005	2005	2005	2005	2004	—	—	—	2003	2003	—
0132-96-0614	32-06377	3.5–4.5	QBT4	—	—	—	2052	2052	2052	2052	2051	—	—	—	2049	2049	—

Note: Numbers in analyte columns are request numbers.
*— = Analysis not requested.

Table 4.2-2
Inorganic Chemicals above BVs at SWMU 32-002(b1)

Sample ID	Location ID	Depth (ft)	Media	Antimony	Barium	Calcium	Chromium	Cobalt	Copper	Cyanide (Total)	Lead	Mercury	Nickel	Nitrate	Selenium	Silver	Sodium	Thallium	Zinc
Qbt 2,3,4 BV[a]				**0.5**	**46**	**2200**	**7.14**	**3.14**	**4.66**	**0.5**	**11.2**	**0.1**	**6.58**	**na[b]**	**0.3**	**1**	**2770**	**1.1**	**63.5**
Soil BV[a]				**0.83**	**295**	**6120**	**19.3**	**8.64**	**14.7**	**0.5**	**22.3**	**0.1**	**15.4**	**na**	**1.52**	**1**	**915**	**0.73**	**48.8**
Industrial SSL[c]				**454**	**223000**	**na**	**63.1[d]**	**300[e]**	**45400**	**681**	**800**	**341**	**22500**	**1820000**	**5680**	**5680**	**na**	**11.4**	**341000**
RE00-08-15167	00-603589	3.5–4.5	QBT3	—[f]	51.3	—	13.6 (J)	—	—	0.59 (U)	13.2	—	11.2 (J)	8.5	—	—	—	—	—
RE00-08-15168	00-603589	5.5–6.5	QBT3	—	60.3	—	14.7 (J)	—	—	0.58 (U)	—	—	11.3 (J)	2.4	—	—	—	—	—
RE32-10-11437	00-603589	7–8	QBT3	1.11 (U)	—	—	9.4	—	—	NA[g]	—	—	—	NA	0.703 (J)	—	—	—	—
RE00-08-15169	00-603590	5.5–6.5	QBT3	—	77.2 (J-)	—	22.2 (J-)	—	5.4 (J-)	—	51.1	—	14.5	3.5	—	—	—	—	—
RE00-08-15170	00-603590	7.5–8.5	QBT3	—	—	—	45.6 (J-)	—	—	—	31.7	—	22.2	1.3	0.31 (J)	—	—	—	98.7 (J-)
RE32-10-11442	00-603590	9–10	QBT3	1.23 (U)	—	—	7.62	—	—	NA	—	—	—	NA	1.18 (UJ)	—	2840	—	—
RE00-08-15171	00-603591	5.5–6.5	QBT3	—	166 (J-)	—	45.1 (J-)	—	4.8 (J-)	—	—	—	23.2	0.92	0.39 (J)	—	—	—	—
RE00-08-15172	00-603591	7.5–8.5	QBT3	—	—	—	60.7 (J-)	—	—	—	—	—	28.5	0.39	0.33 (J)	—	—	—	—
RE32-10-11438	00-603591	9–10	QBT3	1.14 (U)	—	—	12	—	—	NA	—	—	—	NA	0.762 (J)	—	—	—	—
RE00-08-15173	00-603592	3.5–4.5	QBT3	0.78 (U)	—	—	44 (J-)	—	—	—	—	—	21.6	—	—	—	—	—	—
RE00-08-15174	00-603592	5.5–6.5	QBT3	—	—	—	48.3 (J-)	—	—	—	—	—	23.5	—	0.32 (J)	—	—	—	—
RE32-10-11439	00-603592	7–8	QBT3	1.08 (U)	—	—	—	—	—	NA	—	—	—	NA	1.08 (UJ)	—	—	—	—
0132-96-0611	32-06365	5–5.25	QBT4	12 (UJ)	76	—	—	3.6	4.8	NA	33	5	—	NA	—	2.4 (U)	—	1.5 (U)	68 (J-)
0132-96-0612	32-06366	4–4.25	QBT4	11 (UJ)	—	2500	—	—	5.3	NA	—	0.11 (U)	—	NA	—	2.1 (U)	—	1.3 (U)	—
0132-96-0614	32-06377	3.5–4.5	QBT4	6.5 (U)	78.7	—	—	3.6 (J)	5.8	NA	23.6	—	—	NA	0.65 (J)	1.6 (U)	—	—	—

Notes: Results are in mg/kg. Data qualifiers are defined in Appendix A.

[a] BVs are from LANL (1998, 059730).

[b] na = Not available.

[c] SSLs are from NMED (2012, 219971), unless otherwise noted.

[d] SSLs are for hexavalent chromium.

[e] SSLs are from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[f] — = Not detected or not detected above BV.

[g] NA = Not analyzed.

Table 4.2-3
Organic Chemicals Detected at SWMU 32-002(b1)

Sample ID	Location ID	Depth (ft)	Media	Anthracene	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic Acid	Bis(2-ethylhexyl)phthalate	Butylbenzylphthalate	Chrysene	Di-n-butylphthalate	Fluoranthene	Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	Heptachlorodibenzodioxins (Total)	Heptachlorodibenzofuran[1,2,3,4,6,7,8-]
Industrial SSL[a]				**183000**	**8.26**	**23.4**	**2.34**	**23.4**	**18300**[b]	**234**	**2500000**[c]	**1370**	**9100**[c]	**2340**	**68400**	**24400**	**na**[d]	**na**	**na**
RE00-08-15167	00-603589	3.5–4.5	QBT3	—[e]	—	—	—	—	—	—	—	0.23 (J)	—	—	—	—	0.00000052 (J)	0.00000128 (J)	—
RE00-08-15168	00-603589	5.5–6.5	QBT3	—	—	—	—	—	—	—	—	0.098 (J)	—	—	—	—	0.00000215 (J)	0.00000449 (J)	—
RE00-08-15169	00-603590	5.5–6.5	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00000128 (J)	0.00000323 (J)	—
RE00-08-15170	00-603590	7.5–8.5	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	—	0.000000373 (J)	0.00000085 (J)	—
RE00-08-15171	00-603591	5.5–6.5	QBT3	—	—	—	—	—	—	—	—	0.7	0.085 (J)	—	—	—	0.0000195 (J)	0.0000468 (J)	0.00000428 (J)
RE00-08-15172	00-603591	7.5–8.5	QBT3	—	—	—	—	—	—	—	—	0.69	0.051 (J)	—	—	—	0.0000101	0.0000218	0.00000318 (J)
RE00-08-15173	00-603592	3.5–4.5	QBT3	—	0.4	—	—	—	—	—	—	—	—	—	—	—	0.0000047	0.00000824	—
RE00-08-15174	00-603592	5.5–6.5	QBT3	—	0.078	—	—	—	—	—	—	—	—	—	—	—	0.00000174 (J)	0.00000323	—
0132-96-0611	32-06365	5–5.25	QBT4	—	NA[f]	—	—	—	—	—	—	—	—	—	0.054 (J)	—	NA	NA	NA
0132-96-0612	32-06366	4–4.25	QBT4	0.085 (J)	NA	0.27 (J)	0.3 (J)	0.61 (J)	0.13 (J)	0.24 (J)	—	—	—	0.48 (J)	0.77	0.99	NA	NA	NA
0132-96-0614	32-06377	3.5–4.5	QBT4	—	NA	0.023 (J)	0.03 (J)	0.048 (J)	0.045 (J)	0.036 (J)	0.076 (J)	0.059 (J)	—	0.075 (J)	—	0.074 (J)	NA	NA	NA

Table 4.2-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Heptachlorodibenzofuran[1,2,3,4,7,8,9-]	Heptachlorodibenzofurans (Total)	Hexachlorodibenzodioxin[1,2,3,4,7,8-]	Hexachlorodibenzodioxin[1,2,3,6,7,8-]	Hexachlorodibenzodioxin[1,2,3,7,8,9-]	Hexachlorodibenzodioxins (Total)	Hexachlorodibenzofuran[1,2,3,4,7,8-]	Hexachlorodibenzofuran[1,2,3,6,7,8-]	Hexachlorodibenzofuran[2,3,4,6,7,8-]	Hexachlorodibenzofurans (Total)	Indeno(1,2,3-cd)pyrene
Industrial SSL[a]				**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**23.4**
RE00-08-15167	00-603589	3.5–4.5	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15168	00-603589	5.5–6.5	QBT3	—	—	—	—	—	0.000000178 (J)	—	—	—	—	—
RE00-08-15169	00-603590	5.5–6.5	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15170	00-603590	7.5–8.5	QBT3	—	—	—	—	—	—	—	—	—	—	—
RE00-08-15171	00-603591	5.5–6.5	QBT3	—	0.0000122 (J)	0.000000307 (J)	0.00000083 (J)	0.000000656 (J)	0.00000515 (J)	0.000000285 (J)	0.000000183 (J)	0.000000304 (J)	0.00000488 (J)	—
RE00-08-15172	00-603591	7.5–8.5	QBT3	0.000000195 (J)	0.00000868 (J)	—	0.000000406 (J)	0.000000286 (J)	0.00000212	0.00000027 (J)	—	0.000000161 (J)	0.00000278 (J)	—
RE00-08-15173	00-603592	3.5–4.5	QBT3	0.000000318 (J)	0.00000434 (J)	—	—	—	0.000000318	0.000000411 (J)	0.000000167 (J)	0.000000215 (J)	0.00000294 (J)	—
RE00-08-15174	00-603592	5.5–6.5	QBT3	—	—	—	—	—	—	—	—	—	—	—
0132-96-0611	32-06365	5–5.25	QBT4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	—
0132-96-0612	32-06366	4–4.25	QBT4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.14 (J)
0132-96-0614	32-06377	3.5–4.5	QBT4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.026 (J)

Table 4.2-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Methylene Chloride	Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	Pentachlorodibenzofuran[2,3,4,7,8-]	Pentachlorodibenzofurans (Totals)	Phenanthrene	Pyrene	Tetrachlorodibenzofurans (Totals)	Trichlorofluoromethane
Industrial SSL[a]				**4700**	**na**	**na**	**na**	**na**	**20500**	**18300**	**na**	**6940**
RE00-08-15167	00-603589	3.5–4.5	QBT3	—	0.00000464 (J)	—	—	—	—	—	—	—
RE00-08-15168	00-603589	5.5–6.5	QBT3	—	0.000018 (J)	—	—	0.000000365 (J)	—	—	0.00000019 (J)	—
RE00-08-15169	00-603590	5.5–6.5	QBT3	—	0.0000127 (J)	—	0.000000103 (J)	0.000000103 (J)	—	—	—	—
RE00-08-15170	00-603590	7.5–8.5	QBT3	—	0.00000321 (J)	—	—	—	—	—	—	—
RE00-08-15171	00-603591	5.5–6.5	QBT3	—	0.00018 (J)	0.0000118 (J)	0.000000294 (J)	0.00000296 (J)	—	—	0.000000223 (J)	—
RE00-08-15172	00-603591	7.5–8.5	QBT3	—	0.0000899	0.00000799 (J)	—	0.00000118	—	—	—	—
RE00-08-15173	00-603592	3.5–4.5	QBT3	—	0.0000414	0.00000481 (J)	0.000000375 (J)	0.00000266	—	—	0.000000477	—
RE00-08-15174	00-603592	5.5–6.5	QBT3	—	0.0000153	0.00000161 (J)	—	—	—	—	—	—
0132-96-0611	32-06365	5–5.25	QBT4	0.003 (J)	NA	NA	NA	NA	—	0.041 (J)	NA	0.006
0132-96-0612	32-06366	4–4.25	QBT4	—	NA	NA	NA	NA	0.45 (J)	1	NA	0.003 (J)
0132-96-0614	32-06377	3.5–4.5	QBT4	0.014 (J+)	NA	NA	NA	NA	—	0.074 (J)	NA	—

Notes: Results are in mg/kg. Data qualifiers are defined in Appendix A.

[a] SSLs are from NMED (2012, 219971), unless otherwise noted.

[b] Pyrene used as a surrogate based on structural similarity.

[c] SSLs are from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[d] na = Not available.

[e] — = Not detected.

[f] NA = Not analyzed.

Table 4.2-4
Radionuclides Detected or Detected above BVs/FVs at SWMU 32-002(b1)

Sample ID	Location ID	Depth (ft)	Media	Plutonium-239/240	Tritium
Qbt 2, 3, 4 BV				**na**[a]	**na**
Industrial SAL[b]				**210**	**440000**
0132-96-0611	32-06365	5–5.25	QBT4	0.039	—[c]
0132-96-0614	32-06377	3.5–4.5	QBT4	0.016	0.09

Notes: Results are in pCi/g.
[a] na = Not available.
[b] SALs are from LANL (2009, 107655).
[c] — = Not detected.

Appendix A

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

A-1.0 ACRONYMS AND ABBREVIATIONS

%R	percent recovery
ACA	accelerated corrective action
AK	acceptable knowledge
ALARA	as low as reasonably achievable
AOC	area of concern
ATSDR	Agency for Toxic Substances and Disease Registry
AUF	area use factor
BCG	Biota Concentration Guide (DOE)
bgs	below ground surface
BV	background value
Consent Order	Compliance Order on Consent
COC	chain of custody
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
DAF	dilution attenuation factor
DL	detection limit
DOE	Department of Energy (U.S.)
dpm	disintegrations per minute
Eh	oxidation-reduction potential
EP	Environmental Programs Directorate
EPA	Environmental Protection Agency (U.S.)
EPC	exposure point concentration
ESL	ecological screening level
FV	fallout value
HI	hazard index
HQ	hazard quotient
HR	home range
ICPES	Inductively coupled plasma emission spectroscopy
ICS	interference check sample
IDW	investigation-derived waste
IS	internal standard
K_d	soil-water partition coefficient

K_{oc}	organic carbon-water partition coefficient
K_{ow}	octanol-water partition coefficient
LAL	lower acceptance limit
LANL	Los Alamos National Laboratory (the Laboratory)
LANS	Los Alamos National Security, LLC
LCS	laboratory control sample
LOAEL	lowest observed adverse effect level
MDC	minimum detectable concentration
MDL	method detection limit
MS	matrix spike
NMED	New Mexico Environment Department
NOAEL	no observed adverse effect level
PAUF	population area use factor
PID	photoionization detector
PRG	preliminary remediation goal
QA	quality assurance
QC	quality control
RCT	radiation control technician
RESRAD	residual radioactive (model)
RfD	reference dose
RPD	relative percent difference
RPF	Records Processing Facility
SAL	screening action level
SCL	sample collection log
SF	slope factor
SMO	Sample Management Office
SOP	standard operating procedure
SOW	statement of work
SSL	soil screening level
SWMU	solid waste management unit
T&E	threatened and endangered
TA	technical area
TAL	target analyte list
TCDD	tetrachlorordibenzodioxin

TEF	toxicity equivalency factor
TRV	toxicity reference value
TSD	treatment, storage, and disposal
UAL	upper acceptance limit
UCL	upper confidence limit
VOC	volatile organic compound
WCSF	waste characterization strategy form

A-2.0 METRIC CONVERSION TABLE

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

A-3.0 DATA QUALIFIER DEFINITIONS

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

Appendix B

Field Methods

B-1.0 INTRODUCTION

This appendix summarizes field methods used during the sampling performed at Solid Waste Management Unit (SWMU) 32-002(a) at Los Alamos National Laboratory (LANL or the Laboratory) in 2011. This sampling was performed in accordance with the Phase II investigation work plan for Upper Los Alamos Canyon Aggregate Area (LANL 2010, 110860), which was approved by the New Mexico Environment Department (NMED) (NMED 2011, 111674). Table B-1.0-1 provides a general summary of methods used, and the following sections provide more detailed descriptions of the field methods. All activities were conducted in accordance with the applicable Environmental Programs (EP) Directorate standard operating procedures (SOPs), which are listed in Table B-1.0-2. Current versions of SOPs used for sampling are available at http://www.lanl.gov/environment/all/qa.shtml.

B-2.0 EXPLORATORY DRILLING CHARACTERIZATION

No exploratory drilling characterization was conducted.

B-3.0 FIELD SCREENING

This section summarizes the field-screening methods used during the 2011 investigation activities. Field screening for organic vapors and radioactivity was performed on each sample. The field-screening results are presented in Table 4.0-1 of this supplemental remedy completion report.

B-3.1 Field Screening for Organic Vapors

All samples collected were field screened for organic vapors using a MiniRAE 2000 photoionization detector (PID) equipped with an 11.7-electron volt lamp. Screening was performed in accordance with SOP-06.33, Headspace Vapor Screening with a Photo Ionization Detector. Screening was performed on each sample collected, and screening measurements were recorded in the field sample collection log (SCL). The SCLs are provided in Appendix C. The field-screening results are presented in Table 4.0-1 of the supplemental remedy completion report.

B-3.2 Field Screening for Radioactivity

Each sample was screened for radioactivity at the time of collection, targeting alpha and beta/gamma emitters. Screening was conducted by a Laboratory radiation control technician (RCT) using an Eberline E-600 radiation meter with an SHP-380AB alpha and beta/gamma scintillation detector. The Eberline E-600 with attachment SHP-380AB consists of a dual phosphor plate covered by two Mylar windows housed in a light-excluding metal body. The phosphor plate is a plastic scintillator for the detection of beta and gamma emissions and is thinly coated with zinc sulfide for the detection of alpha emissions. The operational range varies from trace emissions to 1 million disintegrations per minute. Screening was performed on each sample collected and screening measurements were recorded on the field SCLs (Appendix C). The field-screening results are presented in Table 4.0-1 of the supplemental remedy completion report.

B-3.3 Field Instrument Calibration

All instruments were calibrated before use. Calibration of the MiniRAE 2000 PID was conducted daily by the site crew. Calibration of the Eberline E-600 was conducted by the RCT. All calibrations were performed according to the manufacturer's specifications and requirements.

B-3.3.1 MiniRAE 2000 Instrument Calibration

The MiniRAE 2000 PID was calibrated both to ambient air and a standard reference gas (100 ppm isobutylene). The ambient-air calibration determined the zero point of the instrument sensor calibration curve in ambient air. Calibration with the standard reference gas determined a second point of the sensor calibration curve. Each calibration was within 3% of 100 ppm isobutylene, qualifying the instrument for use.

The following calibration information was recorded daily on operational calibration logs:

- instrument identification number
- final span settings
- date and time
- concentration and type of calibration gas used (isobutylene at 100 ppm)
- name of the personnel performing the calibration

All daily calibration procedures for the MiniRAE 2000 PID met the manufacturer's specifications for standard reference gas calibration and the requirements.

B-3.3.2 Eberline E-600 Instrument Calibration

The Eberline E-600 was calibrated daily by the RCT before local background levels for radioactivity were measured. The instrument was calibrated using plutonium-239 and chloride-36 sources for alpha and beta emissions, respectively. The following five checks were performed as part of the calibration procedures:

- calibration date
- physical damage
- battery
- response to a source of radioactivity
- background

All calibrations performed for the Eberline E-600 met the manufacturer's specifications and the applicable radiation detection instrument manual.

B-4.0 GEODETIC SURVEY

Samples were collected from three locations at SWMU 32-002(a) previously sampled during the 1996 Phase II Resource Conservation and Recovery Act field investigation (LANL 1996, 059178); 2008 investigation (LANL 2010, 108528); and 2010 accelerated corrective action investigation (LANL 2011, 111806.23). Geodetic surveying to located previous sample locations was performed using a Trimble R8 Global Navigation Satellite System (GNSS), giving centimeter accuracy vertically and horizontally. All

sample locations were surveyed in accordance with the most current version of EP-ERSS-SOP-5028, "Coordinating and Evaluating Geodetic Surveys." Horizontal accuracy of the control points is within 0.1 ft. The GNSS instrument referenced from Laboratory monuments and independently established benchmarks near survey areas.

B-5.0 SUBSURFACE SAMPLING

This section summarizes the methods used for collecting subsurface samples according to the approved Phase II investigation work plan (LANL 2009, 108332; NMED 2010, 108455).

B-5.1 Subsurface Tuff Sampling Methods

Subsurface samples were collected using the hand auger method. At locations where hand auger refusal was encountered, a truck-mounted mechanical auger or mobile mechanical auger was used to reach the top of the sample collection depth interval. A hand auger was then used to collect the sample in accordance with the most current version of Standard Operating Procedure (SOP) 06.10, "Hand Auger and Thin-Wall Tube Sampler."

The sample material was transferred from hand auger to a stainless-steel bowl. The samples were then transferred to sterile sample collection jars for transport to the Sample Management Office (SMO). Samples were only collected for analysis of inorganic chemicals, and no samples were collected for volatile organic compound analysis. The sample collection tools (auger bucket, bowl, and scoop) were decontaminated immediately before each sample was collected in accordance with the most current version of EP-ERSS-SOP-5061, "Field Decontamination of Equipment."

B-5.2 Quality Control Samples

Quality control (QC) samples were collected in accordance with SOP-5059, Field Quality Control Samples. QC samples included field duplicates and field rinsate blanks. Field duplicate samples were collected from the same material as a regular investigation sample and submitted for the same analyses. Field duplicate samples were collected at a frequency of at least 1 duplicate sample for every 10 samples.

Field rinsate blanks were collected to evaluate field decontamination procedures. Rinsate blanks were collected by rinsing sampling equipment (i.e., sampling bowls and spoons) after it was decontaminated with deionized water. The rinsate water was collected in a sample container and submitted to the SMO. Field rinsate blank samples were collected from sampling equipment at a frequency of at least 1 rinsate sample for every 10 investigation samples and were analyzed for the same analyses as the investigation samples.

B-5.3 Sample Documentation and Handling

Field personnel completed a SCL/chain-of-custody (COC) form for each sample. Sample containers were sealed with signed COC seals and placed in coolers at approximately 4°C. Samples were handled and shipped in accordance with the most current versions of EP-ERSS-SOP-5057, "Handling, Packaging, and Transporting Field Samples," and EP-ERSS-SOP-5056, "Sample Containers and Preservation." Samples were transported to the SMO on ice, in sealed coolers, before they were shipped to the analytical laboratory. The SMO personnel reviewed and approved the SCL/COC forms before taking custody of the sample.

B-5.4 Decontamination of Sampling Equipment

All sampling equipment was decontaminated immediately before each sample was collected to avoid outside contamination and cross-contamination between samples. Decontamination included cleaning the equipment with Fantastik and clean paper towels. To evaluate decontamination activities, rinsate blank samples were collected in accordance with the most current versions of EP-ERSS-SOP-5061, "Field Decontamination of Equipment," and EP-ERSS-SOP-5059, "Field Quality Control Samples."

B-6.0 INVESTIGATION-DERIVED WASTE STORAGE AND DISPOSAL

All investigation-derived waste (IDW) generated during investigation activities was managed in accordance with the current version of SOP-5238, "Characterization and Management of Environmental Program Waste." This procedure incorporates the requirements of all applicable U.S. Environmental Protection Agency (EPA) and NMED regulations, U.S. Department of Energy orders, and Laboratory implementation requirements. Details of IDW management are presented in Appendix G.

B-7.0 DEVIATIONS

B-7.1 SWMU 32-002(a)

There were no deviations from the sampling at SWMU 32-002(a) proposed in the Phase II investigation work plan for the Upper Los Alamos Canyon Aggregate Area (LANL 2010, 110860) and as modified by NMED's approval with modifications (NMED 2011, 111674).

B-8.0 REFERENCES

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

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

LANL (Los Alamos National Laboratory), September 1996. "Phase II and Voluntary Corrective Action Report for Potential Release Sites at TA-32: 32-001, Former Incinerator; 32-002(a,b), Former Septic Systems; 32-003, Former Transformer; 32-004, Former Radioactive Source Vault, Drain Line, and Outfall," Los Alamos National Laboratory document LA-UR-96-3128, Los Alamos, New Mexico. (LANL 1996, 059178)

LANL (Los Alamos National Laboratory), December 2009. "Accelerated Corrective Action Work Plan for Upper Los Alamos Canyon Aggregate Area, Former Technical Area 32," Los Alamos National Laboratory document LA-UR-09-8056, Los Alamos, New Mexico. (LANL 2009, 108332)

LANL (Los Alamos National Laboratory), February 2010. "Investigation Report for Upper Los Alamos Canyon Aggregate Area, Revision 1," Los Alamos National Laboratory document LA-UR-10-0422, Los Alamos, New Mexico. (LANL 2010, 108528)

LANL (Los Alamos National Laboratory), October 2010. "Phase II Investigation Work Plan for Upper Los Alamos Canyon Aggregate Area," Los Alamos National Laboratory document LA-UR-10-6327, Los Alamos, New Mexico. (LANL 2010, 110860)

LANL (Los Alamos National Laboratory), February 2011. "Remedy Completion Report for Upper Los Alamos Canyon Aggregate Area, Former Technical Area 32, Revision 1," Los Alamos National Laboratory document LA-UR-11-1177, Los Alamos, New Mexico. (LANL 2011, 111806.23)

NMED (New Mexico Environment Department), January 22, 2010. "Notice of Approval, Accelerated Corrective Action Work Plan, Upper Los Alamos Canyon Aggregate Area, Former Technical Area 32," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010, 108455)

NMED (New Mexico Environment Department), January 19, 2011. "Approval with Modifications, Phase II Investigation Work Plan for Upper Los Alamos Canyon Aggregate Area," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 111674)

Table B-1.0-1
Summary of Field Investigation Methods

Method	Summary
Hand Auger Sampling	This method is typically used for sampling soil or sediment at depths of less than 10–15 ft but may in some cases be used for collecting samples of weathered or nonwelded tuff. The method involves hand-turning a stainless-steel bucket auger (typically 3–4 in.-inside diameter), creating a vertical hole that can be advanced to the desired sampling depth. When the desired depth was reached during the investigation, the auger was decontaminated before the hole was advanced through the sampling depth. The sample material was transferred from the auger bucket to a stainless-steel sampling bowl before the various required sample containers were filled.
Handling, Packaging, and Shipping of Samples	Field team members sealed and labeled samples before packing them to ensure the sample containers and the containers used for transport were free of external contamination. Field team members packaged all samples to minimize the possibility of breakage during transport. After all environmental samples were collected, packaged, and preserved, a field team member transported them to the SMO. The SMO arranged for shipping the samples to analytical laboratories.
Sample Control and Field Documentation	The collection, screening, and transport of samples were documented on standard forms generated by the SMO. These included SCLs, COC forms, and sample container labels. SCLs were completed at the time of sample collection, and the logs were signed by the sampler and a reviewer who verified the logs for completeness and accuracy. Corresponding labels were initialed and applied to each sample container, and custody seals were placed around each sample container. COC forms were completed and signed to verify the samples had not been left unattended.
Field Quality Control Samples	Field quality control samples were collected as follows. *Field duplicates*: At a frequency 10%; collected at the same time as a regular sample and submitted for the same analyses. *Equipment rinsate blank*: At a frequency of 10%; collected by rinsing sampling equipment with deionized water, which was collected in a sample container and submitted for laboratory analysis.
Field Decontamination of Drilling and Sampling Equipment	Dry decontamination was used to minimize the generation of liquid waste. Dry decontamination included using a wire brush or other tool to remove soil or other material adhering to the sampling equipment, followed by using a commercial cleaning agent (nonacid, waxless cleaners) and paper wipes.
Containers and Preservation of Samples	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on EPA guidance for environmental sampling, preservation, and quality assurance. Specific requirements for each sample were printed in the SCLs provided by the SMO (size and type of container [e.g., glass, amber glass, and polyethylene]). All samples were preserved by placing them with ice in insulated containers to maintain a temperature of 4°C.
Coordinating and Evaluating Geodetic Surveys	Geodetic surveys focused on obtaining survey data of acceptable quality to use during project investigations. Geodetic surveys were conducted with a Trimble 5700 DGPS. The survey data conformed to Laboratory Information Architecture project standards IA-CB02, GIS Horizontal Spatial Reference System, and IA-D802, Geospatial Positioning Accuracy Standard for A/E/C/ and Facility Management. All coordinates were expressed as State Plain Coordinate System 83, NM Central, U.S. feet coordinates. All elevation data were reported relative to the National Geodetic Vertical Datum of 1983.

Table B-1.0-1 (continued)

Method	Summary
Management of Environmental Restoration Project Waste, Waste Characterization	IDW is managed, characterized, and stored in accordance with an approved waste characterization strategy form that documents site history, field activities, and the characterization approach for each waste stream managed. Waste characterization complied with on- or off-site waste acceptance criteria. All stored IDW was marked with appropriate signage and labels. Drummed IDW was stored on pallets to prevent deterioration of containers. A waste storage area was established before waste was generated. Waste storage areas were located in controlled areas of the Laboratory to prevent unauthorized personnel from inadvertently adding or managing wastes. Each container of waste generated was individually labeled with the waste classification and item identification number and as radioactive (if applicable), immediately following containerization. All waste was segregated by classification and compatibility to prevent cross-contamination. Management of IDW is discussed in Appendix G.

Table B-1.0-2
SOPs Used for Sampling at SWMU 32-002(a)

EP-DIR-QAP-0001, Quality Assurance Plan for the Environmental Programs
SOP-5028, Coordinating and Evaluating Geodetic Surveys
SOP-5055, General Instructions for Field Investigations
SOP-5056, Sample Containers and Preservation
SOP-5057, Handling, Packaging, and Transporting Field Samples
SOP-5058, Sample Control and Field Documentation
SOP-5059, Field Quality Control Samples
SOP-5061, Field Decontamination of Equipment
SOP-5181, Notebook and Logbook Documentation for Environmental Directorate Technical and Field Activities
SOP-5238, Characterization and Management of Environmental Program Waste
SOP-01.12, Field Site Closeout Checklist
SOP-06.10, Hand Auger and Thin-Wall Tube Sampler
SOP-06.33, Headspace Vapor Screening with a Photoionization Detector

Appendix C

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

Appendix D

Analytical Program

D-1.0 INTRODUCTION

This appendix presents the analytical methods used and the review of the data quality of the analytical results for the 2011 investigation of Solid Waste Management Unit (SWMU) 32-002(a) in former Technical Area 32 (TA-32) in the Upper Los Alamos Canyon Aggregate Area at Los Alamos National Laboratory (LANL or the Laboratory).

The analytical program for this investigation includes submitting samples to approved contract laboratories with specific requirements for analytical methods, data quality, and reporting. Quality assurance (QA), quality control (QC), and data validation procedures were implemented in accordance with the requirements of the Quality Assurance Project Plan Requirements for Sampling and Analysis (LANL 1996, 054609), and the analytical services statement of work (SOW) for contract laboratories (LANL 2008, 109962). The results of the QA/QC activities were used to estimate accuracy, bias, and precision of the analytical measurements. The QC samples included preparation blanks, spikes, matrix spikes (MSs), and laboratory control samples (LCSs) to assess accuracy and bias. Internal standards, external standards, surrogates, and tracers were also used to assess accuracy.

The type and frequency of QC analyses are described in the analytical service SOW (LANL 2008, 109962), along with the applicable analytical methods. Other QC factors such as sample preservation and holding times were also assessed in accordance with the requirements outlined in Standard Operating Procedure (SOP) 5056, Sample Containers and Preservation. Evaluating these QC indicators allows estimates to be made of the accuracy, bias, and precision of the analytical suites. A focused data validation was also performed for all the data packages (also referred to as request numbers).

The following SOP was used for data validation:

- SOP-5165, Routine Validation of Metals Analytical Data

The focused validation included a more detailed review of the data generated by the analytical laboratory. The analytical data and instrument printouts used during focused validation and the validation reports are presented in Appendix C.

Analytical data were reviewed and evaluated based on U.S. Environmental Protection Agency (EPA) National Functional Guidelines for inorganic and organic chemical data review, where applicable (EPA 1994, 048639; EPA 1999, 066649). As a result of the data validation and assessment efforts, qualifiers may be assigned to the analytical records as appropriate. The data qualifiers are defined in Appendix A.

D-2.0 ANALYTICAL DATA ORGANIZATION

The data set evaluated for the supplemental investigation of SWMU 32-002(a) includes analytical results for samples collected in the 2011.

D-3.0 INORGANIC CHEMICAL ANALYSES

Samples collected during the 2011 investigation were analyzed for a subset of the target analyte list (TAL) metals and included aluminum, barium, beryllium, chromium, copper, lead, and nickel. Samples were analyzed for these TAL metals using EPA SW-846 Methods 6010B and 6020. The analytical methods used for inorganic chemicals are listed in Table D-3.0-1.

A total of four samples were submitted for analysis of aluminum, barium, and copper; two samples were submitted for analysis of beryllium and lead; and six samples were submitted for analysis of chromium and nickel.

All decision-level analytical data are presented in Appendix C.

D-3.1 Inorganic Chemical Analyses

The use of QA/QC samples is designed to produce quantitative measures of the reliability of specific parts of an analytical procedure. The results of the QA/QC analyses performed on a sample provide confidence about whether the analyte is present and whether the concentration reported is accurate. To assess the accuracy and precision of inorganic chemical analyses, LCSs, preparation blanks, MS samples, laboratory duplicate samples, interference check samples (ICSs), and serial dilution samples were analyzed. Each of these QA/QC sample types is defined in the analytical services SOW (LANL 2008, 109962) and is described briefly in the sections below.

The LCS serves as a monitor of the overall performance of each step during the analysis, including sample digestion. For inorganic chemicals in soil or tuff, LCS percent recoveries (%R) should fall within the lower acceptance limit (LAL) and upper acceptance limit (UAL).

Preparation blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as those used in the environmental sample processing and which is extracted and analyzed in the same manner as the corresponding environmental samples. Preparation blanks are used to measure bias and potential cross-contamination. All inorganic chemical results should be below the method detection limit (MDL).

MS samples assess the accuracy of inorganic chemical analyses. These samples are designed to provide information about the effect of the sample matrix on the sample preparation procedures and analytical technique. The MS acceptance criterion is between the LAL and UAL, inclusive for all spiked analytes.

Laboratory duplicate samples assess the precision of inorganic chemical analyses. All relative percent differences (RPDs) between the sample and laboratory duplicate should be ±35% for soil (LANL 2008, 109962).

The ICSs assess the accuracy of the analytical laboratory's interelement and background correction factors used for inductively coupled plasma emission spectroscopy. The ICS %R should be between the LAL and UAL.

Serial dilution samples measure potential physical or chemical interferences and correspond to a sample dilution ratio of 1:5. The chemical concentration in the undiluted sample must be at least 50 times the MDL (100 times for inductively coupled plasma mass spectroscopy) for valid comparison. For sufficiently high concentrations, the RPD should be within 10%.

Details regarding the quality of the inorganic chemical analytical data included in the data set are summarized in the following sections.

D-3.2 Data Quality Results for Inorganic Chemicals

The majority of the analytical results were not qualified. These data do not have any quality issues associated with the values presented.

D-3.2.1 Maintenance of Chain of Custody

Chain-of-custody forms were maintained properly for all samples analyzed for inorganic chemicals (Appendix C).

D-3.2.2 Sample Documentation

All samples analyzed for inorganic chemicals were properly documented in the field in sample collection logs (Appendix C).

D-3.2.3 Sample Dilutions

Some samples were diluted for inorganic chemical analyses. No qualifiers were applied to any inorganic chemical analytical results because of dilutions.

D-3.2.4 Sample Preservation

Preservation criteria were met for all samples analyzed for inorganic chemicals.

D-3.2.5 Holding Times

Holding time criteria were met for all samples analyzed for inorganic chemicals.

D-3.2.6 MS Samples

A total of four aluminum results were qualified as estimated and biased high (J+) because the associated MS recovery was above the UAL.

D-3.2.7 Rejected Results

No inorganic chemical results were rejected.

D-4.0 ORGANIC CHEMICAL ANALYSES

No samples from the 2011 investigation of SWMU 32-002(a) were submitted for organic chemical analyses.

D-5.0 RADIONUCLIDE ANALYSES

No samples from the 2011 investigation of SWMU 32-002(a) were submitted for radionuclide analyses.

D-6.0 REFERENCES

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

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

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

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

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

LANL (Los Alamos National Laboratory), June 30, 2008. "Exhibit "D" Scope of Work and Technical Specifications, Analytical Laboratory Services for General Inorganic, Organic, Radiochemical, Asbestos, Low-Level Tritium, Particle Analysis, Bioassay, Dissolved Organic Carbon Fractionation, and PCB Congeners," Los Alamos National Laboratory document RFP No. 63639-RFP-08, Los Alamos, New Mexico. (LANL 2008, 109962)

Table D-3.0-1
Inorganic Chemical Analytical Methods for
Samples Collected during Supplemental Investigation of SWMU 32-002(a)

Analytical Method	Analytical Description	Analytical Suite
SW-846:6010B	Inductively coupled plasma emission spectroscopy (ICPES)–atomic emission spectroscopy	Aluminum, barium, chromium, copper, and lead
SW-846:6020	ICPES	Beryllium and nickel

Appendix E

Box Plots and Statistical Test Results

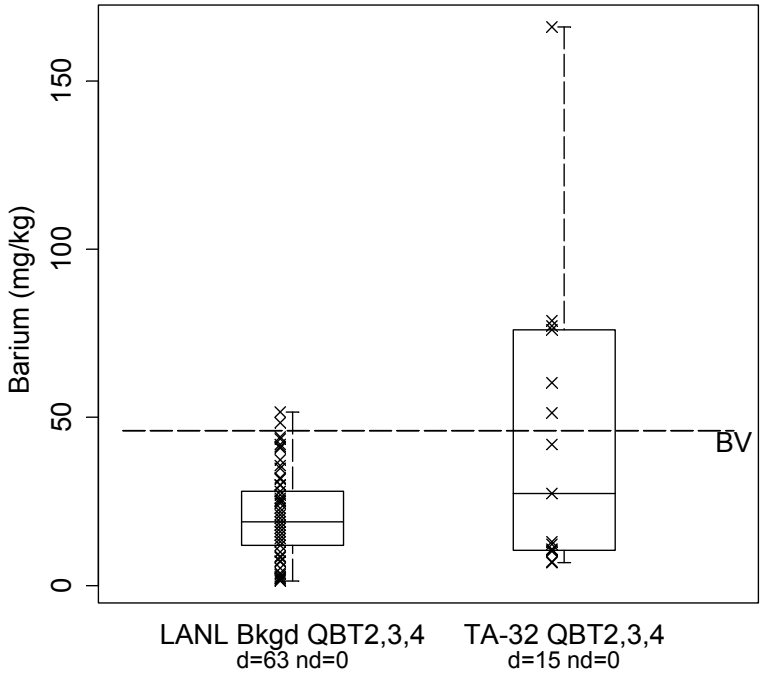


Figure E-1 Site concentrations of barium in tuff at SWMU 32-002(b1) compared with Qbt 2,3,4 background

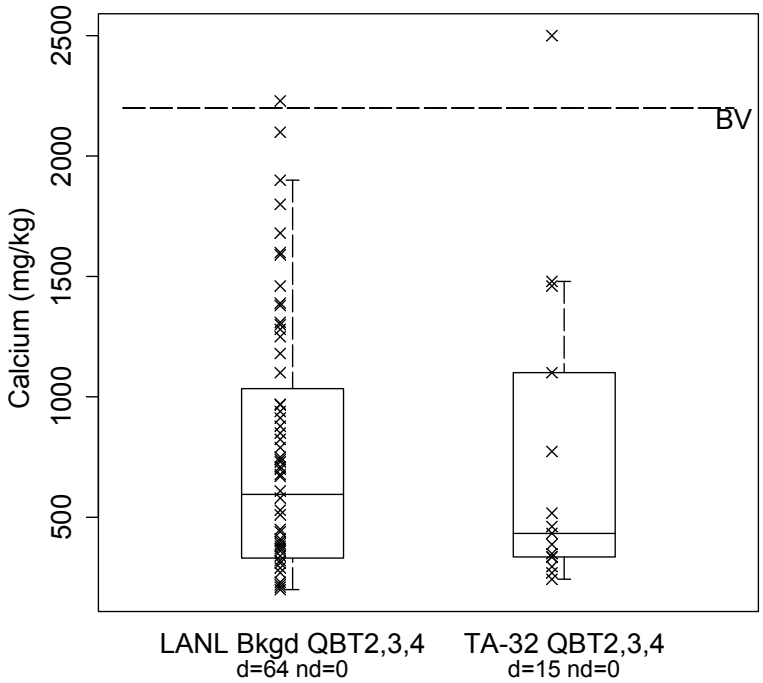


Figure E-2 Site concentrations of calcium in tuff at SWMU 32-002(b1) compared with Qbt 2,3,4 background

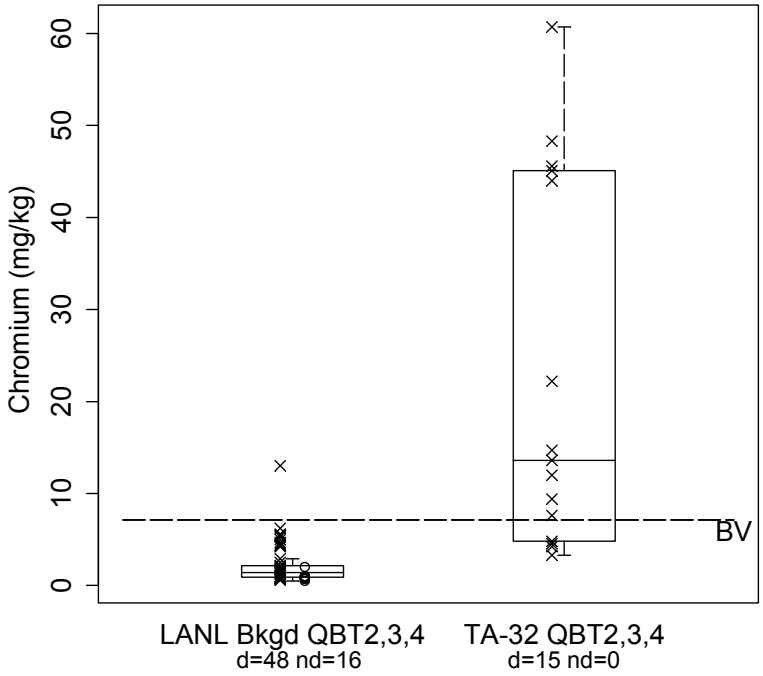


Figure E-3 Site concentrations of chromium in tuff at SWMU 32-002(b1) compared with Qbt 2,3,4 background

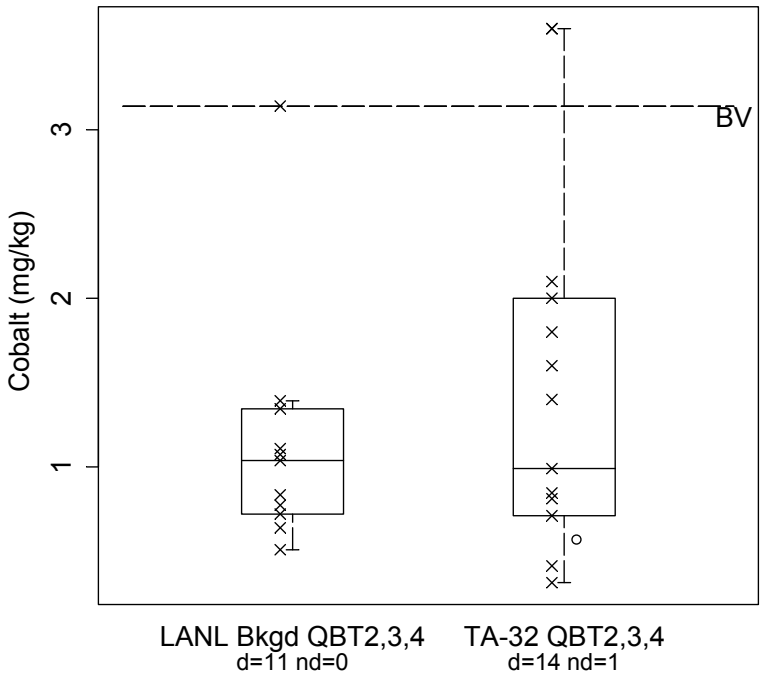


Figure E-4 Site concentrations of cobalt in tuff at SWMU 32-002(b1) compared with Qbt 2,3,4 background

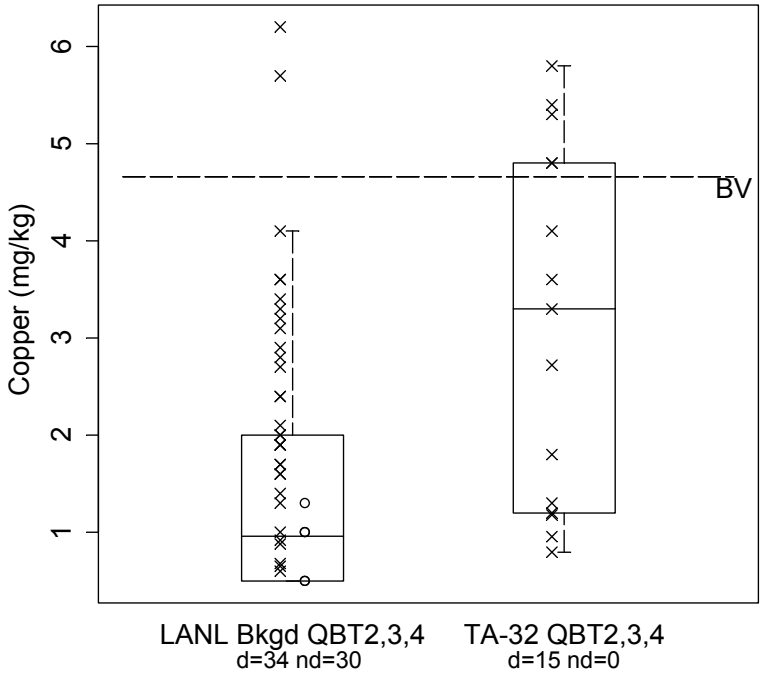


Figure E-5 Site concentrations of copper in tuff at SWMU 32-002(b1) compared with Qbt 2,3,4 background

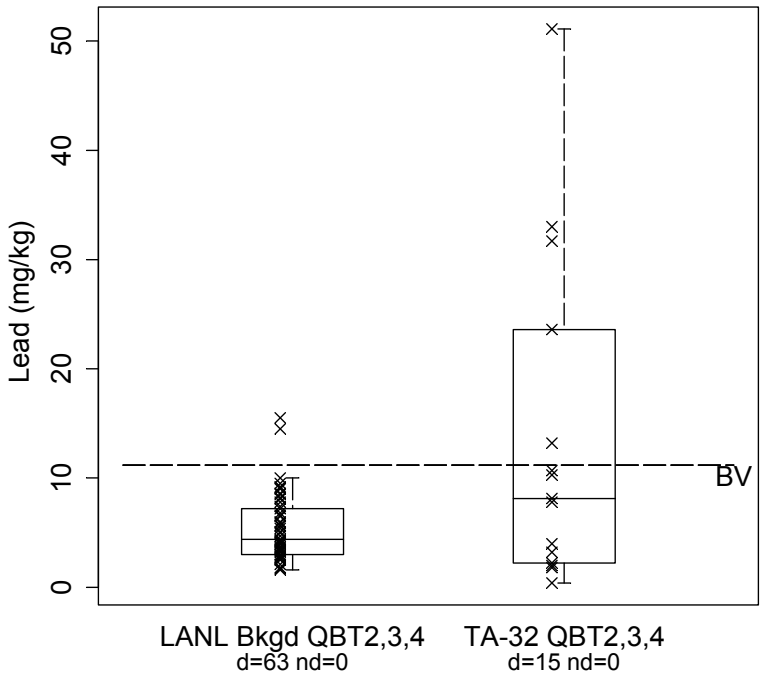


Figure E-6 Site concentrations of lead in tuff at SWMU 32-002(b1) compared with Qbt 2,3,4 background

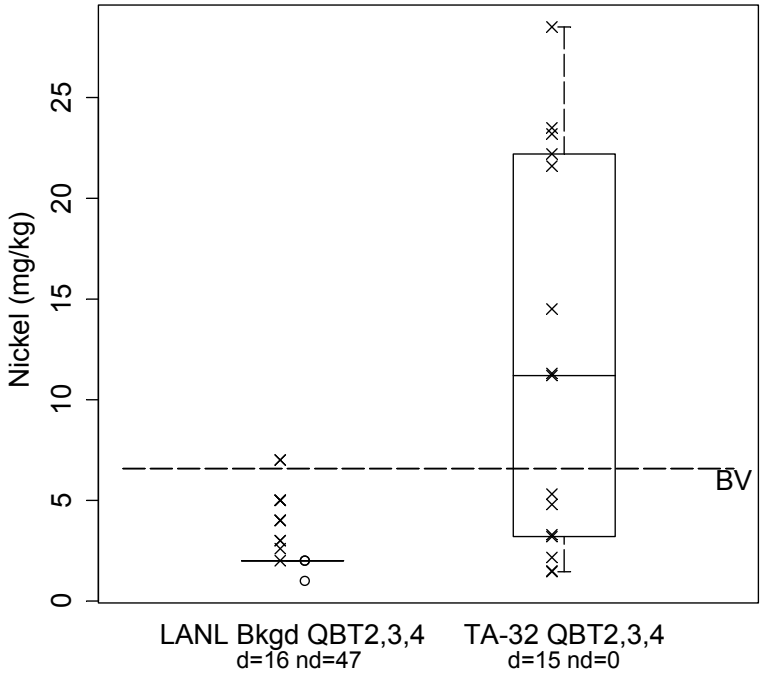


Figure E-7 Site concentrations of nickel in tuff at SWMU 32-002(b1) compared with Qbt 2,3,4 background

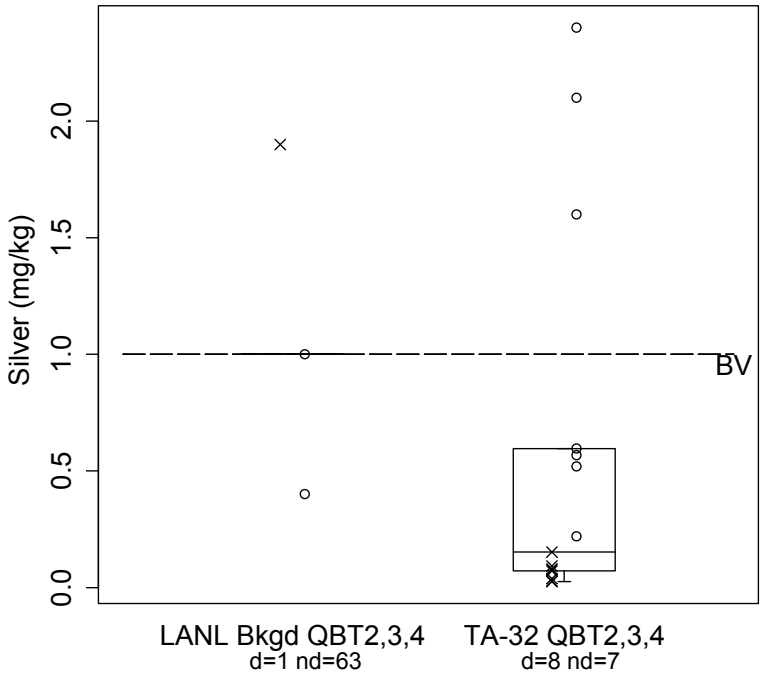


Figure E-8 Site concentrations of silver in tuff at SWMU 32-002(b1) compared with Qbt 2,3,4 background

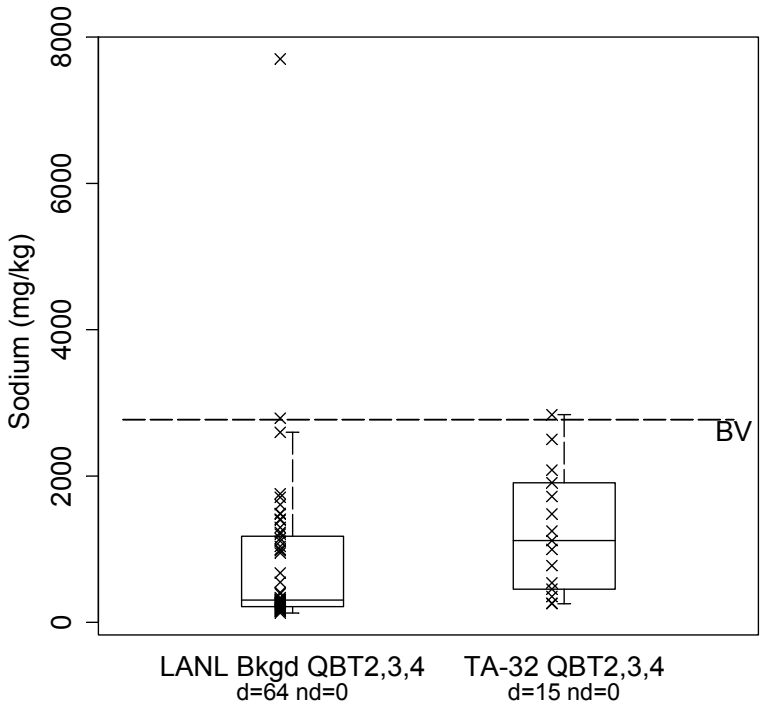


Figure E-9 Site concentrations of sodium in tuff at SWMU 32-002(b1) compared with Qbt 2,3,4 background

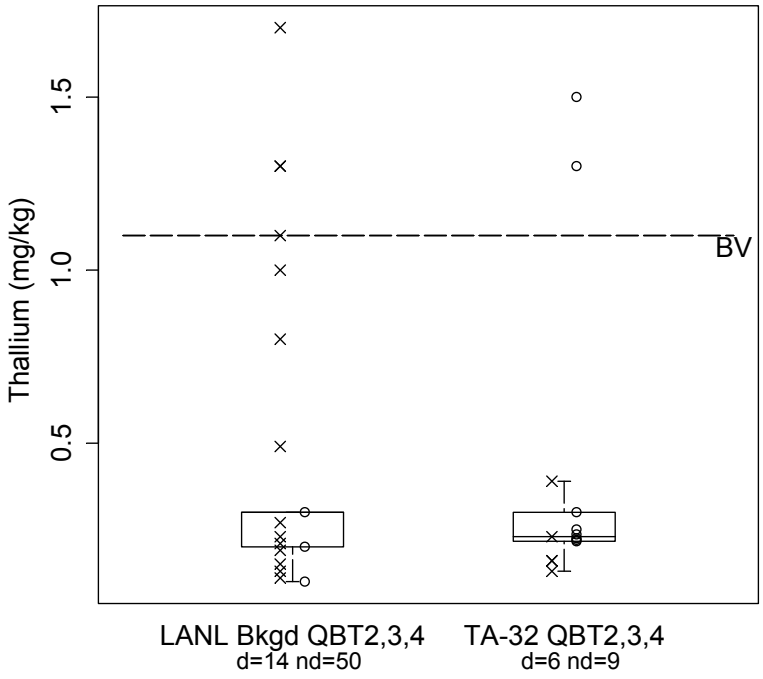


Figure E-10 Site concentrations of thallium in tuff at SWMU 32-002(b1) compared with Qbt 2,3,4 background

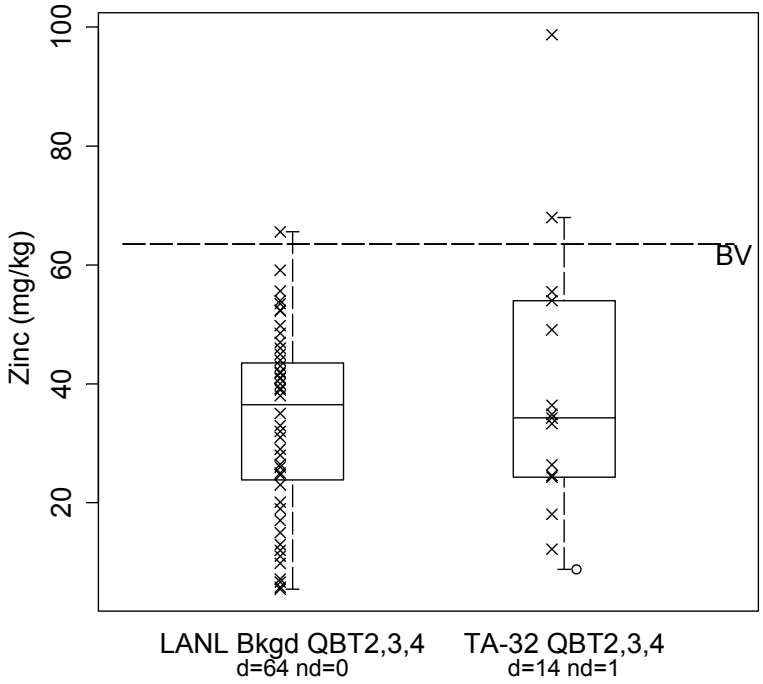


Figure E-11 Site concentrations of zinc in tuff at SWMU 32-002(b1) compared with Qbt 2,3,4 background

Table E-1
Results of Statistical Tests for
Inorganic Chemicals in Tuff at SWMU 32-002(b1)

Analyte	Gehan p-value	Quantile p-value	Slippage p-value	Chemical of Potential Concern?
Calcium	0.71	0.66	n/a*	No
Cobalt	0.31	0.27	n/a	No
Copper	0.0002	0.045	n/a	Yes
Silver	n/a	n/a	1	Yes
Sodium	0.0021	0.24	1	No
Thallium	n/a	n/a	1	Yes
Zinc	0.38	0.24	n/a	No

*n/a = Not applicable.

Appendix F

Risk Assessments

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Attachments

Attachment F-1 ProUCL Files (on CD included with this document)
Attachment F-2 Ecological Scoping Checklist

F-1.0 INTRODUCTION

This appendix presents the results of the human health and ecological risk-screening assessments for two sites located at former Technical Area 32 (TA-32) in the Upper Los Alamos Canyon Aggregate Area at Los Alamos National Laboratory (LANL or the Laboratory). The sites assessed are Solid Waste Management Units (SWMUs) 32-002(a) and 32-002(b1).

F-2.0 BACKGROUND

Former TA-32 was occupied by the medical research facility from 1944 to 1953 when operations were moved to TA-43 as the research group expanded. All the structures at former TA-32 were removed after 1954. Currently, the mesa-top portion of TA-32 is owned by Los Alamos County and the Los Alamos School Board and is almost entirely covered by asphalt. The area was used to store equipment and materials for roadwork and maintenance. Maintenance activities include using solvents, lubricants, and fuels; emptying of street sweeper contents until they are moved to a disposal facility; staging of asphalt, road salt, and other materials; and cleaning vehicles.

Sites addressed in the supplemental remedy completion report include two septic systems that served former buildings 32-01 and 32-02 [SWMUs 32-002(a) and 32-002(b1)]. These sites are shown on Plate 1.

F-2.1 Site Descriptions and Operational History

F-2.1.1 SWMU 32-002(a)

SWMU 32-002(a) is a former septic tank and its associated drainline. The septic system received waste from building 32-1 and discharged to Los Alamos Canyon. In 1944, the septic system was installed south of building 32-01 on the edge of Los Alamos Canyon. The septic system consisted of a wood-frame tank (former structure 32-07) measuring 4 ft × 8 ft × 4 ft, an influent line from building 32-01, and an outlet drainline that discharged to the edge of Los Alamos Canyon. Research activities at the site involved plutonium-238, plutonium-239, americium-241, and carbon-14. Inorganic and organic chemicals also may have been used at the facility. The laboratory (building 32-01) operated from 1944 to 1953 and was decommissioned in 1954. The septic tank was removed before 1996, but no archival records are available on removal date or disposition of the tank. The drainline was removed in 1996 and disposed of at Material Disposal Area G, TA-54 (LANL 1996, 059178, pp. 12, 71). The drainlines were removed during a 1996 voluntary corrective action (LANL 1996, 059178).

F-2.1.2 SWMU 32-002(b1)

SWMU 32-002(b) has recently been divided into two SWMUs: SWMU 32-002(b1), the drainline portion of the septic system from former building 32-02 on Los Alamos School Board property and is evaluated herein, and SWMU 32-002(b2), the portion of the site on U.S. Department of Energy (DOE) property, which will be evaluated in the Phase II Upper Los Alamos Canyon Aggregate Area investigation report.

The septic system [SWMUs 32-002(b1) and 32-002(b2)] was installed when the SWMU 32-002(a) septic tank could no longer meet the usage requirement of the laboratory (former building 32-01). The influent line of SWMU 32-002(a) was diverted to the new septic tank (former structure 32-08), which also received effluent from former building 32-02, the medical research annex. The outfall of SWMU 32-002(b2) was at the edge of Los Alamos Canyon.

Research activities at former building 32-01 involved radionuclides. Inorganic and organic chemicals may also have been used. Because no industrial waste line served former TA-32, it is possible chemical and radioactive wastes may have been disposed of in sinks and drains connected to the septic system. The septic tank was removed in 1988, and the drainlines were removed in 1996.

F-2.2 Sampling Results and Determination of Chemicals of Potential Concern

The data used to identify chemicals of potential concern (COPCs) and to evaluate potential risks to human health and the environment for these sites at former TA-32 consisted of all qualified analytical results compiled from historical sampling activities, the 2010 accelerated corrective action activities, and the 2011 Phase II sampling. Only those data determined to be of decision-level quality following the data-quality assessment (Appendix D) are included in the data sets evaluated in this risk appendix. The data are present in Appendix C (on DVD). Section 1.3 of the supplemental remedy completion report summarizes the COPC identification process.

The COPCs for SWMU 32-002(a) identified in Revision 1 of the remedy completion report (LANL 2011, 111806, p. 11) were reviewed to determine the relevant COPCs for the appropriate depth intervals evaluated for human health and ecological risk. Based on this review, a subset of COPCs were included in the risk screening assessments for this site.

Because former SWMU 32-002(b) has been divided into SWMUs 32-002(b1) and 32-002(b2), the COPCs identified in Revision 1 of the remedy completion report (LANL 2011, 111806.23, p. 16–17) were reviewed to determine whether the COPCs pertained to one or both SWMUs and were associated with the depth intervals evaluated for human health and ecological risk. Based on this review, a subset of COPCs were included in the risk screening assessments for this site.

F-3.0 CONCEPTUAL SITE MODEL

The two sites [SWMUs 32-002(a) and 32-002(b1)] for which extent is defined are of both of one type (i.e., septic systems). The COPCs may occur in the subsurface surrounding the structure, particularly at the junctions between tank and piping or connections in the associated piping structure. The septic tanks have been excavated.

F-3.1 Receptors and Exposure Pathways

The primary exposure pathway for human receptors is from surface and subsurface soil or tuff that may be brought to the surface through intrusive activities. Migration of contamination to groundwater through the vadose zone is not likely given the depth to groundwater (greater than 1000 ft below ground surface [bgs]) at the site. Human receptors may be exposed through direct contact with soil or suspended particulates by ingestion, inhalation, dermal contact, and external irradiation pathways. Direct contact exposure pathways from subsurface contamination to human receptors are not complete for the industrial/commercial scenario. The sources, exposure pathways, and receptors are shown in the conceptual site model in Figure F-3.1-1.

The portion of the sites at former TA-32 on the mesa top provide minimal potential habitat for ecological receptors because the area is highly developed. Exposure pathways are complete to surface soil and tuff for ecological receptors to a depth of 0–5 ft. Weathering of tuff is the only viable natural process that may result in the exposure of receptors to COPCs in tuff. However, because of the slow rate of weathering expected for tuff, exposure to COPCs in tuff is negligible, although it is included in the assessments. Exposure pathways to subsurface contamination below 5 ft are not complete unless contaminated soil or

tuff were excavated and brought to the surface. The potential pathways are root uptake by plants, inhalation of vapors, inhalation of dust, dermal contact, incidental ingestion of soil, external irradiation, and food-web transport. Pathways from subsurface releases may be complete for plants. Surface water was not evaluated because of the lack of surface water features.

F-3.2 Environmental Fate and Transport

The evaluation of environmental fate addresses the chemical processes affecting the persistence of a chemical in the environment; the evaluation of transport addresses the physical processes affecting mobility of a contaminant along a migration pathway. Migration through soil and tuff depends on properties such as soil pH, rate of precipitation or snowmelt, soil moisture content, soil-tuff hydraulic properties, and properties of the COPCs. Migration into and through tuff also depends on the unsaturated flow properties of the tuff and the presence of joints and fractures.

The most important factor with respect to the potential for COPCs to migrate to groundwater is the presence of saturated conditions. Downward migration in the vadose zone is limited also by a lack of hydrostatic pressure as well as lack of a source for the continued release of contamination. Without sufficient moisture and a source, little or no potential migration of materials through the vadose zone to groundwater occurs.

Contamination at depth is addressed in the discussion of nature and extent in section 4 of the remedy completion report (LANL 2011, 111806) and in sections 4.1.1 and 4.2.4 of the supplemental report. Results from the deepest samples collected showed either no detected concentrations of COPCs or low/trace-level concentrations of only a few inorganic, radionuclide, and/or organic COPCs in tuff. The limited extent of contamination is related to the absence of the key factors that facilitate migration, as discussed above. Given how long the contamination has been present in the subsurface, the physical and chemical properties of the COPCs, and the lack of saturated conditions, the potential for contaminant migration to groundwater is very low.

The New Mexico Environment Department (NMED) guidance (NMED 2012, 219971) contains screening levels that consider the potential for contaminants in soil to result in groundwater contamination. These screening levels consider equilibrium partitioning of contaminants among solid, aqueous, and vapor phases and account for dilution and attenuation in groundwater through the use of dilution attenuation factors (DAFs). These DAF soil screening levels (SSLs) can be used to identify chemical concentrations in soil that have the potential to contaminate groundwater (EPA 1996, 059902). However, screening contaminant concentrations in soil against these DAF SSLs do not provide an indication of the potential for contaminants to migrate to groundwater. The assumptions used in the development of these DAF SSLs include an assumption of uniform contaminant concentrations from the contaminant source to the water table (i.e., it is assumed that migration to groundwater has already occurred). Furthermore, this assumption is inappropriate for cases such as former TA-32 where sampling has shown that contamination is vertically bounded near the surface and the distance from the surface to the water table is large. For these reasons, screening of contaminant concentrations in soil against the DAF SSLs was not performed.

The best indication of the potential for future contaminant migration to groundwater is the current vertical distribution of contaminants in the subsurface. The releases from the sites at former TA-32 occurred decades ago. The regional aquifer beneath the aggregate area is greater than 1000 ft bgs. Therefore, for migration of contaminants to occur from shallow soil to the regional aquifer in a meaningful time frame (e.g., 100 to 1000 yr), significant vertical migration should have occurred already. Sampling has shown

that this migration has not occurred, indicating a very low potential for future contaminant migration to groundwater.

The relevant release and transport processes of the COPCs are a function of chemical-specific properties that include the relationship between the physical form of the constituents and the nature of the constituent transport processes in the environment. Specific properties include the degree of saturation, the potential for ion exchange or sorption, and the potential for natural bioremediation. The transport of VOCs occurs primarily in the vapor phase by diffusion or advection in subsurface air. The chemical and physical properties of the COPCs are presented in Tables F-3.2-1, F-3.2-2, and F-3.2-3.

The primary release and transport mechanisms that may lead to the potential exposure of receptors from the sites at former TA-32 include

- dissolution and/or particulate transport of surface contaminants from precipitation and runoff,
- airborne transport of contaminated surface soil or particulates,
- continued dissolution and advective/dispersive transport of chemical and radiological contaminants contained in subsurface soil and bedrock,
- biotic perturbation and/or translocation of contaminants in subsurface contaminated media, and
- uptake of contaminants from soil and water by biota.

Contaminant distributions at the sites indicate that after the initial deposition of contaminants from operational activities and historical remediation efforts, elevated levels of contaminants tend to remain concentrated near the original release points.

F-3.2.1 Inorganic Chemicals

Table F-3.2-1 presents the physical and chemical properties (soil-water partition coefficient [K_d] and solubility) of the inorganic COPCs identified. In general, and particularly in a semiarid climate such as that found at former TA-32, inorganic chemicals are not highly soluble or mobile in the environment. The primary physical and chemical factors that determine and describe the distribution of inorganic COPCs within the soil and tuff are the water solubility of the inorganic chemical and K_d. Other factors besides the K_d values, such as speciation in soil and oxidation-reduction potential (Eh) and pH, also play a role in the likelihood that inorganic chemicals will migrate. The K_d values provide a general assessment of the potential for migration through the subsurface; chemicals with higher K_d values are less likely to be mobile than those with lower K_d values. Inorganic chemicals with K_d values greater than 40 are very unlikely to migrate through soil towards the water table (Kincaid et al. 1998, 093270). Based on this criterion, antimony, barium, beryllium, chromium, lead, mercury, nickel, thallium, and zinc have a very low potential to mobilize and migrate through soil and the vadose zone.

The K_d values for copper, nitrate, perchlorate, selenium, and silver are less than 40 and may indicate that these inorganic chemicals have a greater potential to mobilize and migrate through soil and the vadose zone. These COPCs are discussed further below. Information about the fate and transport properties of inorganic chemicals was obtained from individual chemical profiles published by the Agency for Toxic Substances and Disease Registry (ATSDR) (ATSDR 1997, 056531). Information for these inorganic chemicals is also available from the ATSDR website at http://www.atsdr.cdc.gov/toxpro2.html.

- Copper movement in soil is determined by physical and chemical interactions with the soil components. The K_d value for copper is 35 cm^3/g (Table F-3.2-1), indicating it is not highly mobile. Most copper deposited in soil is strongly adsorbed and remains in the upper few

centimeters. Copper will adsorb to organic matter, carbonate minerals, clay minerals, hydrous iron, and manganese oxides. In most temperate soil, pH, organic matter, and ionic strength of the soil solutions are the key factors affecting adsorption. Copper binds to soil much more strongly than other divalent cations, and the distribution of copper in the soil solution is less affected by pH than other metals. Copper is expected to be bound to the soil and move in the system by way of transport of soil particles by water as opposed to movement as dissolved species. Because the average pH is 7.8 at former TA-32, leaching of copper is unlikely.

- Nitrate is highly soluble in water and may migrate with water molecules in saturated soil. As noted above, the subsurface material beneath former TA-32 has low moisture content, which would inhibit the mobility of nitrate as well as most other inorganic chemicals. In addition, nitrate is naturally occurring and the concentrations detected reflect naturally occurring levels.
- Perchlorate is soluble in water and may migrate with water molecules in saturated soil. As noted above, the subsurface material beneath former TA-32 has low moisture content, which would inhibit the mobility of perchlorate as well as most other inorganic chemicals.
- Selenium is not often found in the environment in its elemental form but is usually combined with sulfide minerals or with silver, copper, lead, and nickel minerals. In soil, pH and Eh are determining factors in the transport and partitioning of selenium. In soil with a pH of greater than 7.5, selenates, which have high solubility and a low tendency to adsorb onto soil particles, are the major selenium species and are very mobile. The average pH at former TA-32 is 7.8, which indicates that selenium does not have a high potential to migrate.
- Silver sorbs onto soil and sediment and tends to form complexes with inorganic chemicals and humic substances in soil. Organic matter complexes with silver and reduces its mobility. Silver compounds tend to leach from well-drained soil so that it may potentially migrate into the subsurface.

F-3.2.2 Organic Chemicals

Table F-3.2-2 presents the physical and chemical properties (organic carbon-water partition coefficient [K_{oc}], logarithm to the base 10 octanol-water partition coefficient [log K_{ow}], solubility, and vapor pressure) of the organic COPCs identified. Physical and chemical properties of organic chemicals are important when evaluating their fate and transport. The following information illustrates some aspects of the fate and transport tendencies of these COPCs. The information is summarized from Ney (1995, 058210).

Water solubility may be the most important chemical characteristic used to assess mobility of organic chemicals. The higher the water solubility of a chemical, the more likely it is to be mobile and the less likely it is to accumulate, bioaccumulate, volatilize, or persist in the environment. A highly soluble chemical (water solubility greater than 1000 mg/L) is prone to biodegradation and metabolism that may detoxify the parent chemical. The following organic COPCs have water solubilities greater than 1000 mg/L: acetone, benzoic acid, methylene chloride, and trichlorofluoromethane.

The lower the water solubility of a chemical, especially below 10 mg/L, the more likely it will be immobilized by adsorption. Chemicals with lower water solubilities are more likely to accumulate or bioaccumulate and persist in the environment, to be slightly prone to biodegradation, and to be metabolized in plants and animals. The following organic COPCs have water solubilities less than 10 mg/L: acenaphthene, anthracene, Aroclor-1260, benzo(a)anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[k]fluoranthene, bis[2-ethylhexyl]phthalate, butylbenzylphthalate, carbazole, chrysene, dibenz[a,h]anthracene, dibenzofuran, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, phenanthrene, pyrene, and 2,3,7,8-tetrachlorodibenzodioxin (TCDD).

Vapor pressure is a chemical characteristic used to evaluate the tendency of organic chemicals to volatize. Chemicals with vapor pressure greater than 0.01 millimeters of mercury (mm Hg) are likely to volatilize, and therefore, concentrations at the site are reduced over time; vapors of these chemicals are more likely to travel toward the atmosphere and not migrate toward groundwater. The following organic COPCs have vapor pressures greater than 0.01 mm Hg: acetone, methylene chloride, tetrachloroethene, and trichlorofluoromethane.

Chemicals with vapor pressures less than 0.000001 mm Hg are less likely to volatilize and therefore tend to remain immobile. The following organic COPCs have vapor pressures less than 0.000001 mm Hg: benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[k]fluoranthene, bis[2-ethylhexyl]phthalate, carbazole, chrysene, dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, and 2,3,7,8-TCDD.

The K_{ow} is an indicator of a chemical's potential to bioaccumulate or bioconcentrate in the fatty tissues of living organisms. The unitless K_{ow} value is an indicator of water solubility, mobility, sorption, and bioaccumulation. The higher the K_{ow}, the greater the affinity the chemical has for bioaccumulation in the food chain, the greater its potential for sorption in the soil, and the lower its mobility (Ney 1995, 058210). The following organic COPCs have K_{ow} values greater than 1000: acenaphthene, anthracene, Aroclor-1260, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[k]fluoranthene, bis[2-ethylhexyl]phthalate, butylbenzylphthalate, carbazole, chrysene, dibenz[a,h]anthracene, dibenzofuran, di-n-butylphthalate, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, naphthalene, phenanthrene, pyrene, tetrachloroethene, and 2,3,7,8-TCDD.

A K_{ow} of less than 500 indicates high water solubility, high mobility, little to no affinity for bioaccumulation, and degradability by microbes, plants, and animals. The following organic COPCs have K_{ow} values less than 500: acetone, benzoic acid, dichlorofluoromethane, methylene chloride, and trichlorofluoromethane.

The K_{oc} measures the tendency of a chemical to adsorb to organic carbon in soil. K_{oc} values above 500 L/kg indicate a strong tendency to adsorb to soil, leading to low mobility (NMED 2012, 219971). The following organic COPCs have K_{oc} values above 500 L/kg, indicating a very low potential to migrate toward groundwater: acenaphthene, anthracene, Aroclor-1260, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[k]fluoranthene, bis[2-ethylhexyl]phthalate, butylbenzylphthalate, carbazole, chrysene, dibenz[a,h]anthracene, dibenzofuran, di-n-butylphthalate, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, naphthalene, phenanthrene, pyrene, and 2,3,7,8-TCDD. The following organic COPCs have K_{oc} values less than 500 L/kg: acetone, benzoic acid, dichlorodifluoromethane, methylene chloride, tetrachloroethene, and trichlorofluoromethane.

In summary, the following organic COPCs are the least mobile and the most likely to bioaccumulate: acenaphthene, anthracene, Aroclor-1260, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[k]fluoranthene, bis[2-ethylhexyl]phthalate, carbazole, chrysene, dibenz[a,h]anthracene, fluoranthene, fluorene, phenanthrene, pyrene, and 2,3,7,8-TCDD. The more soluble and volatile COPCs are more mobile but are also more likely to travel toward the atmosphere and not migrate toward groundwater. They include acetone, benzoic acid, methylene chloride, tetrachloroethene, and trichlorofluoromethane. Because the organic COPCs were detected at low concentrations and the extent is defined, they are not likely to migrate to groundwater.

F-3.2.3 Radionuclides

Table F-3.2-3 gives physical and chemical properties (K_d and solubility) of the radionuclide COPCs identified. Radionuclides are generally not highly soluble or mobile in the environment, particularly in the semiarid climate of the Laboratory. The physical and chemical factors that determine the distribution of

radionuclides within soil and tuff are the K_d, the pH of the soil and other soil characteristics (e.g., sand or clay content), and the Eh. The interaction of these factors is complex, but K_d values provide a general assessment of the potential for migration through the subsurface: chemicals with higher K_d values are less likely to be mobile than those with lower values. Radionuclides with K_d values greater than 40 are very unlikely to migrate through soil towards the water table (Kincaid et al. 1998, 093270).

Based on K_d values, cesium 137, plutonium-238, and plutonium 239/240 have a very low potential to migrate towards groundwater. The K_d values for tritium and uranium-235/236 are less than 40 and indicate a potential to migrate towards groundwater.

- Uranium is a natural and commonly occurring radioactive element present in nearly all rock and soil. The mobility of uranium in soil and its vertical transport to groundwater depend on properties of the soil such as pH, Eh, concentration of complexing anions, porosity of the soil, soil-particle size, and sorption properties as well as the amount of water available. In general, the actinide nuclides form comparatively insoluble compounds in the environment and are therefore not considered biologically mobile. The actinides are transported in ecosystems mainly by physical and sometimes chemical processes. They tend to attach, sometimes strongly, to surfaces and tend to accumulate in soil and sediment, which ultimately serve as strong reservoirs. Retention of uranium by soil may be from adsorption, chemisorption, ion exchange, or a combination of these mechanisms. The sorption of uranium in most soil is such that it may not leach readily from soil surface to groundwater, particularly in soil containing clay and iron oxide.
- Tritium's initial behavior in the environment is determined by the source. If it is released as a gas or vapor to the atmosphere, substantial dispersion can be expected, and the rapidity of deposition is dependent on climatic factors. If tritium is released in liquid form, it is diluted in surface water and is subject to physical dispersion, percolation, and evaporation (Whicker and Schultz 1982, 058209, p. 147). Tritium concentrations are low (<0.1 pCi/g), indicating the area of elevated radioactivity is not a significant source of tritium, although this radionuclide is relatively mobile. Because tritium migrates in association with moisture, the low moisture content of the subsurface limits the potential for tritium to migrate to groundwater.

F-3.3 Exposure Point Concentration Calculations

The exposure point concentrations (EPCs) represent upper bound concentrations of COPCs. For comparison to risk-screening levels, the upper confidence limit (UCL) of the arithmetic mean of a set of concentrations was calculated when possible and used as the EPC. If an appropriate UCL of the mean could not be calculated or if the UCL exceeded the maximum concentration, the maximum detected concentration or the maximum detection limit of the COPC was used as the EPC.

Calculation of the UCLs of the mean concentration was done using the U.S. Environmental Protection Agency (EPA) ProUCL 4.1 software (EPA 2010, 109944), which is based on EPA guidance (EPA 2002, 085640). The ProUCL software performs distributional tests on the data set for each COPC and calculates the most appropriate UCL based on the distribution of the data set. The ProUCL program calculates 95%, 97.5%, and 99% UCLs and recommends a distribution and a value for UCL. The UCL calculated via the recommended distribution was used as the EPC. Environmental data may have a normal, lognormal, or gamma distribution but are often nonparametric (no definable shape to the distribution). The input and output data files for ProUCL calculations for each site are provided on CD as Attachment F-1.

The summary statistics, including the EPC for each COPC for the industrial scenario and ecological receptors along with the distributions used for the calculations are presented in Tables F-3.3-1, F-3.3-2,

and F-3.3-3. The dioxin and furan congener toxicity equivalency factor (TEF) calculations, which yield a 2,3,7,8-TCDD–equivalent EPC for the dioxin and furan congeners, are presented in Tables F-3.3-4, F-3.3-5, and F-3.3-6.

F-4.0 HUMAN HEALTH RISK-SCREENING ASSESSMENTS

Human health and ecological risk assessments were conducted for SWMUs 32-002(a) and 32-002(b1). Both sites were screened using the industrial scenario only, based on the current and reasonably foreseeable future land use.

The risk-screening assessment(s) for a site included all COPCs detected within the depth interval relevant for the exposure scenario evaluated. The relevant depth interval for SWMUs 32-002(a) and 32-002(b1) is 0–1 ft bgs for the industrial scenario (NMED 2012, 219971).

The COPCs evaluated for a scenario may differ depending on the depth at which the COPC was detected. Because sampling depths often overlapped during multiple investigations, all samples with a starting depth of less than the lower bound of the interval for the scenario were included in the risk assessment. Some COPCs may not be evaluated for potential risk under one or more scenarios because they were not detected within the specified depth intervals associated with a given scenario.

F-4.1 SSLs and Screening Action Levels

Human health risk-screening assessments were conducted for inorganic and organic COPCs using the industrial SSLs from NMED guidance (NMED 2012, 219971) or EPA regional screening tables (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm). The EPA SSLs for carcinogens were multiplied by 10 to adjust from a 10^{-6} cancer risk level to the NMED target cancer risk level of 10^{-5}. Exposure parameters used to calculate the SSLs for the industrial scenario are presented in Table F-4.1-1. Surrogate chemicals based on structural similarity or because the surrogate is a parent compound were used if a COPCs does not have a screening value (NMED 2003, 081172).

Radionuclide screening action levels (SALs) are used for comparison with radionuclide COPC concentrations and were derived using the residual radioactive (RESRAD) model, Version 6.5 (LANL 2009, 107655). The SALs are based on a 15-mrem/yr dose (Soden 2000, 067489). Exposure parameters used to calculate the SALs for the industrial scenario are presented in Table F-4.1-2.

F-4.2 Results of the Human Health Risk-Screening Assessments

The EPC of each COPC was compared with the SSL/SAL for the industrial scenario as follows

- For a carcinogenic COPC, the EPC is divided by the SSL and multiplied by 1×10^{-5}. The cancer risks are summed for a site, and the sum is compared with the NMED target cancer risk level of 1×10^{-5} (NMED 2012, 219971).
- For a noncarcinogenic COPC, an HQ is calculated by dividing the EPC by the SSL. The HQs are summed for a site to obtain a hazard index (HI). The HI is compared with the NMED target HI of 1 (NMED 2012, 219971).
- For a radionuclide, the EPC is divided by the SAL and multiplied by 15 mrem/yr. The doses are summed for a site, and the sum is compared with the DOE target dose level of 15 mrem/yr (Soden 2000, 067489).

F-4.2.1 SWMU 32-002(a)

The results of the risk-screening assessments for the industrial scenario are presented in Tables F-4.2-1, F-4.2-2, and F-4.2-3. The total excess cancer risk is approximately 2×10^{-7}, which is less than the NMED target cancer risk level of 1×10^{-5}. The HI is approximately 0.08, which is less than the NMED target HI of 1. The total dose is approximately 1 mrem/yr, which is less than the DOE target dose limit of 15 mrem/yr.

F-4.2.2 SWMU 32-002(b1)

SWMU 32-002(b1) consists of a drainline located below the ground surface, which was part of a former septic system. No samples were collected from 0–1 ft bgs within this SWMU (samples were collected from 3.5 to 10 ft bgs), so no complete exposure pathways exist for the industrial scenario, and a risk-screening assessment was not performed. As a result, no potential unacceptable risk or dose related to the industrial scenario exists.

F-4.3 Uncertainty Analysis

The human health risk-screening assessments are subject to varying degrees and types of uncertainty. Aspects of data evaluation and COPC identification, exposure assessment, toxicity assessment, and the additive approach all contribute to uncertainties in the risk assessment process. Each or all of these uncertainties may affect the evaluation results.

F-4.3.1 Data Evaluation and COPC Identification Process

A primary uncertainty associated with the COPC identification process is the possibility that a chemical may be inappropriately identified as a COPC when it is actually not a COPC or that a chemical may not be identified as a COPC when it actually should be identified as a COPC. Inorganic chemicals are appropriately identified as COPCs because only those chemicals either detected or with detection limits above background are retained for further analysis. However, established background values (BVs) may not accurately represent certain subunits of the Bandelier Tuff (e.g., fractured, clay-rich material) that may be encountered during sampling because such data are not included in the background data set. Some inorganic chemicals and radionuclides may also have been retained as COPCs that are not site-related. All detected organic chemicals are identified as COPCs and are retained for further analysis.

Other uncertainties may include errors in sampling, laboratory analysis, and data analysis. However, because some concentrations used in the risk-screening assessments are less than detection or quantitation limits, data evaluation uncertainties are expected to have little effect on the risk-screening results.

F-4.3.2 Exposure Assessment

The following exposure assessment uncertainties were identified for the risk assessment: (1) the applicability of the standard scenarios, (2) the assumptions underlying the exposure pathways, and (3) the derivation of EPCs.

An individual may be subject to exposures in a different manner than the exposure assumptions used to derive the SSLs/SALs. For the sites evaluated, individuals might not be on-site at present or in the future for that frequency and duration. The industrial assumptions for the SSLs are that the potentially exposed individual is outside on-site for 8 h/d, 225 d/yr, and 25 yr (NMED 2012, 219971). As a result, the industrial scenario evaluated at these sites likely overestimates the potential exposure, risk, and/or dose.

A number of assumptions are made relative to exposure pathways, including input parameters, whether or not a given pathway is complete, the contaminated media to which an individual may be exposed, and intake rates for different routes of exposure. In the absence of site-specific data, the exposure assumptions used were consistent with default values (NMED 2012, 219971). When several upper-bound values (as are found in NMED 2012, 219971) are combined to estimate exposure for any one pathway, the resulting risk can exceed the 99th percentile and, therefore, can exceed the range of risk that may be reasonably expected. Also, the assumption that residual concentrations of chemicals in the tuff are available and result in exposure can overestimate the potential risk/dose to receptors.

Uncertainty is introduced in the concentration aggregation of data for estimating the EPCs at a site. The use of a UCL is intended to provide a protective upper-bound estimate of the COPC concentration and is assumed to be representative of average exposure to a COPC across the entire site. Potential risk and exposure from a single location or area with relatively high COPC concentrations may be overestimated if a representative, site-wide value is used. The use of the maximum detected concentration for the EPC overestimates the exposure to contamination because receptors are not consistently exposed to the maximum detected concentration across the site.

F-4.3.3 Toxicity Assessment

The primary uncertainty associated with the screening values is related to the derivation of toxicity values used in their calculation. Toxicity values (slope factors [SFs] and reference doses [RfDs]) were used to derive the screening values used in this screening evaluation (NMED 2012, 219971). Uncertainties were identified in five areas with respect to the toxicity values: (1) extrapolation from animals to humans, (2) interindividual variability in the human population, (3) the derivation of SFs and RfDs, (4) the chemical form of the COPC, and (5) the use of surrogate chemicals.

Extrapolation from Animals to Humans

The SFs and RfDs are often determined by extrapolation from animal data to humans, which may result in uncertainties in toxicity values because differences exist between other animals and humans in chemical absorption, metabolism, excretion, and toxic response. Differences in body weight, surface area, and pharmacokinetic relationships between animals and humans are taken into account to address these uncertainties in the dose-response relationship. However, conservatism is usually incorporated into each of these steps, resulting in the overestimation of potential risk.

Individual Variability in the Human Population

For noncarcinogenic effects, the degree of human variability in physical characteristics is important in determining the risks that can be expected at low exposures and in determining the no observed adverse effect level (NOAEL). The NOAEL uncertainty factor approach incorporates a factor of 10 to reflect the possible interindividual variability in the human population that can contribute to uncertainty in the risk evaluation. This factor of 10 is generally considered to result in a conservative estimate of risk to noncarcinogenic COPCs.

Derivation of SFs and RfDs

The SFs and RfDs for different chemicals are derived from experiments conducted by different laboratories that may have different accuracy and precision that could lead to an over- or underestimation of the risk. The uncertainty associated with the toxicity factors for noncarcinogens is measured by the uncertainty factor, the modifying factor, and the confidence level. For carcinogens, the weight of evidence

classification indicates the likelihood that a contaminant is a human carcinogen. Toxicity values with high uncertainties may change as new information is evaluated.

Chemical Form of the COPC

COPCs may be bound to the environmental matrix and not available for absorption into the human body. However, the exposure scenarios default to the assumption that the COPCs are bioavailable. This assumption can lead to an overestimation of the total risk or dose.

Use of Surrogate Chemicals

The use of surrogates for chemicals that do not have EPA-approved or provisional toxicity values also contributes to uncertainty in risk assessment. A surrogate was used to establish SSL for benzo[g,h,i]perylene based on structural similarity (NMED 2003, 081172). The overall impact of the surrogate on the risk assessment is minimal because benzo[g,h,i]perylene was detected at low concentrations and the HQs were less than 0.1.

F-4.3.4 Additive Approach

For noncarcinogens, the effects of exposure to multiple chemicals are generally not known, and possible interactions could be synergistic or antagonistic, resulting in either an overestimation or underestimation of the potential risk. Additionally, RfDs used in the risk calculations typically are not based on the same endpoints with respect to severity, effects, or target organs. Therefore, the potential for noncarcinogenic effects may be overestimated for individual COPCs that act by different mechanisms and on different target organs but are addressed additively.

F-4.4 Interpretation

F-4.4.1 SWMU 32-002(a)

The total excess cancer risk for the industrial scenario is approximately 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5}.

The HI is are 0.08 for the industrial scenario and is below the NMED target HI of 1.

The total dose is approximately 1 mrem/yr for the industrial scenario, which is below the DOE target dose limit of 15 mrem/yr. The total dose for the industrial scenario is equivalent to a total risk of approximately 1×10^{-5} based on a comparison with EPA's outdoor worker preliminary remediation goals (PRGs) for radionuclides (available at http://epa-prgs.ornl.gov/radionuclides/download. html).

Based on the risk-screening assessment results, no potential unacceptable risks or dose exists at SWMU 32-002(a) for the industrial scenario.

F-4.4.2 SWMU 32-002(b1)

No samples were collected from 0–1 ft bgs at SWMU 32-002(b1) because the drainline is below the ground surface (samples collected from 3.5–10 ft bgs). Therefore, there is no exposure to COPCs under the industrial scenario at 0–1 ft bgs and there is no potential risk or dose to this receptor.

F-5.0 ECOLOGICAL RISK-SCREENING ASSESSMENT

The approach for conducting ecological risk-screening assessments is described in the "Screening Level Ecological Risk Assessment Methods, Revision 2" (LANL 2004, 087630). The assessment consists of the following four parts: (1) a scoping evaluation, (2) a screening evaluation, (3) an uncertainty analysis, and (4) an interpretation of the results.

F-5.1 Scoping Evaluation

The scoping evaluation establishes the breadth and focus of the screening assessment. The ecological scoping checklist is a useful tool for organizing existing ecological information (Attachment F-2). The information in the scoping checklist is used to determine whether ecological receptors may be affected, identify the types of receptors that may be present, and develop the ecological conceptual site model for each site. Portions of the sites at former TA-32 are developed, with pavement overlying the site, and those areas are inaccessible to ecological receptors. The portions on the hillsides provide some habitat for ecological receptors. However, because of the presence of business and county facilities, the quality of the habitat varies.

The scoping portion of the assessment indicated that terrestrial receptors were appropriate for evaluating the concentrations of contaminants in soil and tuff samples. Aquatic receptors were not evaluated because no aquatic communities and no aquatic habitat or perennial source of water exist at any of the sites at former TA-32. The depth of the regional aquifer (greater than 1000 ft bgs) and the semiarid climate limit transport to groundwater. The potential exposure pathways for terrestrial receptors in soil and tuff are root uptake, inhalation, soil ingestion, dermal contact, external irradiation, and food-web transport (Figure F-3.1-1). The weathering of tuff is the only viable natural process that may result in the exposure of receptors to contaminants in tuff. Because of the slow rate of weathering expected for tuff, exposure in tuff is negligible, although it is included in the assessment. Plant exposure in tuff is largely limited to fractures near the surface, which does not produce sufficient biomass to support an herbivore population. Consequently, the contaminants in tuff are unavailable to receptors.

Potential risk was evaluated in the risk-screening assessments for the following ecological receptors representing several trophic levels:

- a plant,
- soil-dwelling invertebrates (represented by the earthworm),
- the deer mouse (mammalian omnivore),
- the Montane shrew (mammalian insectivore),
- the desert cottontail (mammalian herbivore),
- the red fox (mammalian carnivore),
- the American robin (avian insectivore, avian omnivore, and avian herbivore), and
- the American kestrel [avian intermediate carnivore and avian carnivore, surrogate for threatened and endangered (T&E) species].

The rationale for these receptors is presented in "Screening Level Ecological Risk Assessment Methods, Revision 2" (LANL 2004, 087630). The ecological screening levels (ESLs) are derived for each of these receptors where information is available. The ESLs are based on similar species and are derived from experimentally determined NOAELs, lowest observed-adverse effect levels (LOAELs), or doses

determined lethal to 50% of the test population. Information relevant to the calculate ESLs, including concentration equations, dose equations, bioconcentration factors, transfer factors, and toxicity reference values (TRVs) are presented in the ECORISK Database, Version 3.1 (LANL 2012, 226667).

F-5.2 Assessment Endpoints

An assessment endpoint is an explicit expression of the environmental value to be protected. These endpoints are ecologically relevant and help sustain the natural structure, function, and biodiversity of an ecosystem or its components (EPA 1998, 062809). In a screening-level assessment, assessment endpoints are attributes of ecological receptors that may be adversely affected by exposure to hazardous wastes from past operations (EPA 1997, 059370), wherein receptors are populations and communities (EPA 1999, 070086).

The ecological screening assessment is designed to protect populations and communities of biota rather than individual organisms, except for listed or candidate T&E species or treaty-protected species (EPA 1999, 070086). The protection of individual organisms within these designated protected species could also be achieved at the population level; the populations of these species tend to be small, and the loss of an individual adversely affects the species.

In accordance with this guidance, the Laboratory developed generic assessment endpoints to ensure that values at all levels of the food chain are considered in the ecological screening process (LANL 1999, 064137). These general assessment endpoints can be measured using impacts on reproduction, growth, and survival to represent categories of effects that may adversely impact populations. In addition, specific receptor species were selected to represent each functional group. The receptor species were selected because of their presence at the site, their sensitivity to the COPCs, and their potential for exposure to those COPCs. These categories of effects and the chosen receptor species were used to select the types of effects seen in toxicity studies considered in the development of the TRVs. Toxicity studies used in the development of TRVs included only those in which the evaluated adverse effect affected reproduction, survival, and/or growth.

The selection of receptors and assessment endpoints is designed to be protective of both the representative species used as screening receptors and the other species within their feeding guilds and the overall food web for the terrestrial and aquatic ecosystems. Focusing the assessment endpoints on the general characteristics of species that affect populations (rather than the biochemical and behavioral changes that may affect only the studied species) also ensures applicability to the ecosystem of concern.

F-5.3 Screening Evaluation

The ecological risk-screening assessments identify chemicals of potential ecological concern (COPECs) from 0–5 ft bgs based on the comparison of EPCs with ESLs in accordance with Laboratory guidance (LANL 2004, 087630). The ESLs were obtained from the ECORISK Database, Version 3.1 (LANL 2012, 226667) and are presented in Table F-5.3-1 for all COPCs and receptors evaluated.

The risk-screening assessments involve the following steps (LANL 2004, 087630).

- The HQs are calculated as the ratios of the EPCs (UCLs, maximum detected concentrations, or maximum detection limits) to the ESLs. The minimum ESL for each COPC is used in the initial screening, and HQs greater than 0.3 are identified as COPECs.

- The COPECs are evaluated by receptor with individual HQs for a receptor summed to produce an HI. An HI greater than 1 requires further assessment to determine if exposure to multiple COPECs results in potential adverse impacts to a given receptor population.
- COPCs without ESLs are retained as COPECs and evaluated further in the uncertainty section.

For the purposes of the ecological screening, it is assumed nonradionuclides have common toxicological effects. The HQ and HI analysis is a conservative indication of potential adverse effects and is designed to minimize the potential of overlooking possible COPECs at the site.

F-5.3.1 SWMU 32-002(a)

The results of the minimum ESL comparisons are presented in Table F-5.3-2. Antimony, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, thallium, zinc, benzo(a)anthracene, bis(2-ethylhexyl)phthalate, and 2,3,7,8-TCDD are retained as COPECs because the HQs are greater than 0.3.

Table F-5.3-3 presents the HQs and HIs for each receptor/COPEC at SWMU 32-002(a). The HI analysis indicates all receptors have HIs greater than 1. The COPECs and receptors are discussed in the uncertainty section.

Dichlorodifluoromethane, nitrate, perchlorate, and sodium do not have ESLs. They are retained as COPECs and discussed in the uncertainty section.

F-5.3.2 SWMU 32-002(b1)

The results of the minimum ESL comparisons are presented in Table F-5.3-4. Antimony, barium, chromium, copper, lead, mercury, nickel, selenium, thallium, Aroclor-1260, benzo(a)antracene, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and 2,3,7,8-TCDD are retained as COPECs because the HQs are greater than 0.3.

Table F-5.3-5 presents the HQs and HIs for each receptor/COPEC at SWMU 32-002(b1). The HI analysis indicates that all receptors have HIs greater than 1. The COPECs and receptors are discussed in the uncertainty section.

Nitrate does not have ESLs. It is retained as a COPEC and discussed in the uncertainty section.

F-5.4 Uncertainty Analysis

The uncertainty analysis describes the key sources of uncertainty related to the screening evaluations. This analysis can result in either adding or removing chemicals from the list of COPECs. This following is a qualitative uncertainty analysis of the issues relevant to evaluating potential ecological risk at each site.

F-5.4.1 Chemical Form

The assumptions used in the ESL derivations are conservative and not necessarily representative of actual conditions. These assumptions include maximum chemical bioavailability, maximum receptor ingestion rates, minimum body weight, and additive effects of multiple COPECs. These factors tend to result in conservative ESL estimates, which may lead to an overestimation of the potential risk. The assumption of additive effects for multiple COPECs may result in an over- or underestimation of the potential risk to receptors.

The chemical form of the individual COPCs was not determined as part of the investigation. Toxicological data are typically based on the most toxic and bioavailable chemical species, which are not typically found in the environment. Inorganic, radionuclide, and organic COPECs are generally not 100% bioavailable to receptors in the natural environment because of interference from other natural processes, such as the adsorption of chemical constituents to matrix surfaces (e.g., soil) or rapid oxidation or reduction changes that render harmful chemical forms unavailable to biotic processes. The ESLs were calculated to ensure a conservative indication of potential risk (LANL 2004, 087630), and the values are biased toward overestimating the potential risk to receptors.

F-5.4.2 Exposure Assumptions

The EPCs used in the calculations of HQs are the UCLs, the maximum detected concentrations, or the maximum detection limit in the soil/tuff to depths of 5 ft bgs and are conservative estimates of exposure to each COPEC. The sampling efforts focused on areas of known contamination, and receptors were assumed to ingest 100% of their food and spend 100% of their time at the site. These exposure assumptions for terrestrial receptors at the sites at former TA-32 are likely to overestimate potential ecological exposure and risk.

F-5.4.3 Toxicity Values

The HQs were calculated using ESLs, which are based on NOAELs as threshold effect levels; actual risk for a given COPEC/receptor combination occurs at a higher level, somewhere between the NOAEL-based threshold and the threshold based on the LOAEL. The use of NOAELs leads to an overestimation of potential risk to ecological receptors. ESLs are based on laboratory studies requiring extrapolation to wildlife receptors. Laboratory studies are typically based on artificial and maintained populations with genetically similar individuals and are limited to single chemical exposures in isolated and controlled conditions using a single exposure pathway. Wild species are concomitantly exposed to a variety of chemical and environmental stressors, potentially rendering them more susceptible to chemical stress. On the other hand, wild populations are probably more genetically diverse than laboratory populations, making wild populations, as a whole, less sensitive to chemical exposure than laboratory populations. The uncertainties associated with the ESLs tend to lead to an overestimation of potential risk.

F-5.4.4 Area Use Factors

In addition to the direct comparison of the EPC with the ESLs, area use factors (AUFs) are used to account for the amount of time a receptor is likely to spend within the contaminated areas based on the size of the receptor's home range (HR). The AUFs for individual organisms were developed by dividing the size of the site by the HR for that receptor. Because T&E species must be assessed on an individual basis (EPA 1999, 070086), the AUF is used for the Mexican spotted owl based on an HR of 366 ha (Table 5.4-1). The kestrel (top carnivore) is used as the surrogate receptor for the Mexican spotted owl.

The site area for SWMU 32-002(a) is 0.06 ha, which results in an AUF of 0.0002 for the Mexican spotted owl. Application of this AUF to the HI of the kestrel (top carnivore) results in an adjusted HI of 0.003. Therefore, there are no potential adverse impacts to the Mexican spotted owl.

The site area for SWMU 32-002(b1) is 0.02 ha, which results in an AUF of 0.00005 for the Mexican spotted owl. Application of this AUF to the HI of the kestrel (top carnivore) results in an adjusted HI of 0.002. Therefore, there are no potential adverse impacts to the Mexican spotted owl.

F-5.4.6 Population Area Use Factors

EPA guidance is to manage the ecological risk to populations rather than to individuals, with the exception of T&E species (EPA 1999, 070086). One approach to addressing the potential effects on populations is to estimate the spatial extent of the area inhabited by the local population that overlaps with the contaminated area. The population area for each receptor is based on the individual receptor HR and its dispersal distance (Bowman et al. 2002, 073475). Bowman et al. (2002, 073475) estimate that the median dispersal distance for mammals is 7 times the linear dimension of the HR (i.e., the square root of the HR area). If only the dispersal distances for the mammals with HRs within the range of the screening receptors are used, the median dispersal distance becomes 3.6 times the square root of the HR (R^2 = 0.91) (Bowman et al. 2002, 073475). If it is assumed that the receptors can disperse over the same distance in any direction, the population area is circular and the dispersal distance is the radius of the circle. Therefore, the population area for each receptor can be derived by $\pi(3.6\sqrt{HR})^2$ or approximately 40HR.

The population area use factor (PAUF) is calculated by dividing the site area by the population area of the receptor (Table F-5.4-1). The HQs are adjusted by multiplying by the PAUFs for each remaining COPEC for each receptor after background comparison. The HQs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs. The analyses indicate that the HIs are less than 1 for most receptors, the exceptions being the earthworm and plant at SWMUs 32-002(a) and 32-002(b1). The adjusted HQs and HIs for each site are presented in Tables F-5.4-2 and F-5.4-3.

F-5.4.7 LOAEL Analysis

SWMUs 32-002(a) and 32-002(b1) have adjusted HIs greater than 1 for the earthworm and plant. To address these HIs and reduce the associated uncertainty, a LOAEL HI analysis was conducted using ESLs calculated based on a LOAEL rather than a NOAEL. The LOAEL-based ESLs were calculated based on toxicity information in the ECORISK Database, Version 3.1 and are presented in Table F-5.4-4. The analysis addresses some of the uncertainties and conservativeness of the ESLs used in the initial screening assessments. The HIs calculated using the LOAEL-based ESLs for SWMUs 32-002(a) and 32-002(b1) are presented in Tables F-5.4-5 and F-5.4-6, respectively.

F-5.4.8 Site Discussions

SWMU 32-002(a)

The LOAEL-based HI for the earthworm is less than 1, while the LOAEL-based HI for the plant is above 1 (Table F-5.4-5). The HI (23) for the plant is primarily from antimony.

The NOAEL-based and LOAEL-based plant ESLs for antimony are 0.05 mg/kg and 0.5 mg/kg, respectively, both overestimating the potential risk. The ESLs are not substantially different from or are the same as the soil and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg), making it unlikely that the ESLs reflect an effect level. In addition, the EPC for antimony is the maximum detected concentration, which is only one of two concentration detected above a BV at this site; the other detected antimony concentration is 0.569 mg/kg. Therefore, the potential exposure and risk is substantially overestimated using this value (the HQ would be approximately 1 using the other detected concentration) and antimony does result in any adverse ecological impacts to the plant.

Field observations made during the site visit and field activities found that a plant community at SWMU 32-002(a) is not present on the mesa top portion as this area is paved. There was also no indication of adverse impacts of any kind to the plant community on the hillside portion and there appears

to be functioning ecological habitat for all terrestrial receptors, including plants, invertebrates, birds, and mammals (Attachment F-2). Therefore, the HI is not consistent with field observations and does not indicate potential risk to the plant.

SWMU 32-002(b1)

The LOAEL-based HI for the earthworm is less than 1, while the LOAEL-based HI for the plant is above 1 (Table F-5.4-6). The HI (25) for the plant is from antimony and thallium.

The NOAEL-based and LOAEL-based ESLs for antimony are 0.05 mg/kg and 0.5 mg/kg, respectively, for the plant, both overestimating the potential risk. These screening values are less than or equivalent to the soil and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg), making it unlikely that the ESLs reflect an effect level. In addition, the EPC is the maximum detection limit because antimony was not detected at the site but had elevated detection limits. The plant HI based on the maximum detection limit substantially overestimates the potential risk to the plant. Therefore, antimony does result in any adverse ecological impacts to the plant.

The NOAEL-based and LOAEL-based ESLs for thallium are 0.1 mg/kg and 0.5 mg/kg, respectively, for the plant, both overestimating the potential risk. The ESLs are less than the thallium soil and Qbt 2,3,4 BVs (0.73 mg/kg and 1.1 mg/kg), making it unlikely that the ESLs reflect an effect level. In addition, the EPC is a maximum detection limit and thallium was not detected above BV at this site. The EPC is also less than the maximum Qbt 2,3,4 background concentration (1.7 mg/kg). Therefore, the potential exposure and risk is substantially overestimated using this value as the EPC and there are no adverse ecological impacts to the plant.

Field observations made during the site visit and field activities found that a plant community at SWMU 32-002(b1) is not present on the mesa-top portion as this area is paved. Some vegetation grows along the mesa edge area, but there is not an abundance of vegetation (Attachment F-2). The lack or minimal amount of vegetation is related to the physical disturbance and urban development within and adjacent to this SWMU rather than from antimony and/or thallium. Therefore, the HI is not consistent with field observations and does not indicate potential risk to the plant.

F-5.4.9 COPECs without ESLs

Several COPECs do not have ESLs for any receptor in version 3.1 of the ECORISK Database (LANL 2012, 226667) because literature searches for relevant toxicity data for these chemicals have not been completed. In an effort to address this uncertainty and provide a quantitative assessment of potential ecological risk, several online toxicity databases have been searched in order to determine if any relevant toxicity information are available. The online databases searched were

- EPA Ecotox Database,
- EPA Office of Pesticide Programs Aquatic Life Benchmarks,
- U.S. Army Corps of Engineers/EPA Environmental Residue-Effects,
- California Cal/Ecotox Database,
- Pesticide Action Network Pesticide Database,
- U.S. Army Wildlife Toxicity Assessment Program,
- USDA Integrated Pesticide Management Database,

- American Bird Conservancy Pesticide Toxicity Database, and
- Oak Ridge National Laboratory Risk Assessment Information System.

However, toxicity data were not obtained for several COPECs and receptors as a result of this online database search. Although toxicity data were not found in the online databases listed above, a search of the literature continues in an effort to determine if any relevant toxicity information exists.

In the absence of a chemical-specific ESL, COPEC concentrations can be compared with ESLs for a surrogate chemical. Comparison to surrogate ESLs provides an estimate of potential effects of a chemically related compound and a line of evidence to indicate the likelihood ecological receptors are potentially impacted.

Some COPECs without ESLs do not have chemical-specific toxicity data or surrogate chemicals to be used in the screening assessments and cannot be assessed quantitatively for potential ecological risk. These COPECs are often infrequently detected across the site. In these cases, comparisons to residential human health SSLs are presented as part of a qualitative assessment. The comparison of COPEC concentrations to residential human health SSLs is a viable alternative for several reasons. Animal studies are used to infer effects on humans and is the basic premise of modern toxicology (EPA 1989, 008021). In addition, toxicity values derived for the calculation of human health SSLs are often based on potential effects that are more sensitive than the ones used to derive ESLs (e.g., cellular effects for humans versus survival or reproductive effects for terrestrial animals). The EPA also applies uncertainty factors or modifying factors to ensure that the toxicity values are protective (i.e., they are adjusted by uncertainty factors to values much lower than the study results).

SWMU 32-002(a)

No ESLs are available for dichlorodifluoromethane, nitrate, perchlorate, and sodium.

Dichlorodifluromethane was detected in one sample from 0–5 ft, with a maximum concentration of 0.001 mg/kg. The NMED residential SSL of 168 mg/kg indicates that potential toxicity of dichlorodifluoromethane is low. Because of the potential low toxicity and the infrequent detection, dichlorodifluoromethane is not retained as a COPEC.

Nitrate was detected in 12 samples from 0–5 ft, with a maximum concentration of 4.2 mg/kg. The NMED residential SSL for nitrate is 125,000 mg/kg, indicating that the potential toxicity is very low. In addition, nitrate is naturally occurring, and the detected concentrations reflect natural levels. Because of the potentially low toxicity and naturally occurring concentrations, nitrate is not retained as a COPEC.

Perchlorate was detected in eight samples from 0–5 ft, with a maximum detected concentration of 0.0074 mg/kg. The NMED residential SSL of 54.8 mg/kg indicates that potential toxicity of perchlorate is low. Because of the potential low toxicity and the infrequent detection, perchlorate is not retained as a COPEC.

Sodium was detected in nine samples above the soil and Qbt 2,3,4 from 0–5 ft, with a maximum concentration of 4900 mg/kg. Sodium is an essential nutrient and is naturally occurring. Soil concentrations are up to approximately a factor of 2 above the maximum soil background concentration and are below the maximum Qbt 2,3,4 background concentration. Because sodium is not substantially elevated above background and is an essential nutrient, it is not retained as a COPEC.

SWMU 32-002(b1)

No ESLs are available for nitrate.

Nitrate was detected in one sample from 0–5 ft, with a maximum concentration of 8.5 mg/kg. The NMED residential SSL for nitrate is 125,000 mg/kg, indicating the potential toxicity is very low. In addition, nitrate is naturally occurring, and the detected concentrations probably reflect natural levels. Because of the potentially low toxicity and naturally occurring concentrations, nitrate is not retained as a COPEC.

F-5.5 DOE Tier I Bioconcentration Guide

The DOE Tier I Biota Concentration Guide (BCG) (DOE 2002, 085637) is lower for cesium-137 (21.6 pCi/g) than the ECORISK Database minimum ESL (680 pCi/g). Cesium-137 is a COPC at SWMU 32-002(a). Dividing the EPC for cesium-137 (1.7 pCi/g) by the DOE Tier I BCG, results in an HQ less than 0.1. The HQ is too small to impact the HI for the site. In addition, the DOE BCG incorporates a bioaccumulation factor orders of magnitude higher than that in the ECORISK Database. Environmental surveillance and monitoring at the Laboratory indicate that bioaccumulation factors are not as high as those used by DOE (Bennett et al. 1996, 056035). Therefore, the ESL comparison is more representative than the BCG comparison.

F-5.6 Interpretation

F-5.6.1 Receptor Lines of Evidence

Based on the ecological risk-screening assessments, several COPECs (including COPECs without ESLs) were identified at the sites at former TA-32. Receptors were evaluated using several lines of evidence: minimum ESL comparisons, HI analyses, potential effects to populations (individuals for T&E species), and LOAEL analyses.

Kestrel (Top Carnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the kestrel (top carnivore), were less than 0.3.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the kestrel population area. The adjusted HIs were less than 1 for the kestrel at both sites.
- The kestrel (top carnivore) is a surrogate for the Mexican spotted owl. The HIs were adjusted by the AUF, which is the ratio of the site area to the individual HR. The adjusted HIs are less than 1 for both sites.

These lines of evidence support the conclusion that no potential ecological risk to the kestrel (top carnivore) or the Mexican spotted owl exists at SWMUs 32-002(a) and 32-002(b1).

Kestrel (Intermediate Carnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the kestrel (intermediate carnivore), were less than 0.3.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the kestrel population area. The adjusted HIs were less than for the kestrel at both sites.

These lines of evidence support the conclusion that no potential ecological risk to the kestrel (intermediate carnivore) exists at SWMUs 32-002(a) and 32-002(b1).

Robin (All Feeding Guilds)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the robin, were less than 0.3.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the robin population area. The adjusted HIs were less than 1 for the robin at both sites.

These lines of evidence support the conclusion that no potential ecological risk to the robin exists at SWMUs 32-002(a) and 32-002(b1).

Deer Mouse (Omnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the deer mouse, were less than 0.3.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the deer mouse population area. The adjusted HI was less than 1 at both sites.

These lines of evidence support the conclusion that no potential ecological risk to the deer mouse exists at SWMUs 32-002(a) and 32-002(b1).

Desert Cottontail (Herbivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the cottontail, were less than 0.3.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the cottontail population area. The adjusted HI was less than 1 at both sites.

These lines of evidence support the conclusion that no potential ecological risk to the desert cottontail exists at SWMUs 32-002(a) and 32-002(b1).

Montane Shrew (Insectivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the shrew, were less than 0.3.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the shrew population area. The adjusted HI was less than 1 at both sites.

These lines of evidence support the conclusion that no potential ecological risk to the montane shrew exists at SWMUs 32-002(a) and 32-002(b1).

Red Fox (Carnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the red fox, were less than 0.3.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the red fox population area. The adjusted HI was less than 1 at both sites.

These lines of evidence support the conclusion that no potential ecological risk to the red fox exists at SWMUs 32-002(a) and 32-002(b1).

Earthworm (Invertebrate)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the earthworm, were less than 0.3.
- The LOAEL analyses resulted in HIs less than 1 at both sites.

These lines of evidence support the conclusion that no potential ecological risk to the earthworm exists at SWMUs 32-002(a) and 32-002(b1).

Plant

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the plant, were less than 0.3.
- The LOAEL analyses resulted in HIs above 1 for the plant at both sites. The potential risks are based on the maximum detected concentration for antimony at SWMU 32-002(a), which is more than an order of magnitude higher than the only other detected antimony concentration above the Qbt 2,3,4 BV, and the maximum detection limits for antimony and thallium at SWMU 32-002(b1), which are not indicators of adverse ecological impacts.
- The plant communities were observed during site visits. No evidence of adverse impacts from contamination to the plant communities based on field observations was found during site visits; there is no vegetation on the mesa top because the area is paved, and the plant community on the hillside is typical of the surrounding area and appears healthy.

These lines of evidence support the conclusion that no potential ecological risk to the plant community exists at SWMUs 32-002(a) and 32-002(b1).

F-5.6.2 COPECs with No ESLs

The COPECs without ESLs were not evaluated for each receptor. If a residential SSL was available, it was used to estimate potential toxicity. All COPECs were eliminated based on these comparisons. The analysis of COPECs without ESLs supports the conclusion that there is no potential ecological risk to any receptor at SWMUs 32-002(a) and 32-002(b1).

F-6.0 CONCLUSIONS AND RECOMMENDATIONS

F-6.1 Human Health

The human health risk-screening assessments indicated no potential unacceptable risks or doses from COPCs under the industrial scenario at SWMUs 32-002(a) and 32-002(b1).

The total excess cancer risk was equivalent to the NMED target risk level of 2×10^{-7} (NMED 2012, 219971) for the industrial scenario at SWMU 32-002(a). The HI was 0.08 for SWMU 32-002(a), which is less than the NMED target HI of 1 (NMED 21012, 219971). The dose was below the DOE target dose of 15 mrem/yr at SWMU 32-002(a). The total equivalent risk was approximately 1×10^{-5} for the industrial scenario.

For SWMU 32-002(b1), no samples were collected from 0–1 ft bgs because the drainline is below the ground surface (samples were collected from 3.5–10 ft bgs). Therefore, no exposure to COPCs at the surface and no potential risk or dose to an industrial worker exist.

The Laboratory's as low as reasonably achievable (ALARA) program description states that quantitative ALARA evaluations are not necessary for Laboratory activities that have a potential for annual public exposure less than a 3-mrem total effective dose-equivalent individual dose ("Los Alamos National Laboratory Environmental ALARA Program," PD410, p. 7, effective November 8, 2008). The calculated radiation dose for the industrial scenario at SWMU 32-002(a) was 1 mrem/yr. No industrial dose for SWMU 32-002(b1) exists because no exposure occurs at 0–1 ft bgs. Therefore, radiation exposures to the under the industrial scenario at SWMUs 32-002(a) and 32-002(b1) are ALARA.

F-6.2 Ecology

No potential ecological risks were found for any receptor at SWMUs 32-002(a) and 32-002(b1) based on minimum ESL comparisons, HI analyses, potential effects to populations (individuals for T&E species), and LOAEL analyses. These lines of evidence, discussed above for each receptor, and the analysis of COPECs without ESLs support the conclusion that no potential ecological risks exist at SWMUs 32-002(a) and 32-002(b1) at former TA-32.

F-7.0 REFERENCES

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

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

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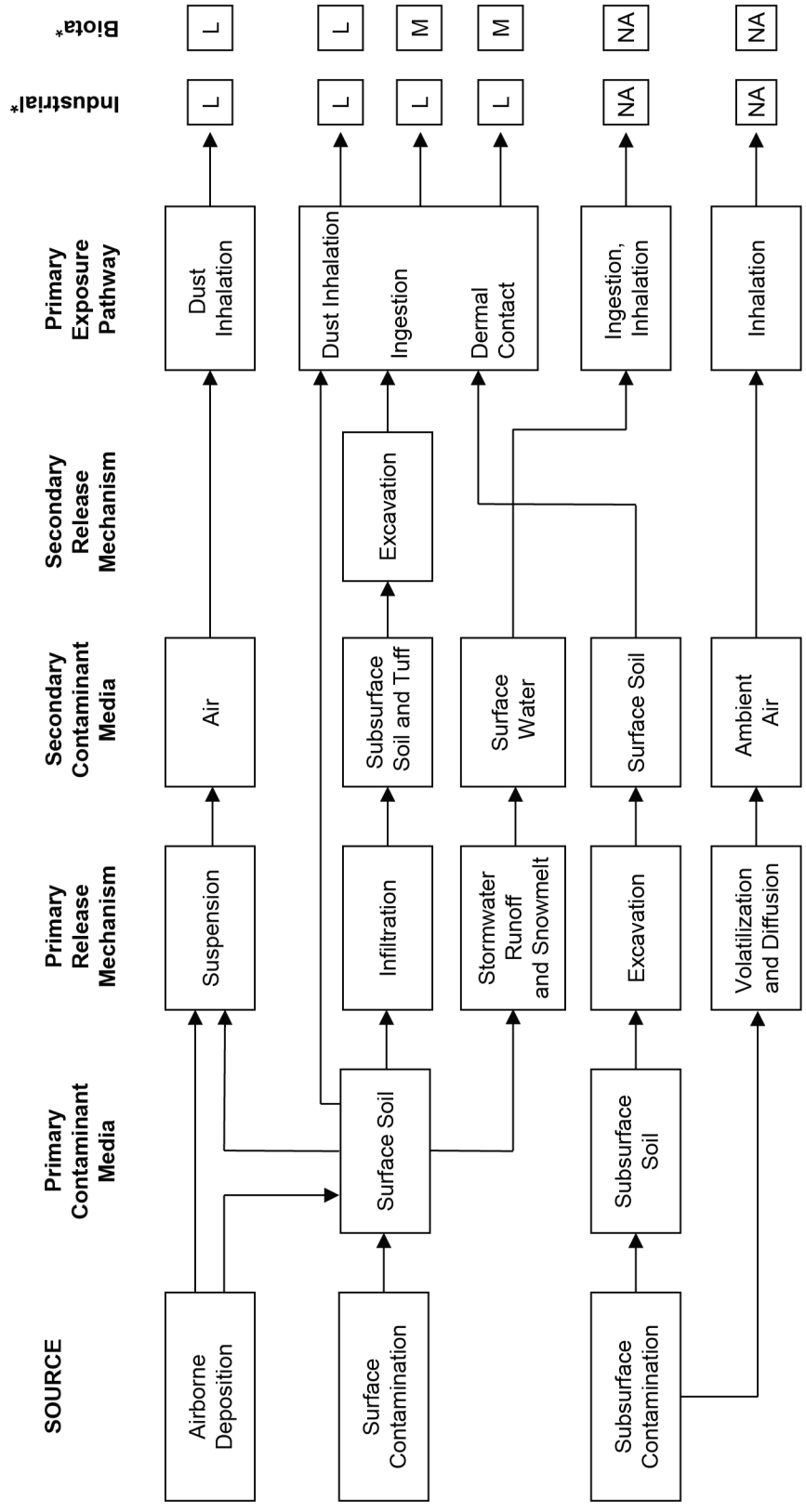
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*VL = Very low, L = low, and M = moderate; designations indicate the pathway is a potentially complete pathway and is evaluated in the risk assessments. NA = Not applicable and indicates the pathway is incomplete and not evaluated in the risk assessments.

Figure F-3.1-1 Conceptual site model for Upper Los Alamos Canyon Aggregate Area

Table F-3.2-1
Physical and Chemical Properties of Inorganic COPCs

COPC	K_d[a] (cm^3/g)	Water Solubility[a,b] (g/L)
Antimony	45	Insoluble
Barium	41	Insoluble
Beryllium	790	Insoluble
Chromium	850[c]	Insoluble
Copper	35	Insoluble
Lead	900	Insoluble
Mercury	52	Insoluble
Nickel	65	Insoluble
Nitrate	0.0356	na[d]
Perchlorate	na	2.45E+02
Selenium	5	Insoluble
Silver	8.3	Insoluble
Sodium	na	Soluble
Thallium	71[e]	Insoluble
Zinc	62	Insoluble

[a] Information from http://rais.ornl.gov/cgi-bin/tox/TOX_select?select=nrad.
[b] Information from http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm.
[c] As chromium salts.
[d] na = Not available.
[e] As thallium salts.

Table F-3.2-2
Physical and Chemical Properties of Organic COPCs

COPC	Water Solubility[a] (mg/L)	Organic Carbon Coefficient K_{oc}[a] (L/kg)	Log Octanol-Water Partition Coefficient K_{ow}[a]	Vapor Pressure[a] (mm Hg at 25°C)
Acenaphthene	3.60E+00[b]	6.12E+03	3.92E+00[b]	2.50E-03[b]
Acetone	1.00E+06[b]	1.98E+00	-2.40E-01[b]	2.31E+02[b]
Anthracene	4.34E-02[b]	2.04E+04	4.45E+00[b]	2.67E-06[b]
Aroclor-1260	2.84E-04[b]	5.30E+05[c]	8.27E+00[b]	4.05E-05[b]
Benzo(a)anthracene	9.40E-03[b]	2.31E+05	5.76+00[b]	1.90E-06[b]
Benzo(a)pyrene	1.62E-03[b]	7.87E+05	6.13E+00[b]	5.49E-09[b]
Benzo(b)fluoranthene	1.50E-03[b]	8.03E+05	5.78E+00[b]	5.00E-07[b]
Benzo(g,h,i)perylene	2.60E-04[b]	2.68E+06	6.63E+00[b]	1.00E-10[b]
Benzoic acid	3.40E+03[b]	1.45E+01	1.87E+00[b]	7.00E-04[b]
Benzo(k)fluoranthene	8.00E-04[b]	7.87E+05	6.1E+00[b]	9.65E-10[b]
Bis(2-ethylhexyl)phthalate	2.70E-01[b]	1.65E+05	7.60E+00[b]	1.42E-07[b]
Butylbenzylphthalate	2.69E+00	9.36E+03	4.73E+00	8.25E-06
Carbazole	1.80E+00	9.16E+03	3.72E+00	7.50E-07
Chrysene	6.30E-03[b]	2.36E+05	5.81E+00[b]	6.23E-09[b]
Dibenz(a,h)anthracene	1.03E-03	2.62E+06	6.54E+00	1.39E-11
Dibenzofuran	3.10E+00	1.13E+04	4.12E+00	2.48E-03
Dichlorofluoromethane	2.80E+02[c]	4.39E+01[c]	2.16E+00	4.85E-03
Di-n-butylphthalate	1.12E+01	1.46E+03	4.50E+00	2.01E-05
Fluoranthene	2.60E-01[c]	5.55E+04[c]	5.16E+00[c]	9.22E-06[c]
Fluorene	1.89E+00[b]	1.13E+04	4.18E+00[b]	8.42E-04[b]
Indeno(1,2,3-cd)pyrene	1.90E-04[b]	2.68E+06	6.70E+00[b]	1.25E-10[b]
Methylene chloride	1.30E+04[b]	2.37E+01	1.30E+00[b]	4.30E+02[b]
Naphthalene	3.10E+01	1.84E+03	3.30E+00	8.50E-02
Phenanthrene	1.15E+00[b]	2.08E+04	4.46E+00[b]	1.12E-04[b]
Pyrene	1.35E-01[b]	6.94E+04	4.88E+00[b]	4.50E-06[b]
TCDD[2,3,7,8-]	2.00E-04	1.46E+05	6.80E+00	1.50E-09
Tetrachloroethene	2.06E+02	1.07E+02	3.40E+00	1.85E+01
Trichlorofluoromethane	1.10E+03	4.86E+01	2.53E+00	8.03E+02

[a] Information from http://rais.ornl.gov/cgi-bin/tox/TOX_select?select=nrad, unless noted otherwise.
[b] Information from http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm.
[c] Information from NMED (2012, 219971).

Table F-3.2-3
Physical and Chemical Properties of Radionuclide COPCs

COPC	Soil-Water Partition Coefficient, K_d[a] (cm^3/g)	Water Solubility[b] (g/L)
Cesium-137	1000	Insoluble
Plutonium-238	4500	Insoluble
Plutonium-239/240	4500	Insoluble
Tritium	9.9	Soluble
Uranium-235/236	0.4	Insoluble

[a] Information from Superfund Chemical Data Matrix (EPA 1996, 064708).
[b] Information from http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm.

Table F-3.3-1
EPCs at SWMU 32-002(a) for the Industrial Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	5	0	0.15(U)	10(U)	n/a[a]	10(U)	Maximum detection limit
Barium	5	5	35.9	55	n/a	55	Maximum detected concentration
Cadmium	5	4	0.011	0.51(U)	n/a	0.27[b]	Maximum detected concentration
Copper	5	5	3.5	7.1	n/a	7.1	Maximum detected concentration
Lead	5	5	14.5	43	n/a	43	Maximum detected concentration
Mercury	5	5	0.114	0.316	n/a	0.316	Maximum detected concentration
Nitrate	4	4	0.57	3.2	n/a	3.2	Maximum detected concentration
Perchlorate	4	2	0.0031	0.0052(U)	n/a	0.036[b]	Maximum detected concentration
Selenium	5	5	0.2	1	n/a	1	Maximum detected concentration
Zinc	5	5	39.2	102	n/a	102	Maximum detected concentration
Organic Chemicals (mg/kg)							
Butylbenzylphthalate	4	1	0.038	0.35(U)	n/a	0.038[b]	Maximum detected concentration
Chrysene	4	1	0.042	0.35(U)	n/a	0.042[b]	Maximum detected concentration
Fluoranthene	4	2	0.036	0.35(U)	n/a	0.074[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	4	4	1.27E-05	1.26E-04	n/a	1.26E-04	Maximum detected concentration
Heptachlorodibenzofuran[1,2,3,4,7,8,9-]	4	4	4.11E-06	4.28E-05	n/a	4.28E-05	Maximum detected concentration
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	4	3	3.52E-07	1.68E-06	n/a	1.68E-06	Maximum detected concentration
Hexachlorodibenzodioxin[1,2,3,4,7,8-]	4	3	3.88E-07	1.29E-06	n/a	1.29E-06	Maximum detected concentration
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	4	4	4.96E-07	4.35E-06	n/a	4.35E-06	Maximum detected concentration
Hexachlorodibenzodioxin[1,2,3,7,8,9-]	4	3	5.13E-07(U)	2.5E-06	n/a	2.5E-06	Maximum detected concentration
Hexachlorodibenzofuran[1,2,3,4,7,8-]	4	4	1.96E-07	1.06E-06	n/a	1.06E-06	Maximum detected concentration

Table F-3.3-1 (continued)

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Hexachlorodibenzofuran[1,2,3,6,7,8-]	4	3	1.25E-07(U)	9.21E-07	n/a	9.21E-07	Maximum detected concentration
Hexachlorodibenzofuran[2,3,4,6,7,8-]	4	4	2.68E-07	1.30E-06	n/a	1.30E-06	Maximum detected concentration
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	4	2	0.0052(UJ)	0.0077	n/a	0.0077	Maximum detected concentration
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	4	4	1.01E-04	9.85E-04	n/a	9.85E-04	Maximum detected concentration
Methylene chloride	4	4	9.29E-06	1.77E-04	n/a	1.77E-04	Maximum detected concentration
Pentachlorodibenzodioxin[1,2,3,7,8-]	4	1	1.34E-07(U)	6.25E-07	n/a	6.25E-07	Maximum detected concentration
Pentachlorodibenzofuran[1,2,3,7,8-]	4	2	1.57E-07	2.01E-07	n/a	2.01E-07	Maximum detected concentration
Pentachlorodibenzofuran[2,3,4,7,8-]	4	3	2.35E-07(U)	8.53E-07	n/a	8.53E-07	Maximum detected concentration
Phenanthrene	4	1	0.041	0.35(U)	n/a	0.041[b]	Maximum detected concentration
Pyrene	4	1	0.059	0.35(U)	n/a	0.059[b]	Maximum detected concentration
Tetrachlorodibenzofuran(2,3,7,8-)	4	2	2.1E-07(U)	5.95E-07	n/a	5.95E-07	Maximum detected concentration
Radionuclides (pCi/g)							
Cesium-137	5	4	0(U)	1.7	n/a	1.7	Maximum detected concentration
Plutonium-239/240	5	2	0.036(U)	0.409	n/a	0.409	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ), and thus the maximum detected concentration is less than the maximum concentration.

Table F-3.3-2
EPCs at SWMU 32-002(a) for the Ecological Receptors

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	32	2	0.1(U)	12(UJ)	n/a[a]	11[b]	Maximum detected concentration
Barium	32	32	11.4	162	Gamma	76.7	95% Approximate Gamma
Beryllium	32	28	0.19	1.4	Normal	0.73	95% KM(t)
Cadmium	32	5	0.016(U)	0.9(U)	Normal	0.166	95% KM(t)
Chromium	32	25	3	18.7	Normal	8.904	95% KM(t)
Copper	32	32	1.4	30.5	Gamma	7.792	95% Approximate Gamma
Lead	32	32	2.2	386	Lognormal	46.96	95% H-UCL
Mercury	32	16	0.00576	1.2	Gamma	0.174	95% KM(t)
Nickel	32	32	2.9	11	Normal	7.055	95% Student's t
Selenium	32	16	0.17	1.13(U)	Nonparametric	0.395	95% KM(t)
Silver	32	17	0.032	2.4(U)	Gamma	0.142	95% KM(t)
Thallium	32	7	0.12(U)	1.4(U)	Gamma	0.266	95% KM(t)
Zinc	32	32	24	102	Lognormal	46.93	95% Student's t
Organic Chemicals (mg/kg)							
Acetone	23	4	0.0032	0.033	n/a	0.033	Maximum detected concentration
Anthracene	23	2	0.064	0.39(U)	n/a	0.081[b]	Maximum detected concentration
Aroclor-1260	16	1	0.033(U)	0.042	n/a	0.042	Maximum detected concentration
Benzo(a)anthracene	23	5	0.17	0.73	Normal	0.311	95% KM (t)
Benzo(a)pyrene	23	6	0.14	0.58	Normal	0.29	95% KM (t)

Table F-3.3-2 (continued)

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Benzo(b)fluoranthene	23	6	0.18(U)	0.81	Normal	0.331	95% KM (t)
Benzo(g,h,i)perylene	23	5	0.074	1.2	Gamma	0.278	95% KM (t)
Benzo(k)fluoranthene	23	5	0.075	0.58	Normal	0.278	95% KM (t)
Bis(2-ethylhexyl)phthalate	23	2	0.044(U)	0.44	n/a	0.44	Maximum detected concentration
Butylbenzylphthalate	23	3	0.034(U)	0.41	n/a	0.055[b]	Maximum detected concentration
Carbazole	3	3	0.049	0.085	n/a	0.085	Maximum detected concentration
Chrysene	23	7	0.042	0.81	Normal	0.33	95% KM (t)
Dibenz(a,h)anthracene	23	1	0.073	0.41(U)	n/a	0.073[b]	Maximum detected concentration
Dichlorofluoromethane	23	1	0.001	0.012(U)	n/a	0.001[b]	Maximum detected concentration
Di-n-butylphthalate	23	9	0.036	1.3	Normal	0.397	95% KM (t)
Fluoranthene	23	3	0.034(U)	0.41	n/a	0.055[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	16	11	1.68E-07(U)	1.26E-04	Gamma	3.75E-05	95% KM (BCA)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	16	8	1.35E-07(U)	4.28E-05	Gamma	1.21E-05	95% KM (t)
Heptachlorodibenzofuran[1,2,3,4,7,8,9-]	16	5	6.28E-08(U)	1.68E-06	Normal	6.83E-07	95% KM (t)
Hexachlorodibenzodioxin[1,2,3,4,7,8-]	16	4	1.46E-07(U)	1.29E-06	n/a	1.29E-06	Maximum detected concentration
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	16	7	1.38E-07(U)	4.35E-06	Normal	1.30E-06	95% KM (t)
Hexachlorodibenzodioxin[1,2,3,7,8,9-]	16	5	1.32E-07(U)	2.5E-06	Normal	9.79E-07	95% KM (t)
Hexachlorodibenzofuran[1,2,3,4,7,8-]	16	6	4.77E-08(U)	1.06E-06	Normal	3.91E-07	95% KM (t)
Hexachlorodibenzofuran[1,2,3,6,7,8-]	16	4	5.22E-08(U)	9.21E-07	n/a	9.21E-07	Maximum detected concentration
Hexachlorodibenzofuran[2,3,4,6,7,8-]	16	5	5.44E-08(U)	1.30E-06	Normal	5.22E-07	95% KM (t)
Indeno(1,2,3-cd)pyrene	23	5	0.076	0.64	Normal	0.24	95% KM (t)
Methylene chloride	23	5	0.003	0.011(U)	Normal	0.00444	95% KM (t)
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	16	16	5.88E-07	9.85E-04	Gamma	4.73E-04	95% Adjusted Gamma
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	16	10	2.71E-07(U)	1.77E-04	Gamma	4.64E-05	95% KM (BCA)
Pentachlorodibenzodioxin[1,2,3,7,8-]	16	1	8.75E-08(U)	6.25E-07	n/a	6.25E-07	Maximum detected concentration
Pentachlorodibenzofuran[1,2,3,7,8-]	16	2	8.54E-08(U)	2.05E-07	n/a	2.05E-07	Maximum detected concentration

Table F-3.3-2 (continued)

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Pentachlorodibenzofuran[2,3,4,7,8-]	16	4	8.3E-08(U)	8.53E-07	n/a	8.53E-07	Maximum detected concentration
Phenanthrene	23	5	0.041	0.39(U)	Normal	0.255	95% KM (t)
Pyrene	23	7	0.059	1	Normal	0.363	95% KM (t)
Tetrachlorodibenzofuran(2,3,7,8-)	16	2	6.75E-08(U)	5.95E-07	n/a	5.95E-07	Maximum detected concentration
Trichlorofluoromethane	23	1	0.005(U)	0.012(U)	n/a	0.006 [b]	Maximum detected concentration
Radionuclides (pCi/g)							
Cesium-137	24	4	-0.05(U)	1.7	n/a	1.7	Maximum detected concentration
Plutonium-238	24	1	-0.018(U)	0.079	n/a	0.079	Maximum detected concentration
Plutonium-239/240	24	4	-0.004(U)	0.681	n/a	0.681	Maximum detected concentration
Tritium	23	1	-0.296(U)	0.21(U)	n/a	0.0999[b]	Maximum detected concentration
Uranium-235/236	21	5	0(U)	0.126	Nonparametric	0.0842	99% KM (Chebyshev)

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ), and thus the maximum detected concentration is less than the maximum concentration.

Table F-3.3-3
EPCs at SWMU 32-002(b1) for the Ecological Receptors

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	4	0	0.21(U)	11(UJ)	n/a[a]	11(UJ)	Maximum detection limit
Barium	4	4	12.3	78.7	n/a[a]	78.7	Maximum detected concentration
Chromium	4	4	3.3	44	n/a	44	Maximum detected concentration
Copper	4	4	1.3	5.8	n/a	5.8	Maximum detected concentration
Lead	4	4	2	23.6	n/a	23.6	Maximum detected concentration
Mercury	4	0	0.0185(U)	0.11(U)	n/a	0.11(U)	Maximum detection limit
Nickel	4	4	3.2	21.6	n/a	21.6	Maximum detected concentration
Selenium	4	3	0.21(U)	0.65	n/a	0.65	Maximum detected concentration
Silver	4	1	0.093	2.1(U)	n/a	0.093[b]	Maximum detected concentration
Thallium	4	0	0.22(U)	1.3(U)	n/a	1.3 (U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Anthracene	4	1	0.085	0.39(U)	n/a	0.085[b]	Maximum detected concentration
Aroclor-1260	2	1	0.039(U)	0.4	n/a	0.4	Maximum detected concentration
Benzo(a)anthracene	4	2	0.023	0.39(U)	n/a	0.27[b]	Maximum detected concentration
Benzo(a)pyrene	4	2	0.03	0.39(U)	n/a	0.3[b]	Maximum detected concentration
Benzo(b)fluoranthene	4	2	0.048	0.61	n/a	0.61	Maximum detected concentration
Benzo(g,h,i)perylene	4	2	0.045	0.39(U)	n/a	0.13[b]	Maximum detected concentration
Benzo(k)fluoranthene	4	2	0.036	0.39(U)	n/a	0.24[b]	Maximum detected concentration
Benzoic acid	4	1	0.076	6.9(U)	n/a	0.076[b]	Maximum detected concentration

Table F-3.3-3 (continued)

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Bis(2-ethylhexyl)phthalate	4	2	0.059	0.69(U)	n/a	0.23[b]	Maximum detected concentration
Chrysene	4	2	0.075	0.48	n/a	0.48	Maximum detected concentration
Di-n-butylphthalate	4	1	0.35(U)	0.77	n/a	0.77	Maximum detected concentration
Fluoranthene	4	2	0.074	0.99	n/a	0.99	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	2	2	5.2E-07	4.7E-06	n/a	4.7E-06	Maximum detected concentration
Heptachlorodibenzofuran[1,2,3,4,7,8,9-]	2	1	8.45E-08(U)	3.18E-07	n/a	3.18E-07	Maximum detected concentration
Hexachlorodibenzofuran[1,2,3,4,7,8-]	2	1	5.16E-08(U)	4.11E-07	n/a	4.11E-07	Maximum detected concentration
Hexachlorodibenzofuran[1,2,3,6,7,8-]	2	1	5.56E-08(U)	1.67E-07	n/a	1.67E-07	Maximum detected concentration
Hexachlorodibenzofuran[2,3,4,6,7,8-]	2	1	5.93E-08(U)	2.15E-07	n/a	2.15E-07	Maximum detected concentration
Indeno(1,2,3-cd)pyrene	4	2	0.026	0.39(U)	n/a	0.14[b]	Maximum detected concentration
Methylene chloride	4	1	0.005(U)	0.014	n/a	0.014	Maximum detected concentration
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	2	2	4.64E-06	4.14E-05	n/a	4.14E-05	Maximum detected concentration
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	2	1	2.38E-07(U)	4.81E-06	n/a	4.81E-06	Maximum detected concentration
Pentachlorodibenzofuran[2,3,4,7,8-]	2	1	6.24E-08(U)	3.75E-07	n/a	3.75E-07	Maximum detected concentration
Phenanthrene	4	1	0.35(U)	0.45	n/a	0.45	Maximum detected concentration
Pyrene	4	2	0.074	1	n/a	1	Maximum detected concentration
Tetrachloroethene	4	1	0.003	0.012(U)	n/a	0.003[b]	Maximum detected concentration
Trichlorofluoromethane	4	2	0.059	0.69(U)	n/a	0.23[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-239/240	4	1	0.011(U)	0.019(U)	n/a	0.016[b]	Maximum detected concentration
Tritium	4	1	-0.26(U)	0.1(U)	n/a	0.09[b]	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ), and thus the maximum detected concentration is less than the maximum concentration.

Table F-3.3-4
Dioxin/Furan TEF Calculations for the
Industrial Scenario at SWMU 32-002(a) (0–1 ft)

Dioxin and Furan Congeners	EPC (mg/kg)	TEF*	TEF EPC (mgkg)
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	1.26E-04	0.01	1.26E-06
Hexachlorodibenzodioxin[1,2,3,4,7,8-]	1.29E-06	0.1	1.29E-07
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	4.35E-06	0.1	4.35E-07
Hexachlorodibenzodioxin[1,2,3,7,8,9-]	2.50E-06	0.1	2.50E-07
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	9.85E-04	0.0003	2.96E-07
Pentachlorodibenzodioxin[1,2,3,7,8-]	6.25E-07	1	6.25E-07
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	4.28E-05	0.01	4.28E-07
Heptachlorodibenzofuran[1,2,3,4,7,8,9-]	1.68E-06	0.01	1.68E-08
Hexachlorodibenzofuran[1,2,3,4,7,8-]	1.06E-06	0.1	1.06E-07
Hexachlorodibenzofuran[1,2,3,6,7,8-]	9.21E-07	0.1	9.21E-08
Hexachlorodibenzofuran[2,3,4,6,7,8-]	1.30E-06	0.1	1.30E-07
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	1.77E-04	0.0003	5.31E-08
Pentachlorodibenzofuran[1,2,3,7,8-]	2.01E-07	0.03	6.03E-09
Pentachlorodibenzofuran[2,3,4,7,8-]	8.53E-07	0.3	2.56E-07
Tetrachlorodibenzofuran[2,3,7,8-]	5.95E-07	0.1	5.95E-08
		2,3,7,8-TCDD Equivalent	**4.14E-06**

*TEF values from http://who.int/ipics/assessment/tef_update/en/index.html.

Table F-3.3-5
Dioxin/Furan TEF Calculations for the
Ecological Receptors at SWMU 32-002(a) (0–5 ft)

Dioxin and Furan Congeners	EPC (mg/kg)	TEF*	TEF EPC (mg/kg)
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	3.75E-05	0.01	3.75E-07
Hexachlorodibenzodioxin[1,2,3,4,7,8-]	1.29E-06	0.1	1.29E-07
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	1.30E-06	0.1	1.30E-07
Hexachlorodibenzodioxin[1,2,3,7,8,9-]	9.79E-07	0.1	9.79E-08
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	4.73E-04	0.0003	1.42E-07
Pentachlorodibenzodioxin[1,2,3,7,8-]	6.25E-07	1	6.25E-07
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	1.21E-05	0.01	1.21E-07
Heptachlorodibenzofuran[1,2,3,4,7,8,9-]	6.83E-07	0.01	6.83E-09
Hexachlorodibenzofuran[1,2,3,4,7,8-]	3.91E-07	0.1	3.91E-08
Hexachlorodibenzofuran[1,2,3,6,7,8-]	9.21E-07	0.1	9.21E-08
Hexachlorodibenzofuran[2,3,4,6,7,8-]	5.22E-07	0.1	5.22E-08
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	4.64E-05	0.0003	1.39E-08
Pentachlorodibenzofuran[1,2,3,7,8-]	2.05E-07	0.03	6.15E-09
Pentachlorodibenzofuran[2,3,4,7,8-]	8.53E-07	0.3	2.56E-07
Tetrachlorodibenzofuran[2,3,7,8-]	5.95E-07	0.1	5.95E-08
		2,3,7,8-TCDD Equivalent	**2.15E-06**

*TEF values from http://who.int/ipics/assessment/tef_update/en/index.html.

Table F-3.3-6
Dioxin/Furan TEF Calculations for the Ecological Receptors at SWMU 32-002(b1) (0–5 ft bgs)

Dioxin and Furan Congeners	EPC (mg/kg)	TEF*	TEF EPC (mg/kg)
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	4.70E-06	0.01	4.70E-08
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	4.14E-05	0.0003	1.24E-08
Heptachlorodibenzofuran[1,2,3,4,7,8,9-]	3.18E-07	0.01	3.18E-09
Hexachlorodibenzofuran[1,2,3,4,7,8-]	4.11E-07	0.1	4.11E-08
Hexachlorodibenzofuran[1,2,3,6,7,8-]	1.67E-07	0.1	1.67E-08
Hexachlorodibenzofuran[2,3,4,6,7,8-]	2.15E-07	0.1	2.15E-08
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	4.81E-06	0.0003	1.44E-09
Pentachlorodibenzofuran[2,3,4,7,8-]	3.75E-07	0.3	1.13E-07
		2,3,7,8-TCDD Equivalent	**2.56E-07**

*TEF values from http://www.who.int/ipcs/assessment/tef_update/en/index.html.

Table F-4.1-1
Exposure Parameter Values Used to
Calculate Chemical SSLs for the Industrial Scenario

Parameter	Industrial Value
Target HQ	1
Target cancer risk	10^{-5}
Averaging time (carcinogen)	70 yr × 365 d
Averaging time (noncarcinogen)	ED × 365 d
Skin absorption factor	Semivolatile orhanic compound = 0.1
	Chemical-specific
Adherence factor–child	n/a*
Body weight–child	n/a
Cancer slope factor–oral (chemical-specific)	$(mg/kg\text{-}d)^{-1}$
Cancer slope factor–inhalation (chemical-specific)	$(mg/kg\text{-}d)^{-1}$
Exposure frequency	225 d/yr
Exposure duration–child	n/a
Age-adjusted ingestion factor	n/a
Age-adjusted inhalation factor	n/a
Inhalation rate–child	n/a
Soil ingestion rate–child	n/a
Particulate emission factor	6.61×10^{9} m^3/kg
Reference dose–oral (chemical-specific)	(mg/kg-d)
Reference dose–inhalation (chemical-specific)	(mg/kg-d)
Exposed surface area–child	n/a
Age-adjusted skin contact factor for carcinogens	n/a
Volatilization factor for soil (chemical-specific)	(m^3/kg)
Body weight–adult	70 kg
Exposure duration	25 yr
Adherence factor–adult	0.2 mg/cm^2
Soil ingestion rate–adult	100 mg/d
Exposed surface area–adult	3300 cm^2/d

Note: Parameter values from NMED (2012, 219971).
*n/a = Not applicable.

Table F-4.1-2
Parameter Values Used to Calculate Radionuclide SALs for the Industrial Scenario

Parameter	Industrial, Adult
Inhalation rate (m^3/yr)	19,481[a]
Mass loading (g/m^3)	1.5×10^{-7}[b]
Outdoor time fraction	0.2053[c]
Indoor time fraction	0
Soil ingestion (g/yr)	97.4[d]

[a] Calculated as [20 m3/d × 225 d/yr] / [indoor + outdoor time fractions], where 20 m3/d is the mean daily inhalation rate of an adult (21 to <81 years) (EPA 2011, 208374, Table 6-1) and 225 d/yr is the exposure frequency (NMED 2012, 219971).

[b] Calculated as [1/6.6 × 10+9 m3/kg) × 1000 g/kg, where 6.6 × 10+9 m3/kg is the particulate emission factor (NMED 2012, 219971).

[c] Calculated as [8 h/d × 225 d/yr] / 8766 h/yr, where 8 h/d is an estimate of the average length of the work day.

[d] Calculated as [0.1 g/d × 225 d/yr] / [indoor + outdoor time fractions], where 0.1 g/d is the adult soil ingestion rate (NMED 2012, 219971).

Table F-4.2-1
Industrial Carcinogenic Screening for SWMU 32-002(a)

COPC	EPC (mg/kg)	Industrial SSL[a] (mg/kg)	Cancer Risk
Butylbenzylphthalate	0.038	9100[b]	4.18E-11
Chrysene	0.042	2340	1.79E-10
Methylene Chloride	0.00018	4700	3.83E-13
TCDD[2,3,7,8-]	4.14E-06	2.04E-04	2.03E-07
Total Excess Cancer Risk			**2E-07**

[a] SSLs from NMED (2012, 219971) unless otherwise noted.

[b] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

Table F-4.2-2
Industrial Noncarcinogenic Screening Evaluation for SWMU 32-002(a)

COPC	EPC (mg/kg)	Industrial SSL* (mg/kg)	HQ
Antimony	10(U)	454	2.2E-02
Barium	55	223000	2.5E-04
Cadmium	0.27	897	3.0E-04
Copper	7.1	45400	1.6E-04
Lead	43	800	5.4E-02
Mercury	0.316	341	9.3E-04
Nitrate	3.2	1820000	1.8E-06
Perchlorate	0.0036	795	4.5E-06
Selenium	1	5680	1.8E-04
Zinc	102	341000	3.0E-04
Fluoranthene	0.074	24400	3.0E-06
Phenanthrene	0.041	20500	2.0E-06
Pyrene	0.059	18300	3.2E-06
		HI	**0.08**

Note: Data qualifiers are defined in Appendix A.
*SSLs from NMED (2012, 219971).

Table F-4.2-3
Industrial Radionuclide Screening for SWMU 32-002(a)

COPC	EPC (pCi/g)	Industrial SAL* (pCi/g)	Total Dose (mrem/yr)
Cesium-137	1.7	23	1.11
Plutonium-239/240	0.409	210	0.03
		Total Dose	**1**

*SALs from LANL (2009, 107655).

Table F-5.3-1
ESLs for Terrestrial Receptors

Analyte	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Herbivorous Robin	Omnivorous Robin	Insectivorous Robin	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Inorganic Chemicals (mg/kg)											
Antimony	45	na*	na	na	na	na	2.9	0.26	0.48	78	0.05
Barium	41000	37000	11000	820	930	1000	3300	1300	1800	330	110
Beryllium	420	na	na	na	na	na	170	18	56	40	2.5
Cadmium	510	580	2	4.4	0.54	0.49	9.9	0.27	0.51	140	32
Chromium	1800	1200	260	68	40	28	840	45	110	na	na
Copper	3800	1600	110	38	22	15	270	38	64	80	70
Lead	3700	810	120	21	16	14	370	72	120	1700	120
Mercury	46	0.28	0.082	0.07	0.022	0.013	22	1.7	3	0.05	34
Nickel	1200	2900	160	160	38	21	500	9.7	20	280	38
Selenium	84	97	5.6	1	0.87	0.75	2.1	0.66	0.83	4.1	0.52
Silver	4100	840	19	11	4.3	2.6	150	14	24	na	560
Thallium	2.8	75	6.6	9.2	1.6	0.9	2.8	0.032	0.068	na	0.1
Zinc	6000	2400	320	350	85	48	1800	98	170	120	160
Organic Chemicals (mg/kg)											
Acetone	2900	30000	1200	7.5	14	170	1.4	15	1.2	na	na
Anthracene	5800	na	na	na	na	na	1100	210	310	na	6.8
Aroclor-1260	0.14	4.6	3.7	46	1.7	0.88	3000	10	20	na	na
Benzene	7600	na	na	na	na	na	35	47	24	na	na
Benzo(a)anthracene	32	9.8	6.9	0.8	0.91	1	6.2	3	3.4	na	18
Benzo(a)pyrene	380	na	na	na	na	na	280	53	85	na	na

Table F-5.3-1 (continued)

Analyte	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Herbivorous Robin	Omnivorous Robin	Insectivorous Robin	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Benzo(b)fluoranthene	250	na	na	na	na	na	130	38	52	na	18
Benzo(g,h,i)perylene	94	na	na	na	na	na	540	24	47	na	na
Benzo(k)fluoranthene	400	na	na	na	na	na	350	62	100	na	na
Benzoic acid	350	na	na	na	na	na	4.2	1.0	1.3	na	na
Bis(2-ethylhexyl)phthalate	1.2	0.033	0.045	20	0.04	0.02	2700	0.59	1.1	na	na
Butylbenzylphthalate	1900	na	na	na	na	na	2300	90	160	na	na
Carbazole	5700	na	na	na	na	na	130	100	80	na	na
Chrysene	25	na	na	na	na	na	6.5	2.4	3.1	na	na
Dibenz(a,h)anthracene	54	na	na	na	na	na	95	12	22	na	na
Di-n-butylphthalate	5000	0.24	0.068	0.39	0.021	0.011	16000	180	370	na	160
Fluoranthene	360	na	na	na	na	na	260	22	38	10	na
Indeno(1,2,3-cd)pyrene	270	na	na	na	na	na	590	62	110	na	na
Methylene chloride	1700	na	na	na	na	na	3.4	9	2.6	na	1600
Phenanthrene	290	na	na	na	na	na	59	10	15	5.5	na
Pyrene	360	460	190	71	46	34	110	22	32	10	na
2,3,7,8-TCDD	0.0000012	na	na	na	na	na	0.000048	0.00000029	0.00000058	5	na
Trichlorofluoromethane	160000	na	na	na	na	na	1700	52	98	na	na
Radionuclides (pCi/g)											
Cesium-137	680	2900	3700	4200	3700	3800	2300	2400	2400	1700	2300
Plutonium-238	30000	130000	32000	8300	2100	2000	120000	92000	110000	44	110000
Plutonium-239/240	33000	160000	34000	8600	2100	2100	170000	110000	150000	47	160000
Tritium	190000	580000	630000	300000	440000	600000	230000	340000	330000	48000	36000
Uranium-235/236	4800	10000	10000	9000	6400	6400	5100	5100	5100	55	4000

Note: Values from ECORISK Database, Version 3.1 (LANL 2012, 226667).

*na = Not available.

Table F-5.3-2
Minimum ESL Comparison for SWMU 32-002(a)

COPC	EPC	ESL	Receptor	HQ
Inorganic Chemicals (mg/kg)				
Antimony	11	0.05	Plant	**220**
Barium	76.7	110	Plant	**0.70**
Beryllium	0.73	2.5	Plant	0.29
Cadmium	0.17	0.27	Shrew	**0.61**
Chromium (total)	8.9	28	Robin	**0.32**
Copper	7.79	15	Robin	**0.52**
Lead	46.96	14	Robin	**3.35**
Mercury	0.17	0.013	Robin	**13.38**
Nickel	7.06	9.7	Shrew	**0.73**
Selenium	0.40	0.52	Plant	**0.76**
Silver	0.14	2.6	Robin	0.05
Thallium	0.27	0.032	Shrew	**8.31**
Zinc	46.93	48	Robin	**0.98**
Organic Chemicals (mg/kg)				
Acetone	0.033	1.2	Deer mouse	0.03
Anthracene	0.081	6.8	Plant	0.01
Aroclor-1260	0.042	0.14	Red fox	0.3
Benzo(a)anthracene	0.311	0.8	Robin	**0.39**
Benzo(a)pyrene	0.29	53	Shrew	0.005
Benzo(b)fluoranthene	0.331	18	Plant	0.02
Benzo(g,h,i)perylene	0.278	24	Shrew	0.01
Benzo(k)fluoranthene	0.278	62	Shrew	0.004
Bis(2-ethylhexyl)phthalate	0.44	0.02	Robin	**22**
Butybenzylphthalate	0.06	90	Shrew	0.001
Carbazole	0.085	80	Deer mouse	0.001
Chrysene	0.33	2.4	Shrew	0.14
Dibenz(a,h)anthracene	0.073	12	Shrew	0.01
Fluoranthene	0.397	10	Earthworm	0.04
Indeno(1,2,3-cd)pyrene	0.24	62	Shrew	0.004
Methylene Chloride	0.0044	2.6	Deer mouse	0.0017
Phenanthrene	0.255	5.5	Earthworm	0.05
Pyrene	0.363	10	Earthworm	0.04
TCDD[2,3,7,8-]	2.15E-06	0.00000029	Shrew	**7.41**
Trichlorofluoromethane	0.006	52	Shrew	0.0001

Table F-5.3-2 (continued)

COPC	EPC	ESL	Receptor	HQ
Radionuclides (pCi/g)				
Cesium-137	1.7	680	Red fox	0.0025
Plutonium-238	0.079	44	Earthworm	0.0018
Plutonium-239/240	0.681	47	Earthworm	0.014
Tritium	0.0999	36000	Plant	2.78E-06
Uranium-235	0.0842	55	Earthworm	0.0015

Note: Bolded values indicate HQ greater than 0.3.

Table F-5.3-3
HI Analysis for SWMU 32-002(a)

COPECs	EPC (mg/kg)	Red Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate American carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Desert Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Antimony	11	0.24	na*	na	na	na	na	**3.79**	**42.3**	**22.9**	0.14	**220**
Barium	76.7	0.002	0.002	0.01	0.09	0.08	0.08	0.02	0.06	0.04	0.23	**0.7**
Cadmium	0.166	0.0003	0.0003	0.08	0.04	**0.31**	**0.57**	0.02	**0.61**	**0.33**	0.001	0.01
Chromium (total)	8.904	0.005	0.01	0.03	0.13	0.22	**0.32**	0.01	0.2	0.08	na	na
Copper	7.79	0.002	0.0049	0.07	0.21	**0.35**	**0.52**	0.03	0.21	0.12	0.1	0.11
Lead	46.96	0.01	0.06	**0.39**	**2.24**	**2.94**	**3.35**	0.13	**0.65**	**0.39**	0.03	**0.39**
Mercury (inorganic)	0.17	0.004	**0.61**	**2.07**	**2.43**	**7.73**	**13.1**	0.01	0.1	0.06	**3.4**	0.01
Nickel	7.055	0.006	0.002	0.04	0.04	0.19	**0.34**	0.014	**0.73**	**0.35**	0.03	0.19
Selenium	0.395	0.005	0.004	0.07	**0.40**	**0.45**	**0.53**	0.19	**0.60**	**0.48**	0.1	**0.76**
Thallium	0.27	0.1	0.004	0.04	0.03	0.17	0.3	0.1	**8.44**	**3.97**	na	**2.7**
Zinc	46.93	0.01	0.02	0.15	0.13	**0.55**	**0.98**	0.03	**0.48**	0.28	**0.39**	0.29
Benzo(a)anthracene	0.311	0.01	0.03	0.05	**0.39**	**0.34**	0.31	0.05	0.1	0.09	na	0.02
Bis(2-ethylhexyl)phthalate	0.44	**0.37**	**13.3**	**9.78**	0.02	**11**	**22**	0.00016	**0.75**	**0.4**	na	na
TCDD[2,3,7,8-]	2.15E-06	**1.79**	na	na	na	na	na	0.04	**7.41**	**3.71**	0.0000004	na
HI		**3**	**14**	**13**	**6**	**24**	**42**	**4**	**63**	**33**	**4**	**225**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.
*na = Not available.

Table F-5.3-4
Minimum ESL Comparison for SWMU 32-002(b1)

COPCs	EPC	Minimum ESL	Receptor	HQ
Inorganic Chemicals (mg/kg)				
Antimony	11(UJ)	0.05	Plant	**220**
Barium	78.7	110	Plant	**0.72**
Chromium (total)	44	28	Robin	**1.57**
Copper	5.8	15	Robin	**0.39**
Lead	23.6	14	Robin	**1.69**
Mercury	0.11(U)	0.013	Robin	**8.46**
Nickel	21.6	9.7	Shrew	**2.23**
Selenium	0.65	0.52	Plant	**1.25**
Silver	0.09	2.6	Robin	0.04
Thallium	1.3(U)	0.032	Shrew	**40.63**
Organic Chemicals (mg/kg)				
Anthracene	0.085	6.8	Plant	0.01
Aroclor-1260	0.4	0.14	Red fox	**2.86**
Benzo(a)anthracene	0.27	0.8	Robin	**0.34**
Benzo(a)pyrene	0.3	53	Shrew	0.006
Benzo(b)fluoranthene	0.61	18	Plant	0.03
Benzo(g,h,i)perylene	0.13	24	Shrew	0.01
Benzo(k)fluoranthene	0.24	62	Shrew	0.004
Benzoic acid	0.076	1	Deer mouse	0.08
Bis(2-ethylhexyl)phthalate	0.23	0.02	Robin	**11.5**
Chrysene	0.48	2.4	Shrew	0.2
Di-n-butylphthalate	0.77	0.011	Robin	**70**
Fluoranthene	0.99	10	Earthworm	0.1
Indeno(1,2,3-cd)pyrene	0.14	62	Shrew	0.002
Methylene chloride	0.014	2.6	Deer mouse	0.006
Phenanthrene	0.45	5.5	Earthworm	0.08
Pyrene	1	10	Earthworm	0.1
2,3,7,8-TCDD	2.56E-07	0.00000029	Shrew	**0.88**
Trichlorofluoromethane	0.003	52	Shrew	0.0001
Radionuclides (pCi/g)				
Plutonium-239/240	0.016	47	Earthworm	0.0003
Tritium	0.09	36000	Plant	0.000002

Notes: Bolded values indicate HQ greater than 0.3. Data qualifiers are defined in Appendix A.

Table F-5.3-5
HI Analysis for COPECs at SWMU 32-002(b1)

COPECs	EPC (mg/kg)	Red Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate American carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Desert Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Antimony	11(UJ)	0.24	na*	na	na	na	na	**3.79**	**42.3**	**22.9**	0.14	**220**
Barium	78.7	0.0019	0.0021	0.0072	0.1	0.08	0.08	0.024	0.06	0.04	0.24	**0.72**
Chromium (total)	44	0.024	0.037	0.17	**0.65**	**1.1**	**1.57**	0.052	**0.98**	**0.4**	na	na
Copper	5.8	0.0015	0.0036	0.05	0.15	0.26	**0.39**	0.021	0.15	0.091	0.073	0.083
Lead	23.6	0.006	0.03	0.2	**1.12**	**1.48**	**1.69**	0.064	**0.33**	0.2	0.014	0.2
Mercury (inorganic)	0.11(U)	0.0024	**0.39**	**1.34**	**1.57**	**5**	**8.46**	0.005	0.065	0.037	**2.2**	0.0032
Nickel	21.6	0.018	0.01	0.14	0.14	**0.57**	**1.03**	0.043	**2.23**	**1.08**	0.077	**0.57**
Selenium	0.65	0.0077	0.01	0.12	**0.65**	**0.75**	**0.87**	**0.31**	**0.98**	**0.78**	0.16	**1.25**
Thallium	1.3 (U)	**0.46**	0.02	0.2	0.14	**0.81**	**1.44**	**0.46**	**40.6**	**19.1**	na	**13**
Aroclor-1260	0.4	**2.86**	0.087	0.11	0.01	0.24	**0.45**	0.00013	0.04	0.02	na	na
Benzo(a)anthracene	0.27	0.01	0.028	0.04	**0.34**	0.30	0.27	0.044	0.09	0.079	na	0.015
Bis(2-ethylhexyl)phthalate	0.23	0.19	**6.97**	**5.11**	0.01	**5.75**	**11.5**	8.5E-05	**0.39**	0.21	na	na
Di-n-butylphthalate	0.77	0.0002	**3.21**	**11.3**	**1.97**	**36.7**	**70**	4.8E-05	0.0043	0.0021	na	0.005
2,3,7,8-TCDD	2.56E-07	0.21	na	na	**na**	**na**	na	0.0053	**0.88**	**0.44**	5E-08	na
HI		**4**	**11**	**19**	**7**	**53**	**98**	**5**	**89**	**45**	**3**	**236**

Notes: Bolded values indicate HQ greater than 0.3 or HI greater than 1. Data qualifiers are defined in Appendix A.
*na = Not available.

Table F-5.4-1
PAUFs and AUFs for Ecological Receptors

Receptor	HR[a] (ha)	Population Area[a] (ha)	PAUF SWMU 32-002(a) Site area = 0.06 ha	PAUF SWMU 32-002(b1) Site area = 0.02 ha
Red fox	1038	41,520	0.000001	0.0000005
American kestrel	106	4240	0.00001	0.000005
American robin	0.42	16.8	0.004	0.001
Desert cottontail	3.1	124	0.0005	0.0002
Montane shrew	0.39	15.6	0.004	0.001
Deer mouse	0.077	3.08	0.02	0.006
Mexican spotted owl[b]	366	n/a[c]	0.0002	0.00005

Notes: PAUF is calculated as the area of the site divided by the population area. No PAUF is calculated for earthworm or plants.

[a] Values from EPA (1993, 059384).

[b] Value for Mexican spotted owl is the AUF based on individual HR.

[c] n/a = Not applicable.

Table F-5.4-2
Adjusted HIs for SWMU 32-002(a)

COPECs	EPC (mg/kg)	Red Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	Kestrel (avian intermediate American carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Desert Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Antimony	11	3.5E-07	na*	na	na	na	na	0.0018	0.16	0.45	0.14	**220**
Barium	76.70	2.7E-09	2.9E-08	9.9E-08	3.3E-04	0.0003	0.0003	1.1E-05	2.3E-04	8.3E-04	0.23	**0.7**
Cadmium	0.166	4.7E-10	4.1E-09	1.2E-06	1.3E-04	0.0011	0.002	8.1E-06	0.0024	0.0063	0.001	0.01
Chromium (total)	8.904	7.1E-09	1.1E-07	4.8E-07	4.7E-04	0.0008	0.0011	5.1E-06	7.6E-04	0.0016	na	na
Copper	7.79	3.0E-09	6.9E-08	1.0E-06	7.3E-04	0.0013	0.0019	1.4E-05	7.9E-04	0.0024	0.1	0.11
Lead	46.96	1.8E-08	8.2E-07	5.5E-06	0.0080	0.0105	0.012	6.1E-05	0.0025	0.0076	0.03	**0.39**
Mercury	0.17	5.3E-09	8.6E-06	2.9E-05	0.0087	0.028	0.047	3.7E-06	3.8E-04	0.0011	**3.4**	0.01
Nickel	7.055	8.5E-09	3.4E-08	6.2E-07	0.00016	0.00066	0.0012	6.8E-06	0.0028	0.0069	0.03	0.19
Selenium	0.395	6.8E-09	5.8E-08	1.0E-06	0.0014	0.0016	0.0019	9.1E-05	0.0023	0.0093	0.1	**0.76**
Thallium	0.27	1.4E-07	5.1E-08	5.8E-07	0.0001	0.0006	0.0011	4.7E-05	0.032	0.077	na	**2.7**
Zinc	46.93	1.1E-08	2.8E-07	2.1E-06	4.8E-04	0.002	0.0035	1.3E-05	0.0018	0.0054	**0.39**	0.29
Benzo(a)anthracene	0.311	1.4E-08	4.5E-07	6.4E-07	0.0014	0.0012	0.0011	2.4E-05	0.0004	0.0018	na	0.02
Bis(2-ethylhexyl)phthalate	0.44	5.3E-07	1.9E-04	1.4E-04	7.9E-05	0.039	0.079	7.9E-08	0.0029	0.0078	na	na
TCDD [2,3,7,8-]	2.15E-06	2.6E-06	na	na	na	na	na	2.2E-05	0.029	0.072	4.3E-07	na
HI		0.000004	0.0002	0.0002	0.02	0.09	0.2	0.002	0.2	0.6	**4**	**225**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.
*na = Not available.

Table F-5.4-3
Adjusted HQs and HIs at SWMU 32-002(b1)

COPECs	EPC (mg/kg)	Red Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	Kestrel (avian intermediate American carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Desert Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Inorganic Chemicals												
Antimony	11(UJ)	1.2E-07	na*	na	na	na	na	7.6E-04	0.042	0.14	0.14	**220**
Barium	78.7	9.2E-10	na	na	na	na	na	3.8E-06	7.8E-05	0.0003	0.24	**0.72**
Chromium (total)	44.00	1.2E-08	1.7E-07	8.0E-07	7.7E-04	0.0013	0.0019	8.4E-06	0.0013	0.0026	na	na
Copper	5.8	7.4E-10	1.7E-08	2.5E-07	1.8E-04	3.1E-04	0.0005	3.5E-06	0.0002	0.0006	0.073	0.08
Lead	23.6	3.1E-09	1.4E-07	9.3E-07	0.0013	0.0018	0.002	1.0E-05	0.0004	0.0013	0.01	0.2
Mercury (inorganic)	0.11(U)	1.2E-09	2.0E-06	6.7E-06	0.0016	0.005	0.0085	1.0E-06	6.5E-05	2.2E-04	**2.2**	0.0032
Nickel	21.6	8.7E-09	3.5E-08	6.4E-07	1.6E-04	6.8E-04	0.0012	7.0E-06	0.0029	0.007	0.08	**0.57**
Selenium	0.65	3.7E-09	3.2E-08	5.5E-07	7.7E-04	8.9E-04	0.001	5.0E-05	0.0013	0.0051	0.16	**1.25**
Thallium	1.3 (U)	2.2E-07	8.2E-08	9.3E-07	1.7E-04	0.001	0.0017	7.5E-05	0.052	0.12	na	**13**
Aroclor-1260	0.4	1.4E-06	4.1E-07	5.1E-07	1.0E-05	2.8E-04	0.0005	2.2E-08	5.1E-05	0.0001	na	na
Benzo(a)anthracene	0.27	4.1E-09	1.3E-07	1.8E-07	4.0E-04	3.5E-04	0.0003	7.0E-06	0.0001	0.0005	na	0.02
Bis(2-ethylhexyl)phthalate	0.23	9.2E-08	3.3E-05	2.4E-05	1.4E-05	0.0068	0.014	1.4E-08	0.0005	0.0014	na	na
Di-n-butyl phthalate	0.77	7.4E-11	1.5E-05	5.3E-05	0.0024	0.044	0.083	7.8E-09	5.0E-06	1.4E-05	na	0.0048
TCDD[2,3,7,8-]	2.56E-07	1.0E-07	na	na	na	na	na	8.6E-07	0.0011	0.0029	5.0E-08	na
HI		0.000002	0.00005	0.00009	0.008	0.07	0.1	0.0009	0.09	0.3	**3**	**236**

Notes: Bolded values indicate HQ greater than 0.3 or HI greater than 1. Data qualifiers are defined in Appendix A.
*na = Not available.

Table F-5.4-4
LOAEL-Based ESLs

COPECs	Receptor	LOAEL-Based ESL* (mg/kg)
Antimony	Plant	0.5
Barium	Plant	260
Lead	Plant	570
Mercury	Earthworm	0.5
Nickel	Plant	270
Selenium	Plant	3.4
Thallium	Plant	0.5
Zinc	Earthworm	930

*Values from ECORISK Database Version 3.1 (LANL 2012, 226667).

Table F-5.4-5
HI Analysis with LOAEL-Based ESLs for SWMU 32-002(a)

COPECs	EPC (mg/kg)	Earthworm	Plant
Antimony	11	n/a*	**22**
Barium	76.7	n/a	0.3
Lead	46.96	n/a	0.082
Mercury	0.17	**0.34**	n/a
Selenium	0.395	n/a	0.12
Thallium	0.27	n/a	**0.54**
Zinc	46.93	0.05	n/a
	HI	0.4	**23**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.
*n/a = Not applicable.

Table F-5.4-6
HI Analysis with LOAEL-Based ESLs for SWMU 32-002(b1)

COPECs	EPC (mg/kg)	Earthworm	Plant
Antimony	11(UJ)	n/a*	**22**
Barium	78.7	n/a	0.3
Mercury	0.11(U)	0.22	n/a
Nickel	21.6	n/a	0.08
Selenium	0.65	n/a	0.19
Thallium	1.3 (U)	n/a	**2.6**
	HI	0.2	**25**

Notes: Bolded values indicate HQ greater than 0.3 or HI greater than 1. Data qualifiers are defined in Appendix A.

Attachment F-1

ProUCL Files
(on CD included with this document)

Attachment F-2

Ecological Scoping Checklist

ECOLOGICAL SCOPING CHECKLIST FOR SWMUs 32-002(a) AND 32-002(b1)

Part A—Scoping Meeting Documentation

Site ID	**SWMUs 32-002(a) and 32-002(b1)**
Form of site releases (solid, liquid, vapor). Describe all relevant known or suspected mechanisms of release (spills, dumping, material disposal, outfall, explosive testing, etc.) and describe potential areas of release. Reference locations on a map as appropriate.	Former TA-32 was occupied by the medical research facility from 1944 to 1953. Releases were generated from septic tanks and drainlines. All the structures at former TA-32 were removed after 1954. The potential areas of release were to the surface and subsurface media on the mesa top and near the mesa edge.
List of Primary Impacted Media **(Indicate all that apply.)**	**Surface soil –** X **Surface water/sediment –** **Subsurface –** X **Groundwater –** **Other, explain –**
FIMAD vegetation class based on Arcview vegetation coverage **(Indicate all that apply.)**	**Water –** **Bare Ground/Unvegetated –** X **Spruce/fir/aspen/mixed conifer –** **Ponderosa pine –** X **Piñon juniper/juniper savannah –** X **Grassland/shrubland –** X **Developed –** X
Is T&E Habitat Present? **If applicable, list species known or suspected to use the site for breeding or foraging.**	No T&E habitat is present.
Provide list of Neighboring/ Contiguous/ Up-gradient sites, include a brief summary of COPCs and form of releases for relevant sites and reference map as appropriate. **(Use information to evaluate need to aggregate sites for screening.)**	There are no up-gradient sites from the SWMUs. All contiguous and neighboring areas are industrial/commercial areas within the townsite.
Surface Water Erosion Potential Information	Run-on occurs from storms. Run-off may infiltrate into the shallow subsurface or move as sheet flow into Los Alamos Canyon.

Part B—Site Visit Documentation

Site ID	**SWMUs 32-002(a) and 32-002(b1)**
Date of Site Visit	3/19/09
Site Visit Conducted by	John Branch, Andrew Goumas, Tracy McFarland

Receptor Information:

Estimate cover	Relative vegetative cover (high, medium, low, none) =low Relative wetland cover (high, medium, low, none) = none Relative structures/asphalt, etc. cover (high, medium, low, none) = high on mesa top, none on mesa edge
Field notes on the FIMAD vegetation class to assist in ground-truthing the Arcview information	The areas in and around the SWMUs on the mesa top are all urban in nature and highly developed. The vegetation on hillsides consists of ponderosa pine trees, piñon-juniper stands, and small scrub species.
Field notes on T&E Habitat, if applicable. Consider the need for a site visit by a T&E subject matter expert to support the use of the site by T&E receptors.	There is no T&E habitat present at these sites.
Are ecological receptors present at the site? **(yes/no/uncertain)** **Describe the general types of receptors present at the site (terrestrial and aquatic), and make notes on the quality of habitat present at the site.**	Yes. The areas in and around the SWMUs are highly developed on the mesa top and therefore the habitat quality is poor. As a result, the SWMUs are not well populated by receptors on the mesa top. The general types of receptors on the hillside include reptiles, small mammals, insects, birds, and plants.

Contaminant Transport Information:

Surface water transport **Field notes on the erosion potential, including a discussion of the terminal point of surface water transport (if applicable).**	There is a low potential for surface water transport from the mesa top because the SWMUs were primarily located in the subsurface.
Are there any off-site transport pathways (surface water, air, or groundwater)? **(yes/no/uncertain)** **Provide explanation**	Sheet flow from the mesa top to the canyons occurs during summer storms and as a result of snow melt. Groundwater is located more than 1000 feet below the surface of the mesa top.
Interim action needed to limit off-site transport? **(yes/no/uncertain)** **Provide explanation/ recommendation to project lead for IA SMDP.**	Yes. BMPs are in place to reduce off-site surface transport. The mesa top portions of the SWMUs are subsurface.

Ecological Effects Information:

Physical Disturbance **(Provide list of major types of disturbances, including erosion and construction activities, review historical aerial photos where appropriate.)**	The SWMUs have a high level of physical disturbance due to the industrial/commercial development including parking areas, roads, and buildings.
Are there obvious ecological effects? **(yes/no/uncertain)** **Provide explanation and apparent cause (e.g., contamination, physical disturbance, other).**	Yes, due to the industrial/commercial development of the area. The habitat is of poor quality on the mesa top.
Interim action needed to limit apparent ecological effects? **(yes/no/uncertain)** **Provide explanation and recommendations to mitigate apparent exposure pathways to project lead for IA SMDP.**	No. The area is highly developed. BMPs are in place to reduce runoff onto the hillside and into Los Alamos Canyon.

No Exposure/Transport Pathways:

If there are no complete exposure pathways to ecological receptors onsite and no transport pathways to offsite receptors, the remainder of the checklist should not be completed. Stop here and provide additional explanation/justification for proposing an ecological No Further Action recommendation (if needed). At a minimum, the potential for future transport should include likelihood that future construction activities could make contamination more available for exposure or transport. Not applicable.

Adequacy of Site Characterization:

Do existing or proposed data provide information on the nature, rate and extent of contamination? **(yes/no/uncertain)** **Provide explanation** **(Consider if the maximum value was captured by existing sample data.)**	Yes. The nature and extent of potential contamination has been defined for the SWMUs.
Do existing or proposed data for the site address potential transport pathways of site contamination? **(yes/no/uncertain)** **Provide explanation** **(Consider if other sites should aggregated to characterize potential ecological risk.)**	Yes. The extent of contamination has been defined.

Part C—Ecological Pathways Conceptual Exposure Model

Question A:

Could soil contaminants reach receptors via vapors?

- **Volatility of the hazardous substance (volatile chemicals generally have Henry's Law constant >10^{-5} atm-me/mol and molecular weight <200 g/mol).**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: Volatile organic compounds were not frequently detected, most were in the subsurface, and were at low concentrations.

Question B:

Could the soil contaminants reach receptors through fugitive dust carried in air?

- **Soil contamination would have to be on the actual surface of the soil to become available for dust.**
- **In the case of dust exposures to burrowing animals, the contamination would have to occur in the depth interval where these burrows occur.**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: Potential for dust entrainment on the mesa top is negligible because the area is highly developed and covered with asphalt, while the hillside is well vegetated.

Question C:

Can contaminated soil be transported to aquatic ecological communities?

- **If erosion is a transport pathway, evaluate the terminal point to see if aquatic receptors could be affected by contamination from this site.**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: The SWMUs are subsurface and there are BMPs in place so there is little potential for surface water transport. Not aquatic communities are present on the mesa top. The hillside is well vegetated.

Question D:

Is contaminated groundwater potentially available to biological receptors through seeps or springs or shallow groundwater?

- **Known or suspected presence of contaminants in groundwater.**
- **The potential for contaminants to migrate via groundwater and discharge into habitats and/or surface waters.**
- **Contaminants may be taken up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (~1 m depth).**
- **Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: No seeps or springs are present on the mesa top and no perched water has been found. The depth to groundwater is greater than 1000 ft below ground surface.

Question E:

Is infiltration/percolation from contaminated subsurface material a viable transport and exposure pathway?

- **Suspected ability of contaminants to migrate to groundwater.**
- **The potential for contaminants to migrate via groundwater and discharge into habitats and/or surface waters.**
- **Contaminants may be taken up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (~1 m depth).**
- **Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: Contaminants are unlikely to migrate to the regional aquifer given the depth to groundwater. The lack of a significant hydraulic driver (e.g., no pond water on the surface) facilitating infiltration also mitigates the potential for contaminants reaching groundwater.

Question F:

Might erosion or mass wasting events be a potential release mechanism for contaminants from subsurface materials or perched aquifers to the surface?

- **This question is only applicable to release sites located on or near the mesa edge.**
- **Consider the erodability of surficial material and the geologic processes of canyon/mesa edges.**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: Surface contamination is minimal or non-existent. There are no perched aquifers near these sites.

Question G:

Could airborne contaminants interact with receptors through respiration of vapors?

- **Contaminants must be present as volatiles in the air.**
- **Consider the importance of inhalation of vapors for burrowing animals.**
- **Foliar uptake of organic vapors is typically not a significant exposure pathway.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 1

Terrestrial Animals: 1

Provide explanation: Volatile organic compounds were detected infrequently and at low concentrations.

Question H:

Could airborne contaminants interact with plants through deposition of particulates or with animals through inhalation of fugitive dust?

- **Contaminants must be present as particulates in the air or as dust for this exposure pathway to be complete.**
- **Exposure via inhalation of fugitive dust is particularly applicable to ground-dwelling species that would be exposed to dust disturbed by their foraging or burrowing activities or by wind movement.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 1

Terrestrial Animals: 1

Provide explanation: Buildings, roads, and parking areas minimize particulates and dust.

Question I:

Could contaminants interact with plants through root uptake or rain splash from surficial soils?

- **Contaminants in bulk soil may partition into soil solution, making them available to roots.**
- **Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces by rain striking contaminated soils (i.e., rain splash).**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 2

Provide explanation: Most contamination is subsurface. The mesa top area is highly developed and paved.

Question J:

Could contaminants interact with receptors through food web transport from surficial soils?

- **The chemicals may bioaccumulate in animals.**
- **Animals may ingest contaminated food items.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 2

Provide explanation: Some bioaccumulating contaminants were present but at low concentrations.

Question K:

Could contaminants interact with receptors via incidental ingestion of surficial soils?

- **Incidental ingestion of contaminated soil could occur while animals grub for food resident in the soil, feed on plant matter covered with contaminated soil or while grooming themselves clean of soil.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 2

Provide explanation: Surface and subsurface soil contamination is minor.

Question L:

Could contaminants interact with receptors through dermal contact with surficial soils?

- **Significant exposure via dermal contact would generally be limited to organic contaminants that are lipophilic and can cross epidermal barriers.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 2

Provide explanation: Most detected concentrations are subsurface.

Question M:

Could contaminants interact with plants or animals through external irradiation?

- **External irradiation effects are most relevant for gamma emitting radionuclides.**
- **Burial of contamination attenuates radiological exposure.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 2

Terrestrial Animals: 2

Provide explanation: Gamma-emitting radionuclides detected at low concentrations.

Question N:

Could contaminants interact with plants through direct uptake from water and sediment or sediment rain splash?

- **Contaminants may be taken-up by terrestrial plants whose roots are in contact with surface waters.**
- **Terrestrial plants may be exposed to particulates deposited on leaf and stem surfaces by rain striking contaminated sediments (i.e., rain splash) in an area that is only periodically inundated with water.**
- **Contaminants in sediment may partition into soil solution, making them available to roots.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 0

Provide explanation: There are no aquatic environments onsite.

Question O:

Could contaminants interact with receptors through food web transport from water and sediment?

- **The chemicals may bioconcentrate in food items.**
- **Animals may ingest contaminated food items.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 0

Provide explanation: There are no aquatic environments onsite.

Question P:

Could contaminants interact with receptors via ingestion of water and suspended sediments?

- **If sediments are present in an area that is only periodically inundated with water, terrestrial receptors may incidentally ingest sediments.**
- **Terrestrial receptors may ingest water-borne contaminants if contaminated surface waters are used as a drinking water source.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 0

Provide explanation: There are no aquatic environments onsite.

Question Q:

Could contaminants interact with receptors through dermal contact with water and sediment?

- **If sediments are present in an area that is only periodically inundated with water, terrestrial species may be dermally exposed during dry periods.**
- **Terrestrial organisms may be dermally exposed to water-borne contaminants as a result of wading or swimming in contaminated waters.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 0

Provide explanation: There are no aquatic environments onsite.

Question R:

Could contaminants interact with plants or animals through external irradiation?

- **External irradiation effects are most relevant for gamma emitting radionuclides.**
- **Burial of contamination attenuates radiological exposure.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 0

Terrestrial Animals: 0

Provide explanation: There are no aquatic environments onsite.

Question S:

Could contaminants bioconcentrate in free floating aquatic, attached aquatic plants, or emergent vegetation?

- **Aquatic plants are in direct contact with water.**
- **Contaminants in sediment may partition into pore water, making them available to submerged roots.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Plants/Emergent Vegetation: 0

Provide explanation: There are no aquatic environments onsite.

Question T:

Could contaminants bioconcentrate in sedimentary or water column organisms?

- **Aquatic receptors may actively or incidentally ingest sediment while foraging.**
- **Aquatic receptors may be directly exposed to contaminated sediments or may be exposed to contaminants through osmotic exchange, respiration, or ventilation of sediment pore waters.**
- **Aquatic receptors may be exposed through osmotic exchange, respiration, or ventilation of surface waters.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Animals: 0

Provide explanation: There are no aquatic environments onsite.

Question U:

Could contaminants bioaccumulate in sedimentary or water column organisms?

- **Lipophilic organic contaminants and some metals may concentrate in an organism's tissues**
- **Ingestion of contaminated food items may result in contaminant bioaccumulation through the food web.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Animals: 0

Provide explanation: There are no aquatic environments onsite.

Question V:

Could contaminants interact with aquatic plants or animals through external irradiation?

- **External irradiation effects are most relevant for gamma emitting radionuclides.**
- **The water column acts to absorb radiation, thus external irradiation is typically more important for sediment dwelling organisms.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

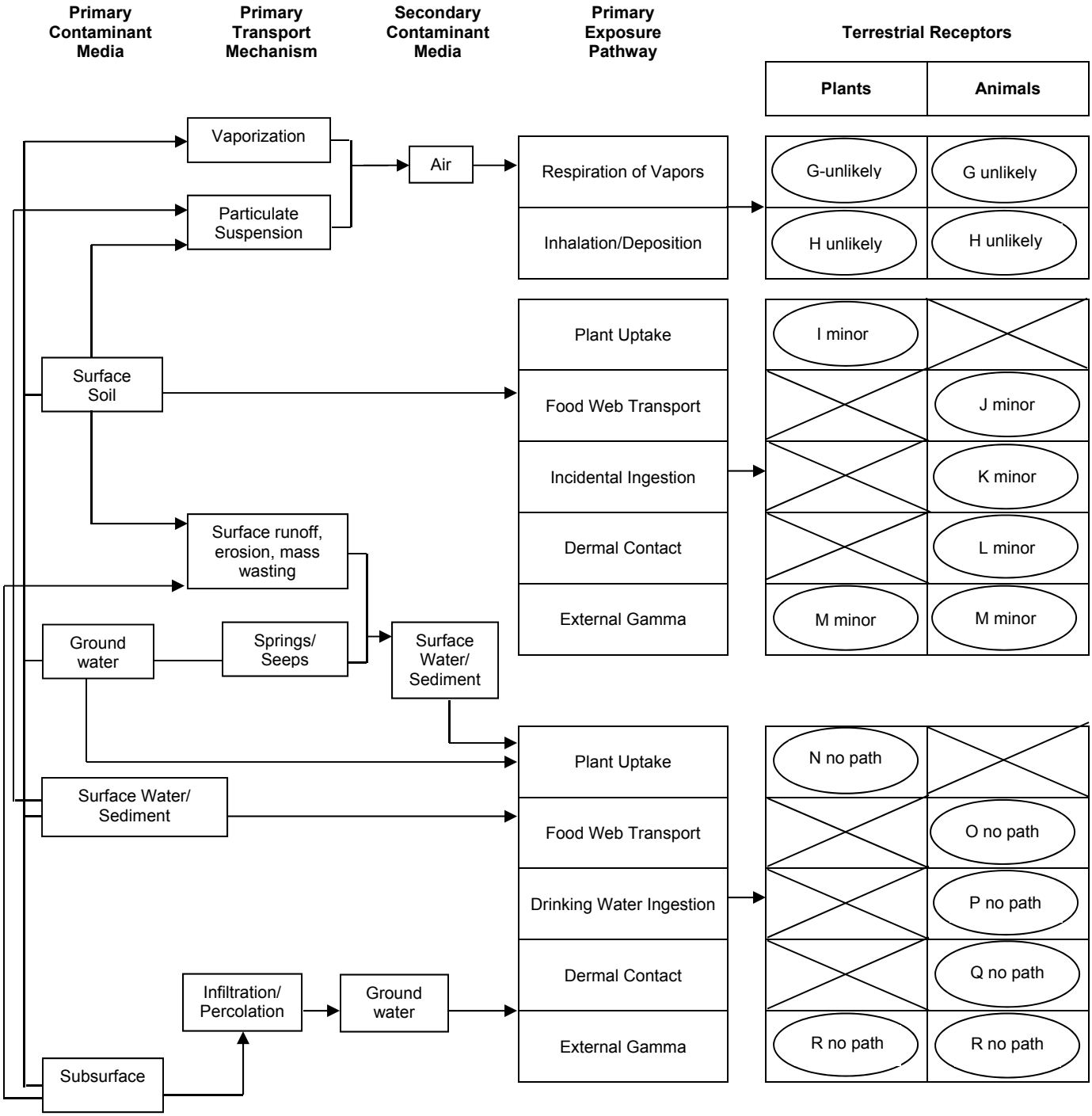
Aquatic Plants: 0

Aquatic Animals: 0

Provide explanation: There are no aquatic environments onsite.

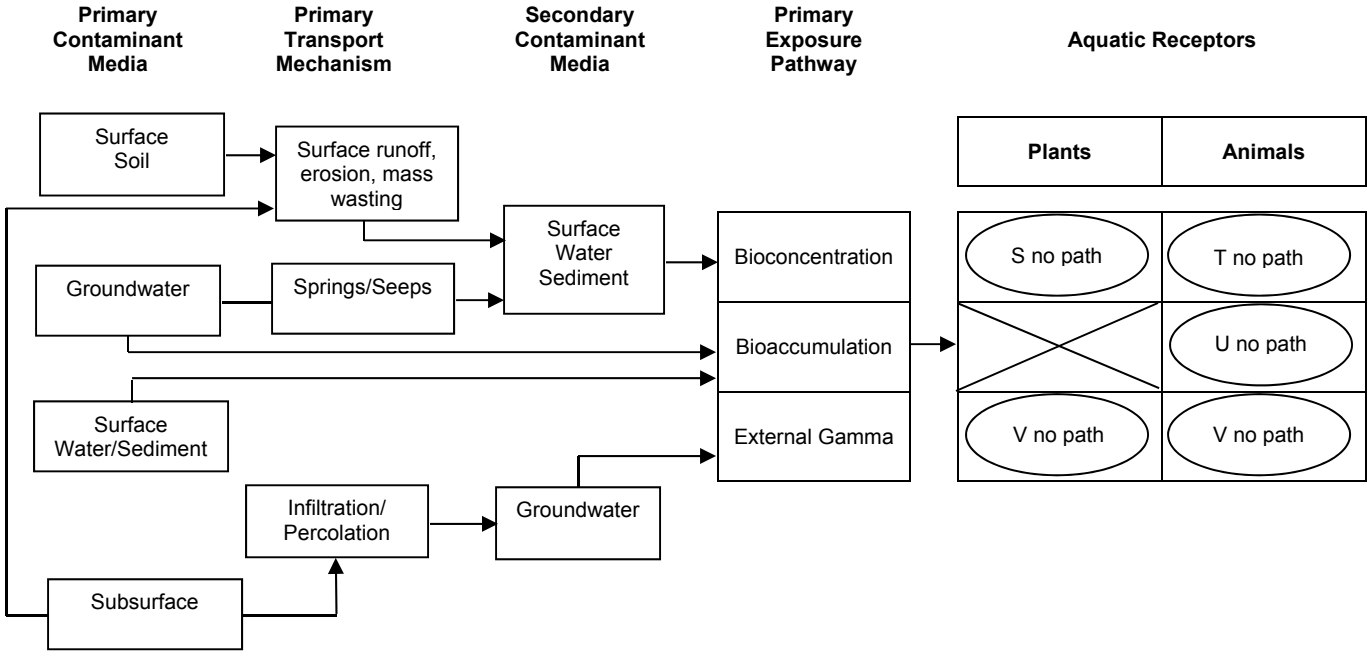
NOTE:
Letters in circles refer to questions on the Scoping Checklist

Ecological Scoping Checklist
Terrestrial Receptors
Ecological Pathways Conceptual Exposure Model



NOTE:
Letters in circles refer to questions on the Scoping Checklist

Ecological Scoping Checklist
Aquatic Receptors
Ecological Pathways Conceptual Exposure Model



Signatures and certifications:

Checklist completed by (provide name, organization and phone number):

Name (printed): Richard Mirenda
Name (signature): Richard Mirenda
Organization: LANL ET-ER
Date completed: 12/17/2012

Checklist reviewed by:

Name (printed): Richard Mirenda
Name (signature): Richard Mirenda
Organization: LANL ET-ER
Date reviewed: 12/20/2012

Appendix G

Investigation-Derived Waste Management

G-1.0 INTRODUCTION

This appendix describes the management of the investigation-derived waste (IDW) generated during the 2011 investigation sampling at Solid Waste Management Unit (SWMU) 32-002(a) at Los Alamos National Laboratory (the Laboratory). This sampling was performed as part of the Phase II investigation for Upper Los Alamos County Aggregate Area. Documentation of the management of all IDW generated during the Phase II investigation of Upper Los Alamos Canyon Aggregate Area, including the 2011 investigation sampling at SWMU 32-002(a), will be presented in the Phase II investigation report for Upper Los Alamos Canyon Aggregate Area.

All IDW generated during the field investigation was managed in accordance with Standard Operating Procedure (SOP) 5238, Characterization and Management of Environmental Program Waste. This procedure incorporates the requirements of all applicable U.S. Environmental Protection Agency (EPA) and New Mexico Environment Department regulations, U.S. Department of Energy orders, and Laboratory implementation requirements.

Consistent with Laboratory procedures, a waste characterization strategy form (WCSF) was prepared to address characterization approaches, on-site management, and final disposition options for wastes. Information from previous investigation wastes and analytical data and/or acceptable knowledge (AK) were used to complete the WCSF.

The selection of waste containers was based on appropriate U.S. Department of Transportation requirements, waste types, and volumes of IDW generated. Immediately following containerization, each waste container was individually labeled with a unique identification number and with information regarding waste classification, contents, radioactivity, and date generated.

Wastes were staged in clearly marked and appropriately constructed waste accumulation areas. Waste accumulation area postings, regulated storage duration, and inspection requirements were based on the type of IDW and its classification. Container and storage requirements were detailed in the WCSF and approved before waste was generated.

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

G-2.0 WASTE STREAMS

The IDW streams generated and managed during the 2011 investigation activities at SWMU 32-002(a) are described below and are summarized in Table G-2.0-1.

- *Contact Waste:* This waste stream includes spent personal protective equipment, contaminated sampling supplies, and dry decontamination waste that may have come in contact with contaminated media. These wastes were containerized at the point of generation and were characterized based on AK of the waste materials, the extent of contamination of the contact waste, the methods of generation as well as existing analytical data available for the media with which it came into contact. These wastes were managed as hazardous or nonhazardous depending on the contaminants expected at the SWMU from which they were generated. Less than 1 yd^3 of contact waste was generated and disposed of at an authorized treatment, storage, and disposal (TSD) facility.

- *Drill Cuttings:* This waste stream includes soil and tuff cuttings from boreholes. Less than 1 yd^3 of cuttings was stored in lined 55-gal. drums within appropriate waste staging areas. All drums were directly sampled and were determined to be industrial waste. The waste was analyzed for total metals, toxicity characteristic leaching procedure metals, semivolatile organic compounds, volatile organic compounds, polychlorinated biphenyls, and radionuclides. All drill cuttings were disposed of at an authorized TSD facility.

Table G-2.0-1
Summary of 2011 IDW Generation and Management

Waste Stream	Waste Type	Volume	Characterization Method	On-Site Management	Disposition
Contact waste	Nonhazardous	<1 yd^3	AK and results of site characterization	55-gal. drums, plastic bags	Off-site TSD
Drill cuttings	Nonhazardous	<1 yd^3	Direct sampling and use of environmental samples	55-gal. drums, and 5-gal. poly buckets	Land-applied