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Supplemental Investigation Report for Threemile Canyon Aggregate Area, Revision 1

Newport News Nuclear BWXT – Los Alamos, LLC (N3B), under the U.S. Department of Energy Office of Environmental Management Contract No. 89303318CEM000007 (the Los Alamos Legacy Cleanup Contract), has prepared this document pursuant to the Compliance Order on Consent, signed June 24, 2016. The Compliance Order on Consent contains requirements for the investigation and cleanup, including corrective action, of contamination at Los Alamos National Laboratory. The U.S. government has rights to use, reproduce, and distribute this document. The public may copy and use this document without charge, provided that this notice and any statement of authorship are reproduced on all copies.

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July 2018

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EXECUTIVE SUMMARY

This supplemental investigation report evaluates the nature and extent of contamination and potential human health and ecological risks for 25 solid waste management units (SWMUs) and areas of concern (AOCs) in the Threemile Canyon Aggregate Area at Los Alamos National Laboratory (LANL or the Laboratory). The SWMUs and AOCs addressed in this report are located in Technical Area 14 (TA-14), TA-15, TA-36, and former TA-12. Twenty-six sites within the Threemile Canyon Aggregate Area were investigated in 2009–2010, and the investigation results were documented in the Threemile Canyon Aggregate Area investigation report, submitted by the U.S. Department of Energy (DOE) and Los Alamos National Security, LLC (LANS) to the New Mexico Environment Department (NMED) in November 2010. The approved investigation report concluded that additional sampling to define the extent of contamination was needed for 26 SWMUs and AOCs. Additional sampling requirements for 25 of these sites were documented in the approved Phase II investigation work plan for Threemile Canyon Aggregate Area, submitted by DOE and LANS to NMED in October 2011. Investigation of the remaining site is delayed because it is within an area affected by firing site activities. This revised supplemental investigation report, prepared by Newport News Nuclear BWXT – Los Alamos, LLC (N3B), addresses NMED’s comments concerning the original submission of the supplemental investigation report.

After the investigation report and Phase II investigation work plan had been approved, NMED and ~~the U.S. Department of Energy (DOE)~~ entered into a framework agreement for the realignment of environmental priorities at the Laboratory. Under the framework agreement, NMED and DOE agreed to review characterization efforts undertaken to date pursuant to the Compliance Order on Consent (Consent Order) to identify those sites where the nature and extent of contamination ~~has~~ have been adequately characterized. Pursuant to the framework agreement, the Laboratory reviewed its data evaluation process with respect to U.S. Environmental Protection Agency (EPA) guidance and the framework agreement principles and concluded that this process could be revised to more efficiently complete site characterization, while providing full protection of human health and the environment. Specifically, the process for evaluating data to define extent of contamination was revised to provide a greater emphasis on risk reduction, consistent with EPA guidance.

The revised process was used to evaluate the 2009–2010 data and previous decision-level investigation data for the 25 sites identified in the Phase II investigation work plan as requiring additional sampling to define extent. The revised process does not affect the status of the 15 other sites within the aggregate area approved for completion of corrective action or deferred or delayed investigation. Based on the evaluation of investigation results using the revised process, the extent of contamination has been defined (or a determination has been made that no further sampling for extent is warranted) at 20~~4~~ sites, and additional sampling for extent is required at 5~~4~~ sites, of which 2 sites also require remediation. Human health and ecological risk assessments were performed for all sites.

Based on the results of data evaluations presented in this supplemental investigation report, ~~the Laboratory~~N3B recommends the following:

- Corrective action complete without controls is recommended for 20~~4~~ sites for which extent is defined and which pose no potential unacceptable human health risk under the residential scenario and no unacceptable ecological risk.
- Additional sampling and analyses are recommended for 5~~4~~ sites for which extent is not defined.
- Soil removal is recommended for 2 sites (includes 2 of the sites requiring additional sampling and analysis for extent above), which pose a potential unacceptable risk under the industrial scenario, and one of which may pose an unacceptable ecological risk.

CONTENTS

1.0	INTRODUCTION	1
1.1	General Site Information	1
1.2	Purpose of the Supplemental Investigation Report	2
1.3	Document Organization	2
2.0	SITE CONDITIONS	3
2.1	Surface Conditions	3
2.1.1	Soil	3
2.1.2	Surface Water	4
2.2	Subsurface Conditions	5
2.2.1	Stratigraphic Units	5
2.2.2	Hydrogeology	7
3.0	SCOPE OF ACTIVITIES	9
3.1	Site Access and Premobilization Activities	9
3.2	Field Activities	10
3.2.1	Geodetic Surveys	10
3.2.2	Field Screening	10
3.2.3	Surface and Shallow-Subsurface Soil Investigation	11
3.2.4	Subsurface Investigation	11
3.2.5	Health and Safety Measures	12
3.2.6	Waste Management	12
3.3	Sample Analyses	14
3.4	Deviations	14
4.0	REGULATORY CRITERIA	15
4.1	Current and Future Land Use	15
4.2	Screening Levels	15
4.3	Ecological Screening Levels	16
4.4	Cleanup Standards	16
5.0	DATA REVIEW METHODOLOGY	16
5.1	Identification of COPCs	16
5.1.1	Inorganic Chemical and Radionuclide Background Comparisons	17
5.1.2	Statistical Methods Overview	19
5.2	Extent of Contamination	20
6.0	FORMER TA-12 BACKGROUND AND FIELD INVESTIGATION RESULTS	21
6.1	Background of Former TA-12	21
6.1.1	Operational History	21
6.1.2	Summary of Releases	22
6.1.3	Current Site Usage and Status	22
6.2	SWMU 12-001(a)—Firing Site Steel-Lined Pit	23
6.2.1	Site Description and Operational History	23
6.2.2	Relationship to Other SWMUs and AOCs	23
6.2.3	Summary of Previous Investigations	23
6.2.4	Site Contamination	24
6.2.5	Summary of Human Health Risk Screening	31
6.2.6	Summary of Ecological Risk Screening	31

6.3	SWMU 12-001(b)—Former Firing Pit	32
6.3.1	Site Description and Operational History	32
6.3.2	Relationship to Other SWMUs and AOCs.....	32
6.3.3	Summary of Previous Investigations.....	32
6.3.4	Site Contamination.....	32
6.3.5	Summary of Human Health Risk Screening.....	33
6.3.6	Summary of Ecological Risk Screening	33
6.4	SWMU 12-002—Potential Soil Contamination	33
6.4.1	Site Description and Operational History	33
6.4.2	Relationship to Other SWMUs and AOCs.....	33
6.4.3	Summary of Previous Investigations.....	33
6.4.4	Site Contamination.....	34
6.4.5	Summary of Human Health Risk Screening.....	37
6.4.6	Summary of Ecological Risk Screening	37
6.5	AOC 12-004(a)—Radiation Test Site	38
6.5.1	Site Description and Operational History	38
6.5.2	Relationship to Other SWMUs and AOCs.....	38
6.5.3	Summary of Previous Investigations.....	38
6.5.4	Site Contamination.....	39
6.5.5	Summary of Human Health Risk Screening.....	46
6.5.6	Summary of Ecological Risk Screening	46
6.6	AOC 12-004(b)—Pipe.....	46
6.6.1	Site Description and Operational History	46
6.6.2	Relationship to Other SWMUs and AOCs.....	47
6.6.3	Summary of Previous Investigations.....	47
6.6.4	Site Contamination.....	47
6.6.5	Summary of Human Health Risk Screening.....	53
6.6.6	Summary of Ecological Risk Screening	53
6.7	AOC C-12-001—Potential Soil Contamination Associated with Former Building 12-1	54
6.7.1	Site Description and Operational History	54
6.7.2	Relationship to Other SWMUs and AOCs.....	54
6.7.3	Summary of Previous Investigations.....	54
6.7.4	Site Contamination.....	54
6.7.5	Summary of Human Health Risk Screening.....	58
6.7.6	Summary of Ecological Risk Screening	58
6.8	AOC C-12-002—Potential Soil Contamination Associated with Former Building 12-2	58
6.8.1	Site Description and Operational History	58
6.8.2	Relationship to Other SWMUs and AOCs.....	59
6.8.3	Summary of Previous Investigations.....	59
6.8.4	Site Contamination.....	59
6.8.5	Summary of Human Health Risk Screening.....	63
6.8.6	Summary of Ecological Risk Screening	63
6.9	AOC C-12-003—Potential Soil Contamination Associated with Former Building 12-3	63
6.9.1	Site Description and Operational History	63
6.9.2	Relationship to Other SWMUs and AOCs.....	64
6.9.3	Summary of Previous Investigations.....	64
6.9.4	Site Contamination.....	64
6.9.5	Summary of Human Health Risk Screening.....	67
6.9.6	Summary of Ecological Risk Screening	67

6.10	AOC C-12-004—Potential Soil Contamination Associated with Former Building 12-5.....	67
6.10.1	Site Description and Operational History	67
6.10.2	Relationship to Other SWMUs and AOCs.....	67
6.10.3	Summary of Previous Investigations.....	67
6.10.4	Site Contamination.....	68
6.10.5	Summary of Human Health Risk Screening.....	72
6.10.6	Summary of Ecological Risk Screening	73
6.11	AOC C-12-005—Potential Soil Contamination Associated with Former Junction Box	73
6.11.1	Site Description and Operational History	73
6.11.2	Relationship to Other SWMUs and AOCs.....	73
6.11.3	Summary of Previous Investigations.....	73
6.11.4	Site Contamination.....	73
6.11.5	Summary of Human Health Risk Screening.....	75
6.11.6	Summary of Ecological Risk Screening	76
7.0	TA-14 BACKGROUND AND FIELD INVESTIGATION RESULTS.....	76
7.1	Background of TA-14.....	76
7.1.1	Operational History.....	76
7.1.2	Summary of Releases	76
7.1.3	Current Site Usage and Status	77
7.2	AOC C-14-006—Potential Soil Contamination Associated with Former Building 14-9.....	77
7.2.1	Site Description and Operational History	77
7.2.2	Relationship to Other SWMUs and AOCs.....	77
7.2.3	Summary of Previous Investigations.....	77
7.2.4	Site Contamination.....	77
7.2.5	Summary of Human Health Risk Screening.....	80
7.2.6	Summary of Ecological Risk Screening	80
8.0	TA-15 BACKGROUND AND FIELD INVESTIGATION RESULTS.....	80
8.1	Background of TA-15.....	80
8.1.1	Operational History.....	80
8.1.2	Summary of Releases	81
8.1.3	Current Site Usage and Status	81
8.2	AOC 15-005(c)—Container Storage Area (R-41).....	81
8.2.1	Site Description and Operational History	81
8.2.2	Relationship to Other SWMUs and AOCs.....	82
8.2.3	Summary of Previous Investigations.....	82
8.2.4	Site Contamination.....	82
8.2.5	Summary of Human Health Risk Screening.....	88
8.2.6	Summary of Ecological Risk Screening	88
8.3	SWMU 15-007(c)—Shaft.....	88
8.3.1	Site Description and Operational History	88
8.3.2	Relationship to Other SWMUs and AOCs.....	88
8.3.3	Summary of Previous Investigations.....	89
8.3.4	Site Contamination.....	89
8.3.5	Summary of Human Health Risk Screening.....	95
8.3.6	Summary of Ecological Risk Screening	96

8.4	SWMU 15-007(d)—Shaft.....	96
8.4.1	Site Description and Operational History	96
8.4.2	Relationship to Other SWMUs and AOCs.....	96
8.4.3	Summary of Previous Investigations.....	96
8.4.4	Site Contamination.....	97
8.4.5	Summary of Human Health Risk Screening.....	100
8.4.6	Summary of Ecological Risk Screening	100
8.5	SWMU 15-008(b)—Surface Disposal Area	100
8.5.1	Site Description and Operational History	100
8.5.2	Relationship to Other SWMUs and AOCs.....	100
8.5.3	Summary of Previous Investigations.....	100
8.5.4	Site Contamination.....	101
8.5.5	Summary of Human Health Risk Screening.....	112
8.5.6	Summary of Ecological Risk Screening	112
8.6	AOC 15-008(g)—Surface Disposal Associated with Firing Site R-45.....	112
8.6.1	Site Description and Operational History	112
8.6.2	Relationship to Other SWMUs and AOCs.....	112
8.6.3	Summary of Previous Investigations.....	112
8.6.4	Site Contamination.....	113
8.6.5	Summary of Human Health Risk Screening.....	116
8.6.6	Summary of Ecological Risk Screening	116
8.7	SWMU 15-009(b)—Septic System	117
8.7.1	Site Description and Operational History	117
8.7.2	Relationship to Other SWMUs and AOCs.....	117
8.7.3	Summary of Previous Investigations.....	117
8.7.4	Site Contamination.....	117
8.7.5	Summary of Human Health Risk Screening.....	124
8.7.6	Summary of Ecological Risk Screening	124
8.8	SWMU 15-009(c)—Septic System	124
8.8.1	Site Description and Operational History	124
8.8.2	Relationship to Other SWMUs and AOCs.....	125
8.8.3	Summary of Previous Investigations.....	125
8.8.4	Site Contamination.....	125
8.8.5	Summary of Human Health Risk Screening.....	131
8.8.6	Summary of Ecological Risk Screening	131
8.9	SWMU 15-009(h)—Septic System	131
8.9.1	Site Description and Operational History	131
8.9.2	Relationship to Other SWMUs and AOCs.....	132
8.9.3	Summary of Previous Investigations.....	132
8.9.4	Site Contamination.....	132
8.9.5	Summary of Human Health Risk Screening.....	136
8.9.6	Summary of Ecological Risk Screening	137
8.10	SWMU 15-010(b)—Settling Tank	137
8.10.1	Site Description and Operational History	137
8.10.2	Relationship to Other SWMUs and AOCs.....	137
8.10.3	Summary of Previous Investigations.....	137
8.10.4	Site Contamination.....	137
8.10.5	Summary of Human Health Risk Screening.....	144
8.10.6	Summary of Ecological Risk Screening	144

8.11	AOC 15-014(h)—Outfalls from Building 15-40	144
8.11.1	Site Description and Operational History	144
8.11.2	Relationship to Other SWMUs and AOCs.....	145
8.11.3	Summary of Previous Investigations.....	145
8.11.4	Site Contamination.....	145
8.11.5	Summary of Human Health Risk Screening.....	156
8.11.6	Summary of Ecological Risk Screening	156
9.0	TA-36 BACKGROUND AND FIELD INVESTIGATION RESULTS.....	157
9.1	Background of TA-36.....	157
9.1.1	Operational History.....	157
9.1.2	Summary of Releases	157
9.1.3	Current Site Usage and Status	157
9.2	SWMU 36-002—Former Sump	157
9.2.1	Site Description and Operational History	157
9.2.2	Relationship to Other SWMUs and AOCs.....	158
9.2.3	Summary of Previous Investigations.....	158
9.2.4	Site Contamination.....	158
9.2.5	Summary of Human Health Risk-Screening Assessments.....	162
9.2.6	Summary of Ecological Risk-Screening Assessment	162
9.3	SWMU 36-003(a)—Septic System	162
9.3.1	Site Description and Operational History	162
9.3.2	Relationship to Other SWMUs and AOCs.....	163
9.3.3	Summary of Previous Investigations.....	163
9.3.4	Site Contamination.....	163
9.3.5	Summary of Human Health Risk-Screening Assessments.....	168
9.3.6	Summary of Ecological Risk-Screening Assessment	168
9.4	SWMU 36-008—Surface Disposal Area Located Near Building 36-1.....	168
9.4.1	Site Description and Operational History	168
9.4.2	Relationship to Other SWMUs and AOCs.....	168
9.4.3	Summary of Previous Investigations.....	168
9.4.4	Site Contamination.....	169
9.4.5	Summary of Human Health Risk-Screening Assessments.....	182
9.4.6	Summary of Ecological Risk-Screening Assessment	182
9.5	SWMU C-36-003—Outfall from Building 36-1	182
9.5.1	Site Description and Operational History	182
9.5.2	Relationship to Other SWMUs and AOCs.....	182
9.5.3	Summary of Previous Investigations.....	183
9.5.4	Site Contamination.....	183
9.5.5	Summary of Human Health Risk-Screening Assessments.....	190
9.5.6	Summary of Ecological Risk-Screening Assessment	192
10.0	CONCLUSIONS.....	192
10.1	Nature and Extent of Contamination	192
10.1.1	Former TA-12	192
10.1.2	TA-14.....	192
10.1.3	TA-15.....	193
10.1.4	TA-36.....	193

10.2	Summary of Risk-Screening Assessments	193
10.2.1	Human Health Risk-Screening Assessment	194
10.2.2	Ecological Risk-Screening Assessment.....	194
11.0	RECOMMENDATIONS.....	194
11.1	Additional Field Characterization and Remediation Activities	195
11.2	Recommendations for Corrective Actions Complete.....	195
11.3	Schedule for Recommended Activities.....	196
12.0	REFERENCES AND MAP DATA SOURCES.....	196
12.1	References	196
12.2	Map Data Sources.....	205

Figures

Figure 1.1-1	Location of Threemile Canyon Aggregate Area with respect to Laboratory technical areas	205
Figure 2.2-1	Generalized stratigraphy of bedrock geologic units of the Pajarito Plateau	206
Figure 2.2-2	Elevations of top of regional aquifer across the Laboratory	207
Figure 6.1-1	Former TA-12 site map	208
Figure 6.5-1	Site map and sampling locations at AOCs 12-004(a) and 12-004(b).....	209
Figure 6.5-2	Inorganic chemicals detected or detected above BVs at AOCs 12-004(a) and 12-004(b).....	210
Figure 6.5-3	Organic chemicals detected at AOCs 12-004(a) and 12-004(b)	211
Figure 6.5-4	Radionuclides detected or detected above BVs/FVs at AOCs 12-004(a) and 12-004(b).....	212
Figure 7.2-1	AOC C-14-006 site map and sampling locations.....	213
Figure 7.2-2	Inorganic chemicals detected or detected above BVs at AOC C-14-006.....	214
Figure 7.2-3	Organic chemicals detected at AOC C-14-006.....	215
Figure 8.1-1	Site map of TA-15	216
Figure 8.2-1	AOC 15-005(c) site map and sampling locations	217
Figure 8.2-2	Inorganic chemicals detected or detected above BVs at AOC 15-005(c)	218
Figure 8.2-3	Organic chemicals detected at AOC 15-005(c)	219
Figure 8.2-4	Radionuclides detected or detected above BVs/FVs at AOC 15-005(c)	220
Figure 8.6-1	AOC 15-008(g) site map and sampling locations	221
Figure 8.6-2	Inorganic chemicals detected or detected above BVs at AOC 15-008(g)	222
Figure 8.6-3	Organic chemicals detected at AOC 15-008(g)	223
Figure 8.6-4	Radionuclides detected or detected above BVs/FVs at AOC 15-008(g).....	224
Figure 8.7-1	SWMU 15-009(b) site map and sampling locations.....	225
Figure 8.7-2	Inorganic chemicals detected or detected above BVs at SWMU 15-009(b).....	226
Figure 8.7-3	Organic chemicals detected at SWMU 15-009(b)	227
Figure 8.7-4	Radionuclides detected or detected above BVs/FVs at SWMU 15-009(b)	228
Figure 8.9-1	SWMU 15-009(h) site map and sampling locations.....	229
Figure 8.9-2	Inorganic chemicals detected or detected above BVs at SWMU 15-009(h).....	230

Figure 8.9-3	Organic chemicals detected at SWMU 15-009(h)	231
Figure 8.9-4	Radionuclides detected or detected above BVs/FVs at SWMU 15-009(h)	232
Figure 8.10-1	SWMU 15-010(b) site map and sampling locations.....	233
Figure 8.10-2	Inorganic chemicals detected or detected above BVs at SWMU 15-010(b).....	234
Figure 8.10-3	Organic chemicals detected at SWMU 15-010(b)	235
Figure 8.10-4	Radionuclides detected or detected above BVs/FVs at SWMU 15-010(b)	236
Figure 9.1-1	Site map of TA-36	237
Figure 9.2-1	SWMU 36-002 site map and sampling locations	238
Figure 9.2-2	Inorganic chemicals detected or detected above BVs at SWMU 36-002	239
Figure 9.2-3	Organic chemicals detected at SWMU 36-002.....	240
Figure 9.2-4	Radionuclides detected or detected above BVs/FVs at SWMU 36-002.....	241
Figure 9.3-1	SWMU 36-003(a) site map and sampling locations.....	242
Figure 9.3-2	Inorganic chemicals detected or detected above BVs at SWMU 36-003(a).....	243
Figure 9.3-3	Organic chemicals detected at SWMU 36-003(a)	244
Figure 9.3-4	Radionuclides detected or detected above BVs/FVs at SWMU 36-003(a)	245

Tables

Table 1.1-1	Sites under Investigation in the Threemile Canyon Aggregate Area.....	247
Table 3.2-1	Surveyed Coordinates for Locations Sampled in 2009–2010	249
Table 3.2-2	Field-Screening Results for Samples Collected at Threemile Canyon Aggregate Area	258
Table 6.2-1	Samples Collected and Analyses Requested at SWMUs 12-001(a) and 12-001(b)	279
Table 6.2-2	Inorganic Chemicals above BVs at SWMUs 12-001(a) and 12-001(b)	283
Table 6.2-3	Organic Chemicals Detected at SWMUs 12-001(a) and 12-001(b)	287
Table 6.2-4	Radionuclides Detected or Detected above BVs/FVs at SWMUs 12-001(a) and 12-001(b).....	288
Table 6.4-1	Samples Collected and Analyses Requested at SWMU 12-002	289
Table 6.4-2	Inorganic Chemicals above BVs at SWMU 12-002	290
Table 6.5-1	Samples Collected and Analyses Requested at AOC 12-004(a)	291
Table 6.5-2	Inorganic Chemicals above BVs at AOC 12-004(a)	293
Table 6.5-3	Organic Chemicals Detected at AOC 12-004(a).....	295
Table 6.5-4	Radionuclides Detected or Detected above BVs/FVs at AOC 12-004(a).....	296
Table 6.6-1	Samples Collected and Analyses Requested at AOC 12-004(b)	297
Table 6.6-2	Inorganic Chemicals above BVs at AOC 12-004(b)	298
Table 6.6-3	Organic Chemicals Detected at AOC 12-004(b).....	299
Table 6.6-4	Radionuclides Detected or Detected above BVs/FVs at AOC 12-004(b).....	299
Table 6.7-1	Samples Collected and Analyses Requested at AOC C-12-001	300
Table 6.7-2	Inorganic Chemicals above BVs at AOC C-12-001	301
Table 6.7-3	Organic Chemicals Detected at AOC C-12-001	301
Table 6.8-1	Samples Collected and Analyses Requested at AOC C-12-002.....	302
Table 6.8-2	Inorganic Chemicals above BVs at AOC C-12-002	302

Table 6.9-1	Samples Collected and Analyses Requested at AOC C-12-003.....	303
Table 6.9-2	Inorganic Chemicals above BVs at AOC C-12-003.....	304
Table 6.10-1	Samples Collected and Analyses Requested at AOC C-12-004.....	305
Table 6.10-2	Inorganic Chemicals above BVs at AOC C-12-004.....	306
Table 6.11-1	Samples Collected and Analyses Requested at AOC C-12-005.....	307
Table 6.11-2	Inorganic Chemicals above BVs at AOC C-12-005.....	308
Table 7.2-1	Samples Collected and Analyses Requested at AOC C-14-006.....	309
Table 7.2-2	Inorganic Chemicals above BVs at AOC C-14-006.....	310
Table 7.2-3	Organic Chemicals Detected at AOC C-14-006.....	311
Table 8.2-1	Samples Collected and Analyses Requested at AOC 15-005(c).....	311
Table 8.2-2	Inorganic Chemicals above BVs at AOC 15-005(c).....	312
Table 8.2-3	Organic Chemicals Detected at AOC 15-005(c).....	314
Table 8.2-4	Radionuclides Detected or Detected above BVs/FVs at AOC 15-005(c).....	315
Table 8.3-1	Samples Collected and Analyses Requested at SWMU 15-007(c).....	316
Table 8.3-2	Inorganic Chemicals above BVs at SWMU 15-007(c).....	319
Table 8.3-3	Organic Chemicals Detected at SWMU 15-007(c).....	322
Table 8.3-4	Radionuclides Detected or Detected above BVs/FVs at SWMU 15-007(c).....	323
Table 8.4-1	Samples Collected and Analyses	324
Table 8.4-2	Inorganic Chemicals above BVs at SWMU 15-007(d).....	325
Table 8.4-3	Organic Chemicals Detected at SWMU 15-007(d).....	326
Table 8.4-4	Radionuclides Detected or Detected above BVs/FVs at SWMU 15-007(d).....	327
Table 8.5-1	Samples Collected and Analyses Requested at SWMU 15-008(b).....	328
Table 8.5-2	Inorganic Chemicals above BVs at SWMU 15-008(b).....	337
Table 8.5-3	Organic Chemicals Detected at SWMU 15-008(b).....	343
Table 8.5-4	Radionuclides Detected or Detected above BVs/FVs at SWMU 15-008(b).....	345
Table 8.6-1	Samples Collected and Analyses Requested at AOC 15-008(g).....	354
Table 8.6-2	Inorganic Chemicals above BVs at AOC 15-008(g).....	355
Table 8.6-3	Organic Chemicals Detected at AOC 15-008(g).....	356
Table 8.6-4	Radionuclides Detected or Detected above BVs/FVs at AOC 15-008(g).....	356
Table 8.7-1	Samples Collected and Analyses Requested at SWMU 15-009(b).....	357
Table 8.7-2	Inorganic Chemicals above BVs at SWMU 15-009(b).....	358
Table 8.7-3	Organic Chemicals Detected at SWMU 15-009(b).....	359
Table 8.7-4	Radionuclides Detected or Detected above BVs/FVs at SWMU 15-009(b).....	361
Table 8.8-1	Samples Collected and Analyses Requested at SWMU 15-009(c).....	362
Table 8.8-2	Inorganic Chemicals above BVs at SWMU 15-009(c).....	364
Table 8.8-3	Organic Chemicals Detected at SWMU 15-009(c).....	366
Table 8.8-4	Radionuclides Detected or Detected above BVs/FVs at SWMU 15-009(c).....	367
Table 8.9-1	Samples Collected and Analyses Requested at SWMU 15-009(h).....	368
Table 8.9-2	Inorganic Chemicals above BVs at SWMU 15-009(h).....	369
Table 8.9-3	Organic Chemicals Detected at SWMU 15-009(h).....	370
Table 8.9-4	Radionuclides Detected or Detected above BVs/FVs at SWMU 15-009(h).....	370

Table 8.10-1	Samples Collected and Analyses Requested at SWMU 15-010(b).....	371
Table 8.10-2	Inorganic Chemicals above BVs at SWMU 15-010(b).....	372
Table 8.10-3	Organic Chemicals Detected at SWMU 15-010(b).....	373
Table 8.10-4	Radionuclides Detected or Detected above BVs/FVs at SWMU 15-010(b)	374
Table 8.11-1	Samples Collected and Analyses Requested at AOC 15-014(h)	375
Table 8.11-2	Inorganic Chemicals above BVs at AOC 15-014(h)	377
Table 8.11-3	Organic Chemicals Detected at AOC 15-014(h).....	379
Table 8.11-4	Radionuclides Detected or Detected above BVs/FVs at AOC 15-014(h).....	383
Table 9.2-1	Samples Collected and Analyses Requested at SWMU 36-002	385
Table 9.2-2	Inorganic Chemicals above BVs at SWMU 36-002	385
Table 9.2-3	Organic Chemicals Detected at SWMU 36-002	386
Table 9.2-4	Radionuclides Detected or Detected above BVs/FVs at SWMU 36-002.....	386
Table 9.3-1	Samples Collected and Analyses Requested at SWMU 36-003(a).....	387
Table 9.3-2	Inorganic Chemicals above BVs at SWMU 36-003(a).....	388
Table 9.3-3	Organic Chemicals Detected at SWMU 36-003(a).....	389
Table 9.3-4	Radionuclides Detected or Detected above BVs/FVs at SWMU 36-003(a)	389
Table 9.4-1	Samples Collected and Analyses Requested at SWMUs 36-008 and C-36-003	390
Table 9.4-2	Inorganic Chemicals above BVs at SWMUs 36-008 and C-36-003	394
Table 9.4-3	Organic Chemicals Detected at SWMUs 36-008 and C-36-003	402
Table 9.4-4	Radionuclides Detected or Detected above BVs/FVs at SWMUs 36-008 and C-36-003	411
Table 11.1-1	Summary of Investigation Results and Recommendations	413

Appendixes

Appendix A	Acronyms and Abbreviations, Metric Conversion Table, and Data Qualifier Definitions
Appendix B	Field Methods
Appendix C	Borehole Logs (on CD included with this document)
Appendix D	Analytical Program
Appendix E	Analytical Suites and Results and Analytical Reports (on DVD included with this document)
Appendix F	Investigation-Derived Waste Management
Appendix G	Box Plots and Statistical Results
Appendix H	Risk Assessments
Appendix I	Site Photographs

Plates

Plate 1	Threemile Canyon Aggregate Area
Plate 2	SWMUs 12-001(a), 12-001(b), and 12-002 and AOC C-12-005 site map and sampling locations
Plate 3	Inorganic chemicals detected or detected above BVs at SWMUs 12-001(a), 12-001(b), and 12-002 and AOC C-12-005
Plate 4	Organic chemicals detected at SWMUs 12-001(a), 12-001(b), and 12-002 and AOC C-12-005
Plate 5	Radionuclides detected or detected above BVs/FVs at SWMUs 12-001(a), 12-001(b), and 12-002 and AOC C-12-005
Plate 6	AOCs C-12-001, C-12-002, C-12-003, and C-12-004 site map and sampling locations
Plate 7	Inorganic chemicals detected or detected above BVs at AOCs C-12-001, C-12-002, C-12-003, and C-12-004
Plate 8	Organic chemicals detected at AOCs C-12-001, C-12-002, C-12-003, and C-12-004
Plate 9	SWMUs 15-007(c) and 15-007(d) site map and sampling locations
Plate 10	Inorganic chemicals detected or detected above BVs at SWMUs 15-007(c) and 15-007(d)
Plate 11	Organic chemicals detected at SWMUs 15-007(c) and 15-007(d)
Plate 12	Radionuclides detected or detected above BVs/FVs at SWMUs 15-007(c) and 15-007(d)
Plate 13	SWMU 15-008(b) site map and sampling locations
Plate 14	Inorganic chemicals detected or detected above BVs at SWMU 15-008(b)
Plate 15	Organic chemicals detected at SWMU 15-008(b)
Plate 16	Radionuclides detected or detected above BVs/FVs at SWMU 15-008(b)
Plate 17	SWMU 15-009(c) site map and sampling locations
Plate 18	Inorganic chemicals detected or detected above BVs at SWMU 15-009(c)
Plate 19	Organic chemicals detected at SWMU 15-009(c)
Plate 20	Radionuclides detected or detected above BVs/FVs at SWMU 15-009(c)
Plate 21	AOC 15-014(h) site map and sampling locations
Plate 22	Inorganic chemicals detected or detected above BVs at AOC 15-014(h)
Plate 23	Organic chemicals detected at AOC 15-014(h)
Plate 24	Radionuclides detected or detected above BVs/FVs at AOC 15-014(h)
Plate 25	SWMU 36-008 and SWMU C-36-003 site map and sampling locations
Plate 26	Inorganic chemicals detected or detected above BVs at SWMU 36-008 and SWMU C-36-003
Plate 27	Organic chemicals detected at SWMU 36-008 and SWMU C-36-003
Plate 28	Radionuclides detected or detected above BVs/FVs at SWMU 36-008 and SWMU C-36-003

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 approximately 39 mi² 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 ft to 7800 ft above mean sea level.

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

This supplemental investigation report addresses potentially contaminated sites, designated as solid waste management units (SWMUs) and/or areas of concern (AOCs), within the Threemile Canyon Aggregate Area at the Laboratory. These sites are potentially contaminated with hazardous chemicals and radionuclides. The New Mexico Environment Department (NMED), pursuant to the New Mexico Hazardous Waste Act, regulates cleanup of hazardous wastes and hazardous constituents. DOE regulates cleanup of radioactive contamination, pursuant to DOE Order 458.1, Administrative Change 3, 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 provided to NMED in accordance with DOE policy.

Corrective actions at the Laboratory are subject to a Compliance Order on Consent (the Consent Order). This supplemental investigation report describes work activities that were completed in accordance with the Consent Order.

1.1 General Site Information

The Threemile Canyon Aggregate Area is located in Technical Area 14 (TA-14), TA-15, TA-36, and former TA-12 (most of which is within the boundary of TA-67, with the remainder in TA-15) at the Laboratory (Figure 1.1-1) and consists of 40 SWMUs and AOCs, 10 of which were investigated and/or remediated before the March 2005 effective date of the Consent Order and have been approved for no further action. The remaining 30 SWMUs and AOCs were addressed in the approved investigation work plan for Threemile Canyon Aggregate Area (LANL 2008, 105673; NMED 2008, 104256). These sites were investigated in 2009–2010 and the results documented in the approved investigation report for Threemile Canyon Aggregate Area (LANL 2010, 111324.14; NMED 2010, 111458). Investigation of four sites is deferred under Table IV-2 of the Consent Order. These four deferred sites were discussed in the investigation report but were not sampled. The approved investigation report documented that additional sampling to define the nature and extent of contamination was needed for all 26 of the remaining SWMUs and AOCs. Additional sampling requirements for 25 of these sites were documented in the approved Phase II investigation work plan for Threemile Canyon Aggregate Area (LANL 2011, 207405; NMED 2011, 208344). Because the other site needing additional sampling is within the footprint of a site deferred under Table IV-2 of the Consent Order, additional sampling for this site is delayed. Table 1.1-1 lists the 30 sites, with a brief description, summary of previous investigations, and the current status for each site.

1.2 Purpose of the Supplemental Investigation Report

Twenty-six SWMUs and AOCs within the Threemile Canyon Aggregate Area were addressed by the 2009–2010 investigation because these sites are potentially contaminated with hazardous chemicals and radionuclides, and final assessments of site contamination, associated risks, and recommendations for additional corrective actions remained incomplete. For each site, the objectives of the 2009–2010 investigation were to (1) establish the nature and extent of contamination; (2) determine whether current site conditions pose a potential unacceptable risk/dose to human health or the environment; and (3) assess whether any additional sampling and/or corrective actions are required.

Based on the data evaluation guidelines the Laboratory used at the time the investigation report was prepared, the Laboratory concluded that the extent of contamination was not defined for all 26 SWMUs and AOCs, and recommendations for additional sampling at 25 of these sites to define extent were incorporated into the approved Phase II investigation work plan (LANL 2011, 207405; NMED 2011, 208344). (Additional sampling for one site is delayed since it is within the footprint of a deferred site.) In January 2012, after the investigation report and Phase II investigation work plan were approved, NMED and DOE entered into a framework agreement for realignment of environmental priorities at the Laboratory. Under the framework agreement, NMED and DOE agreed to review characterization efforts undertaken to date pursuant to the Consent Order to identify those sites where the nature and extent of contamination have been adequately characterized. The framework agreement also stipulated the use of U.S. Environmental Protection Agency (EPA) guidance in this process, except in cases where EPA guidance was not supported by sound science. Pursuant to the framework agreement, the Laboratory reviewed its data evaluation process with respect to EPA guidance and the framework agreement principles and concluded that this process could be revised to complete site characterization more efficiently, while providing full protection of human health and the environment. Specifically, the process for evaluating data to define extent of contamination was revised to provide a greater emphasis on risk/dose reduction, consistent with EPA guidance. Key changes to the data evaluation process are as follows:

- Initially identify chemicals of potential concern (COPCs) to focus efforts on the constituents of most concern.
- Screen COPCs against soil screening levels (SSLs) and screening action levels (SALs) during determination of extent to focus efforts on characterizing contamination potentially posing a risk/dose and requiring corrective action.
- Perform screening level risk/dose evaluations on all sites, even if extent is not defined, to incorporate risk/dose reduction into recommendations for further actions.

The 2009–2010 investigation data for the 25 sites proposed for Phase II investigation were reevaluated using this revised process, and the results are presented in this supplemental investigation report.

All analytical data collected from the 2009–2010 investigation activities are presented and evaluated in this report, along with decision-level data from previous investigations.

1.3 Document Organization

This report is organized in 12 sections, including this introduction, with multiple supporting appendixes. Section 2 provides details on the aggregate area site conditions (surface and subsurface). Section 3 provides an overview of the scope of the activities performed during implementation of the work plan. Section 4 describes the regulatory criteria used to evaluate potential risk/dose to ecological and human health receptors. Section 5 describes the data review methods. Sections 6 through 9 present an overview of the operational history of each site, historical releases, summaries of previous investigations, results of

the field activities performed during the 2009–2010 investigation, site contamination, evaluation of the nature and extent of contamination, and summaries of the results of the human health and ecological risk-screening assessments for former TA-12, TA-14, TA-15, and TA-36, respectively. Section 10 presents the conclusions of the nature and extent of contamination investigation and risk-screening assessments. Section 11 discusses recommendations based on applicable data and the risk-screening assessments. Section 12 includes a list of references cited and the map data sources used in all the figures and plates.

The appendixes include acronyms, a metric conversion table, and definitions of data qualifiers used in this report (Appendix A); field methods (Appendix B); borehole logs (Appendix C); analytical program descriptions and summaries of data quality (Appendix D); analytical suites and results and analytical reports (Appendix E); investigation-derived waste management (Appendix F); box plots and statistical results (Appendix G); risk-screening assessments (Appendix H); and site photographs (Appendix I).

2.0 SITE CONDITIONS

2.1 Surface Conditions

2.1.1 Soil

Soil on the Pajarito Plateau was initially mapped and described by Nyhan et al. (1978, 005702). The soil on the slopes between the mesa tops and canyon floors was mapped as mostly steep rock outcrops consisting of approximately 90% bedrock outcrop and patches of shallow, weakly developed colluvial soil. South-facing canyon walls generally are steep and usually have shallow soil in limited, isolated patches between rock outcrops. In contrast, the north-facing canyon walls generally have more extensive areas of shallow, dark-colored soil under thicker forest vegetation. The canyon floors generally contain poorly developed, deep, well-drained soil on floodplain terraces or small alluvial fans (Nyhan et al. 1978, 005702).

The soil in the Threemile Canyon Aggregate Area belongs to the Carjo, Frijoles, Hackroy, Nyjack, Pogna, Seaby, Tocal, Totavi, and the fine Typic Eutoboralfs series, and the Sanjue-Arriba complex (LANL 1993, 015313, pp. 3-17–3-21; LANL 1993, 020946). Soil descriptions are summarized below (Nyhan et al. 1978, 005702).

- The Carjo series is typical of mesa tops and consists of moderately deep, well-drained, and moderately developed soil with an A-B-C horizon sequence. The parent material of the soil may range from Bandelier Tuff to sequences of alluvium/colluvium interstratified with moderately developed to well-developed buried soil. The soil textures of the Carjo series can be very fine sandy loams.
- The Frijoles series is characteristic of deep, well-drained soil formed from pumice on level to moderately sloping mesa tops. The soil is developed with an A-B-C horizon sequence, with textures grading from a brown sandy loam through a clay layer, to a gravelly clay loam.
- Hackroy soil consists of very shallow to shallow, well-drained, and moderately developed soil with an A-B horizon sequence. Soil textures can range from sandy loams to clay loams derived from tuff.
- Nyjack soil consists of moderately deep, well-drained, and moderately developed soil with an A-B-C horizon sequence. Soil textures can range from fine sandy loams to clay loams. The parent material of the soil may range from Bandelier Tuff to sequences of alluvium/colluvium interstratified with moderately developed to well-developed buried soil.

- The Pogna series is a shallow well-drained soil with an A-C horizon sequence. Typically, the soil is a fine sandy loam or sandy loam formed over tuff bedrock on gently to strongly sloping mesa tops.
- The Seaby series consists of shallow to moderately deep, well-drained soil with an A-B-C horizon sequence formed on weathered tuff on gently to moderately sloping mesas. The soil texture grades from a sandy loam to a strong brown gravelly clay loam.
- The Tocal series consists of very shallow to shallow, well-drained soil formed in material weathered from tuff on gently to moderately sloping mesa tops. The soil is developed with an A-B-C horizon sequence and grades from a very fine sandy loam through a clay loam to a silt loam.
- The Totavi series consists of deep, well-drained soil with an A horizon sequence that formed in alluvium in canyon bottoms. Soil textures are a gravelly loamy sand or sandy loam.
- The fine Typic Eutoboralfs consist of moderately deep, well-drained soil that formed in colluvium and material weathered from tuff. Textures include very fine sandy loam, or sandy loam, developed with an A-B horizon sequence, on gentle to moderate slopes and are usually located downgradient of fault zones.
- The Sanjue-Arriba complex includes deep, well-drained soil with an A-C horizon sequence that weathered in materials derived from pumice and that are found on moderately steep to very steep slopes. Soil textures range from a gravelly sandy loam to a loamy sand.

2.1.2 Surface Water

Most surface water in the Los Alamos area occurs as ephemeral, intermittent, or interrupted streams in canyons cut into the Pajarito Plateau. Springs on the flanks of the Jemez Mountains, west of the Laboratory's western boundary, supply flow to the upper reaches of Cañon de Valle and to Guaje, Los Alamos, Pajarito, and Water Canyons (Purtymun 1975, 011787; Stoker 1993, 056021). These springs discharge water perched in the Bandelier Tuff and Tschicoma Formation at rates from 2 to 135 gal./min (Abee et al. 1981, 006273). The volume of flow from the springs maintains natural perennial reaches of varying lengths in each of the canyons.

The hydrogeology of the canyon systems is thoroughly discussed in section 2.1.3 of the Laboratory's hydrogeologic work plan (LANL 1998, 059599). The surface water infiltration pathways within the aggregate area include native or disturbed soil, unconsolidated alluvium, Bandelier Tuff, Puye Formation, and basalt, faults and fracture systems, and cooling joints (LANL 1999, 064617, p. 3-25).

Threemile Canyon is the second largest tributary to Pajarito Canyon. Threemile Canyon joins Pajarito Canyon at TA-18 and parallels Pajarito Canyon on the south and extends for a distance of approximately 3.3 mi. Threemile Canyon has several unnamed tributaries; the largest is referred to informally as the south fork of Threemile Canyon, which has a total drainage area of approximately 1.67 mi². Other tributaries to Threemile Canyon are informally referred to as the middle fork of Threemile Canyon and the west fork of Threemile Canyon (LANL 1998, 059577, p. 3-5).

Springs discharging to Threemile Canyon include Threemile Spring and TA-18 Spring (Plate 1). These springs are perennial and support short reaches of perennial flow in Threemile Canyon (LANL 1998, 059577, pp. 3-4–3-5).

2.2 Subsurface Conditions

2.2.1 Stratigraphic Units

This section summarizes the stratigraphy of the Threemile Canyon Aggregate Area. Additional information on the geologic setting of the area and information on the Pajarito Plateau can be found in the hydrogeologic work plan (LANL 1998, 059599).

The bedrock at or near the surface of the mesa top is the Bandelier Tuff. There are approximately 1250 ft of volcanic and sedimentary materials between any potential contaminant-bearing units at the mesa surface and the regional aquifer. The stratigraphic units that may be encountered during investigation of the Threemile Canyon Aggregate Area are described briefly in the following sections. The descriptions begin with the oldest (deepest) and proceed to the youngest (topmost). The stratigraphic units that may be encountered during investigation of the Threemile Canyon Aggregate Area are limited to the upper units (Qbt 3, Qbt 2, Qbt 1v, and Qbt 1g) of the Tshirege Member of the Bandelier Tuff, described below (LANL 1998, 059577, p. 13; LANL 2006, 093196). Stratigraphic units comprising the Bandelier Tuff are described briefly in the following sections and are shown in Figure 2.2-1.

The Bandelier Tuff consists of the Otowi and Tshirege Members, which are stratigraphically separated in many places by the tephra and volcanoclastic sediment of the Cerro Toledo interval. The Bandelier Tuff was emplaced during cataclysmic eruptions of the Valles Caldera between 1.61 and 1.22 million years ago. The tuff is composed of pumice, minor rock fragments, and crystals supported in an ashy matrix. It is a prominent cliff-forming unit because of its generally strong consolidation (Broxton and Reneau 1995, 049726).

2.2.1.1 Otowi Member

Griggs and Hem (1964, 092516), Smith and Bailey (1966, 021584), Bailey et al. (1969, 021498), and Smith et al. (1970, 009752) describe the Otowi Member. The Otowi Member consists of moderately consolidated (indurated), porous, and nonwelded vitric tuff (ignimbrite) that forms gentle colluvium-covered slopes along the base of canyon walls. The Otowi ignimbrites contain light gray to orange pumice supported in a white-to-tan ash matrix (Broxton et al. 1995, 050121; Broxton et al. 1995, 050119; Goff 1995, 049682). The ash matrix consists of glass shards, broken pumice, crystal fragments, and fragments of perlite.

2.2.1.2 The Guaje Pumice Bed

The Guaje Pumice Bed occurs at the base of the Otowi Member, making a significant and extensive marker horizon. The Guaje Pumice Bed (Bailey et al. 1969, 021498; Self et al. 1986, 021579) contains well-sorted pumice fragments whose mean size varies between 0.8 and 1.6 in. Its thickness averages approximately 28 ft below most of the Pajarito Plateau, with local areas of thickening and thinning. Its distinctive white color and texture make it easily identifiable in cuttings and core, and it is an important marker bed for the base of the Bandelier Tuff.

2.2.1.3 Tephra and Volcanoclastic Sediment of the Cerro Toledo Interval

The Cerro Toledo interval is an informal name given to a sequence of volcanoclastic sediment and tephra of mixed provenance that separates the Otowi and Tshirege Members of the Bandelier Tuff (Broxton et al. 1995, 050121; Goff 1995, 049682; Broxton and Reneau 1995, 049726). Although it is located between the two members of the Bandelier Tuff, it is not considered part of that formation (Bailey et al. 1969, 021498). Outcrops of the Cerro Toledo interval generally occur wherever the top of the Otowi Member

appears in Pajarito Canyon and in canyons to the north. The unit contains primary volcanic deposits described by Smith et al. (1970, 009752) as well as reworked volcanoclastic sediment. The occurrence of the Cerro Toledo interval is widespread; however, its thickness is variable, ranging between several feet and more than 100 ft.

The predominant rock types in the Cerro Toledo interval are rhyolitic tuffaceous sediment and tephra (Heiken et al. 1986, 048638; Stix et al. 1988, 049680; Broxton et al. 1995, 050121; Goff 1995, 049682). The tuffaceous sediment is the reworked equivalents of Cerro Toledo rhyolite tephra. Oxidation and clay-rich horizons indicate at least two periods of soil development occurred within the Cerro Toledo deposits. Because the soil is rich in clay, it may act as a barrier to the movement of vadose zone moisture. Some of the deposits contain both crystal-poor and crystal-rich varieties of pumice. The pumice deposits tend to form porous and permeable horizons within the Cerro Toledo interval and locally may provide important pathways for moisture transport in the vadose zone. A subordinate lithology within the Cerro Toledo interval includes clast-supported gravel, cobble, and boulder deposits derived from the Tschicoma Formation (Broxton et al. 1995, 050121; Goff 1995, 049682; Broxton and Reneau 1996, 055429).

2.2.1.4 Tshirege Member

The Tshirege Member is the upper member of the Bandelier Tuff and is the most widely exposed bedrock unit of the Pajarito Plateau (Griggs and Hem 1964, 092516; Smith and Bailey 1966, 021584; Bailey et al. 1969, 021498; Smith et al. 1970, 009752). Emplacement of this unit occurred during eruptions of the Valles Caldera approximately 1.2 million years ago (Izett and Obradovich 1994, 048817; Spell et al. 1996, 055542). The Tshirege Member is a multiple-flow, ash-and-pumice sheet that forms the prominent cliffs in most of the canyons on the Pajarito Plateau. It is a cooling unit whose physical properties vary vertically and laterally. The consolidation in this member is largely from compaction and welding at high temperatures after the tuff was emplaced. Its light brown, orange-brown, purplish, and white cliffs have numerous, mostly vertical fractures that may extend from several feet up to several tens of feet. The Tshirege Member includes thin but distinctive layers of bedded, sand-sized particles called surge deposits that demarcate separate flow units within the tuff. The Tshirege Member is generally over 200 ft thick.

The Tshirege Member differs from the Otowi Member most notably in its generally greater degree of welding and compaction. Time breaks between the successive emplacement of flow units caused the tuff to cool as several distinct cooling units. For this reason, the Tshirege Member consists of at least four cooling subunits that display variable physical properties vertically and horizontally (Smith and Bailey 1966, 021584; Crowe et al. 1978, 005720; Broxton et al. 1995, 050121). The welding and crystallization variability in the Tshirege Member produces recognizable vertical variations in its properties, such as density, porosity, hardness, composition, color, and surface-weathering patterns. The subunits are mappable based on a combination of hydrologic properties and lithologic characteristics.

Broxton et al. (1995, 050121) provide extensive descriptions of the Tshirege Member cooling units. The following paragraphs describe, in ascending order, subunits of the Tshirege Member.

The Tsankawi Pumice Bed forms the base of the Tshirege Member. Where exposed, it is commonly 20 to 30 in. thick. This pumice-fall deposit contains moderately well-sorted pumice lapilli (diameters reaching about 2.5 in.) in a crystal-rich matrix. Several thin ash beds are interbedded with the pumice-fall deposits.

Subunit Qbt 1g is the lowermost tuff subunit of the Tshirege Member. It consists of porous, nonwelded, and poorly sorted ash-flow tuff. This unit is poorly indurated but nonetheless forms steep cliffs because of a resistant bench near the top of the unit; the bench forms a harder, protective cap over the softer underlying tuff. A thin (4 to 10 in.) pumice-poor surge deposit commonly occurs at the base of this unit.

Subunit Qbt 1v forms alternating cliff-like and sloping outcrops composed of porous, nonwelded, crystallized tuff. The base of this unit is a thin, horizontal zone of preferential weathering that marks the abrupt transition from glassy tuff below (in unit Qbt 1g) to the crystallized tuff above. This feature forms a widespread marker horizon (locally termed the vapor-phase notch) throughout the Pajarito Plateau that is readily visible in canyon walls in parts of Pajarito Canyon. The lower part of Qbt 1v is orange-brown, resistant to weathering, and has distinctive columnar (vertical) joints; hence, the term “colonnade tuff” is appropriate for its description. A distinctive white band of alternating cliff- and slope-forming tuffs overlies the colonnade tuff. The tuff of Qbt 1v is commonly nonwelded (pumices and shards retain their initial equant shapes) and have an open, porous structure.

Subunit Qbt 2 forms a distinctive, medium-brown, vertical cliff that stands out in marked contrast to the slope-forming, lighter-colored tuff above and below. It displays the greatest degree of welding in the Tshirege Member. A series of surge beds commonly mark its base. It typically has low porosity and permeability relative to the other units of the Tshirege Member.

Subunit Qbt 3 is a nonwelded to partially welded, vapor-phase altered tuff that forms the upper cliffs in Pajarito Canyon. Its base consists of a purple-gray, unconsolidated, porous, and crystal-rich nonwelded tuff that forms a broad, gently sloping bench developed on top of Qbt 2. Abundant fractures extend through the upper units of the Bandelier Tuff, including the ignimbrite of Qbt 3 of the Tshirege. The origin of the fractures has not been fully determined, but the most probable cause is brittle failure of the tuff caused by cooling contraction soon after initial emplacement (Vaniman 1991, 009995.1; Wohletz 1995, 054404).

2.2.2 Hydrogeology

The hydrogeology of the Pajarito Plateau is separable in terms of mesas and canyons forming the plateau. Mesas are generally devoid of water, both on the surface and within the rock forming the mesa. Canyons range from wet to relatively dry; the wettest canyons contain continuous streams and contain perennial groundwater in the canyon-bottom alluvium. Dry canyons have only occasional stream flow and may lack alluvial groundwater. Intermediate perched groundwater has been found at certain locations on the plateau at depths ranging between 100 and 700 ft below ground surface (bgs). The regional aquifer is found at depths of about 600 to 1200 ft bgs (Figure 2.2-2).

Hydrogeologic conceptual site models for each watershed at the Laboratory are presented in watershed investigation reports (e.g., LANL 2009, 106939). These conceptual models show that, under natural conditions, relatively small volumes of water move beneath mesa tops because of low rainfall, high evaporation, and efficient water use by vegetation. Atmospheric evaporation may extend into mesas, further inhibiting downward flow.

2.2.2.1 Groundwater

In the Los Alamos area, groundwater occurs as (1) water in shallow alluvium in some of the larger canyons, (2) intermediate perched groundwater (a perched groundwater body lies above a less permeable layer and is separated from the underlying aquifer by an unsaturated zone), and (3) the regional aquifer. Numerous wells have been installed at the Laboratory and in the surrounding area to investigate the presence of groundwater in these zones and to monitor groundwater quality. The locations of the existing wells within the vicinity of the Threemile Canyon Aggregate Area are shown on Plate 1.

The Laboratory formulated a comprehensive groundwater protection plan (LANL 1995, 050124) for an enhanced set of characterization and monitoring activities. The approved hydrogeologic work plan (LANL 1998, 059599) details the implementation of extensive groundwater characterization across the Pajarito Plateau within an area potentially affected by past and present Laboratory operations. Following implementation of the hydrogeologic work plan, watershed-scale groundwater investigations were implemented for each major watershed at the Laboratory (e.g., LANL 2009, 106939).

Alluvial Groundwater

Intermittent and ephemeral stream flows in the canyons of the Pajarito Plateau have deposited alluvium that is as much as 100 ft thick. The alluvium in canyons that head on the Jemez Mountains is generally composed of sands, gravels, pebbles, cobbles, and boulders derived from the Tschicoma Formation and Bandelier Tuff on the flank of the mountains. The alluvium in canyons that head on the plateau is comparatively more finely grained, consisting of clays, silts, sands, and gravels derived from the Bandelier Tuff (LANL 1998, 059599, p. 2-17).

In contrast to the underlying volcanic tuff and sediment, alluvium is relatively permeable. Ephemeral runoff in some canyons infiltrates the alluvium until downward movement is impeded by the less permeable tuff and sediment, which results in the buildup of a shallow alluvial groundwater body. Depletion by evapotranspiration and movement into the underlying rock limit the horizontal and vertical extent of the alluvial water (Purtymun et al. 1977, 011846). The limited saturated thickness and extent of the alluvial groundwater preclude its use as a viable source of water for municipal and industrial needs. Lateral flow of the alluvial perched groundwater is in an easterly, downcanyon direction (Purtymun et al. 1977, 011846).

Intermediate Groundwater

Identification of perched groundwater systems beneath the Pajarito Plateau comes mostly from direct observation of saturation in boreholes, wells, or piezometers or from borehole geophysics. In boreholes across the Pajarito Plateau, 33 occurrences of perched groundwater have been detected. Perched groundwater is widely distributed across the northern and central part of the Pajarito Plateau with depth to water ranging from 118 to 894 ft bgs. The principal occurrences of perched groundwater occur in (1) the relatively wet Los Alamos and Pueblo Canyon watersheds, (2) the smaller watersheds of Sandia and Mortandad Canyons that receive significant volumes of treated effluent from Laboratory operations, and (3) in the Cañon de Valle area in the southwestern part of the Laboratory. Perched water is most often found in Puye fanglomerates, Cerros del Rio basalt, and in units of Bandelier Tuff. There are few reported occurrences in the southern part of the Laboratory, but few deep boreholes are located in that area. Additional perched zones probably occur beneath the adjacent wet watersheds of Pajarito and Water Canyons (Collins et al. 2005, 092028, pp. 2-96–2-97).

Regional Aquifer

The regional aquifer is the only aquifer capable of large-scale municipal water supply in the Los Alamos area (Purtymun 1984, 006513). The surface of the regional aquifer rises westward from the Rio Grande within the Santa Fe Group into the lower part of the Puye Formation beneath the central and western part of the Pajarito Plateau. The depths to groundwater below the mesa top range between about 1200 ft along the western margin of the plateau and about 600 ft at the eastern margin. The location of wells and generalized water-level contours on top of the regional aquifer are described in the 2011 General Facility Information report (LANL 2011, 201568). The regional aquifer is typically separated from the alluvial groundwater and intermediate perched zone groundwater by 350 to 620 ft of tuff, basalt, and sediment (LANL 1993, 023249).

Groundwater in the regional aquifer flows east-southeast toward the Rio Grande. The velocity of groundwater flow ranges from about 20 ft/yr to 250 ft/yr (LANL 1998, 058841, p. 2-7). Details of depths to the regional aquifer, flow directions and rates, and well locations are presented in various Laboratory documents (Purtymun 1995, 045344; LANL 1997, 055622; LANL 2000, 066802).

2.2.2.2 Vadose Zone

The unsaturated zone from the mesa surface to the top of the regional aquifer is referred to as the vadose zone. The source of moisture for the vadose zone is precipitation, but much of it runs off, evaporates, or is absorbed by plants. The subsurface vertical movement of water is influenced by properties and conditions of the materials that make up the vadose zone.

Although water moves slowly through the unsaturated tuff matrix, it can move rapidly through fractures if saturated conditions exist (Hollis et al. 1997, 063131). Fractures may provide conduits for fluid flow but probably only in discrete, disconnected intervals of the subsurface. Because they are open to the passage of both air and water, fractures can have both wetting and drying effects, depending on the relative abundance of water in the fractures and the tuff matrix.

The Bandelier Tuff is very dry and does not readily transmit moisture. Most of the pore spaces in the tuff are of capillary size and have a strong tendency to hold water against gravity by surface-tension forces. Vegetation is very effective at removing moisture near the surface. During the summer rainy season, when rainfall is highest, near-surface moisture content is variable because of higher rates of evaporation and of transpiration by vegetation, which flourishes during this time.

The various units of the Bandelier Tuff tend to have relatively high porosities. Porosity ranges between 30% and 60% by volume, generally decreasing for more highly welded tuff. Permeability varies for each cooling unit of the Bandelier Tuff. The moisture content of native tuff is low, generally less than 5% by volume throughout the profile (Kearl et al. 1986, 015368; Purtymun and Stoker 1990, 007508).

3.0 SCOPE OF ACTIVITIES

This section presents an overview of field activities performed during the implementation of the Threemile Canyon Aggregate Area approved investigation work plan (LANL 2008, 105673; NMED 2008, 104256); the field investigation results and observations are presented in detail in sections 6 through 9 and in the appendixes. The scope of activities for the 2009–2010 Threemile Canyon Aggregate Area investigation included site access and premobilization activities; geodetic surveys; surface and shallow-subsurface sampling; borehole drilling, sampling, and abandonment; tank excavation; health and safety monitoring; and waste management activities.

3.1 Site Access and Premobilization Activities

The Threemile Canyon Aggregate Area is closed to the public and is accessible only to Laboratory employees with a clearance or under supervision of an escort. Before field mobilization, the issue of public access was reviewed, and efforts were made to provide a secure and safe work area.

Premobilization activities included completing the permit requirements identification form, completing excavation permits, requesting sampling paperwork from the Laboratory's Sample Management Office (SMO), and conducting the readiness review. Additional premobilization activities included constructing the less-than-90-day waste storage areas and staging waste drums.

3.2 Field Activities

This section describes the field activities conducted during the 2009–2010 investigation. Additional details regarding the field methods and procedures used to perform these field activities are presented in Appendix B.

3.2.1 Geodetic Surveys

Geodetic surveys were conducted during the Threemile Canyon Aggregate Area investigation to identify surface and subsurface sampling locations. The planned sampling locations for the 2009–2010 investigation are described in the approved work plan (LANL 2008, 105673; NMED 2008, 104256). An initial geodetic survey was performed to establish and mark the planned locations in the field.

Geodetic surveys were conducted in accordance with LANL standard operating procedure (SOP) 5028, Coordinating and Evaluating Geodetic Surveys, using a Trimble 5700 differential global positioning system (GPS) unit. Horizontal accuracy of the Trimble GPS 5700 is within 0.1 ft. During sampling, if the planned location could not be sampled because of surface or subsurface obstruction or other unanticipated field conditions, the relocated sampling location was resurveyed.

The surveyed coordinates for all sampling locations are presented in Table 3.2-1. All coordinates are expressed as State Plane Coordinate System 83, New Mexico Central, U.S. All surveyed coordinates for sampling locations were uploaded to the Environmental Information Management database.

3.2.2 Field Screening

Core samples, cuttings, and excavated material were screened for gross-alpha and beta radioactivity by a Laboratory radiological control technician (RCT). Screening was performed using an Eberline E600 with either a 380AB or SHP360 probe (or equivalent) and an ESP-1 rate meter with a 210 probe (or equivalent) in accordance with LANL SOP 10.07, Field Monitoring for Surface and Volume Radioactivity Levels. The probe was held less than 1 in. away from the medium. Measurements were made by conducting a quick scan to find the location with the highest initial reading and then collecting a 1-min reading at that location to determine levels of gross-alpha and -beta radioactivity.

After field-screening measurements were established, appropriate precautions were taken before samples were collected. Samples from the soil and core material were collected and logged. The RCT collected and recorded background level measurements for gross-alpha and -beta radioactivity on a daily basis.

Before samples were collected, all surface sampling locations were screened for high explosives (HE) with a spot test for explosives developed by the Laboratory Dynamic Experimentation Division's High Explosives and Technology group (DE-1). A small amount of soil was placed on a piece of filter paper, followed by a few drops of reagent 1 (sodium methoxide and dimethyl sulfoxide), a few drops of reagent 2 (hydrochloric acid and sulfanilamide), and a few drops of reagent 3 [1-N-(naphthyl)-ethylene diamine hydrochloride in water]. The detection limit (DL) of the test is approximately 100 to 200 parts per million. The test was used only qualitatively to determine 1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX); nitrocellulose; nitroglycerine; pentaerythritol tetranitrate (PETN); hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX); tetryl; triaminotrinitrobenzene (TATB); or 2,4,6-trinitrotoluene (TNT) contamination.

All samples were submitted to American Radiation Services, Inc. in White Rock, NM for gross-alpha, -beta, and -gamma analyses before shipment by the SMO to ensure compliance with U.S. Department of Transportation requirements.

Field-screening results were recorded on borehole logs and/or corresponding sample collection logs (SCLs). Borehole logs are presented in Appendix C, and SCLs / chain of custody (COC) forms are included in Appendix E. Radiation screening results are presented in Table 3.2-2.

3.2.3 Surface and Shallow-Subsurface Soil Investigation

Samples were collected according to the approved investigation work plan (LANL 2008, 105673; NMED 2008, 104256). Surface samples were collected using the spade-and-scoop method in accordance with LANL SOP-06.09, Spade and Scoop Method for Collection of Soil Samples, or with a hand auger in accordance with LANL SOP-06.10, Hand Auger and Thin-Wall Tube Sampler. Shallow-subsurface samples were collected using the hand auger method in accordance with SOP-06.10. Before any other samples were collected and before core material was broken into smaller pieces for containerization, samples were collected for volatile organic compound (VOC) analysis. Samples were collected using stainless-steel shovels or spoons and placed in stainless-steel bowls and transferred to sterile sample collection jars or bags for transport to the SMO.

Quality assurance / quality control samples (field duplicates, field trip blanks, and rinsate blanks) were collected in accordance with LANL SOP-5059, Field Quality Control Samples. Field duplicate samples were collected at a minimum rate of 1 per 10 investigation samples. Rinsate blanks were also collected at a minimum rate of 1 per 10 investigation samples to confirm decontamination of the sampling equipment. When VOC samples were collected, field trip blank samples were collected in conjunction with investigation samples at a minimum rate of 1 per day.

All sample collection activities were coordinated with the SMO. Upon collection, samples remained at all times in the controlled custody of the field team until they were delivered to the SMO. Sample custody was then relinquished to the SMO for delivery to a preapproved off-site contract analytical laboratory for the analyses specified by the approved work plan (LANL 2008, 105673; NMED 2008, 104256). The SCLs / COC forms for all samples are provided in Appendix E.

3.2.4 Subsurface Investigation

3.2.4.1 Borehole Drilling and Subsurface Sampling

At locations where the required sample depths could not be reached by hand augers, a drill rig with a hollow-stem auger was used to collect subsurface samples. Samples were collected using stainless-steel core barrel samplers in accordance with LANL SOP-06.26, Core Barrel Sampling for Subsurface Earth Materials, at depth intervals based on criteria established in the approved work plan (LANL 2008, 105673; NMED, 2008, 104256).

For the 2009–2010 investigation, nine boreholes were drilled to depths ranging from 10.0–182.5 ft bgs, and samples were collected to characterize the sites. The samples were extracted from the core barrels, placed in stainless-steel bowls, and handled the same way as the surface and shallow-subsurface samples were handled, as described in section 3.2.3. Samples were then submitted to the SMO under COC for laboratory analyses as specified by the approved work plan (LANL 2008, 105673; NMED, 2008, 104256).

3.2.4.2 Borehole Abandonment

Boreholes were abandoned in accordance with LANL SOP-5034, Monitoring Well and Borehole Abandonment. Borehole abandonment is described in detail in Appendix B, Field Methods.

3.2.4.3 Excavation

Excavation was performed at two sites during the 2009–2010 investigation. The septic tanks at SWMUs 15-009(b) and 15-009(c) were removed.

Fill material was removed to the tops of the two tanks, approximately 3 ft bgs at SWMU 15-009(c) and approximately 6 ft bgs at SWMU 15-009(b). The septic tanks were removed and samples were collected beneath each tank's inlet pipe, the inlet to the tank, the tank, and the outlet pipe from the tank. The inlet and outlet drainlines to each tank were plugged and left in place. Excavated tank material was placed in rolloff containers; the volume of excavated material was approximately 30 yd³.

Because sample analysis results of the material removed from the SWMU 15-009(b) excavation indicated the material was nonhazardous and met residential SSLs and SALs, the excavation was backfilled with soil removed from the excavation. In addition, clean fill material from an off-site source was placed above the fill material to restore the area to its approximate original grade and condition.

Because sample results of the material from SWMU 15-009(c) indicated the material was nonhazardous and the radioactivity was below the residential SALs, the excavation was backfilled with soil removed from the excavation. In addition, clean fill material from an off-site source was placed above the fill material to restore the area to its approximate original grade and condition.

3.2.4.4 Equipment Decontamination

Between collection of each sample and between sampling locations, all field equipment with the potential to contact sample material (e.g., hand augers, sampling scoops, bowls, and core barrel sections) was decontaminated to prevent cross-contamination of samples and locations. Dry decontamination was performed in accordance with LANL SOP-5061, Field Decontamination of Equipment. The dry decontamination methods used are described in Appendix B. Rinsate blanks were used to check the effectiveness of decontamination.

At sites where a drill rig was used, an RCT field screened the drilling equipment for gross-alpha and -beta radioactivity after each borehole was drilled. An RCT also surveyed the drill rig before it was brought on site and before it was released back to the drilling contractor.

3.2.5 Health and Safety Measures

All 2009–2010 investigation activities were conducted in accordance with a site-specific health and safety plan, an integrated work document, and two radiological work permits that detailed work steps, potential hazards, hazard controls, and required training to conduct work. These health and safety measures included the use of modified level-D personal protective equipment (PPE) and field monitoring for organic vapors and for gross-alpha and -beta radioactivity using portable air monitoring systems. Organic vapor monitoring was performed for health and safety purposes only and was not part of field screening (section 3.2.2).

3.2.6 Waste Management

All investigation-derived waste (IDW) generated during the Threemile Canyon Aggregate Area investigation was managed in accordance with the IDW management plan in the approved work plan (LANL 2008, 105673; NMED 2008, 104256) and the Laboratory-approved project waste characterization strategy form (WCSF) (Appendix F). These documents incorporate the requirements of all applicable EPA and NMED regulations and DOE orders. Characterization and management of IDW was performed in accordance with LANL SOP-5238, Characterization and Management of Environmental Program Waste.

The waste streams associated with the investigation included drill cuttings, septic tank debris, HE spot-test waste, metal pipe, returned radiological screening laboratory samples, water, asphalt, lead shot, and contact IDW.

Drill cuttings and discarded core from boreholes were collected and containerized in rolloff bins or 55-gal. drums in a fenced and locked less-than-90-day waste storage area pending characterization. This waste stream was characterized in accordance with the Laboratory-approved WCSF (Appendix F). The drill cuttings and discarded core waste stream were initially classified as hazardous waste pending characterization results. The waste from the drilling at SWMUs 15-007(c) and 15-007(d) was determined to be low-level radioactive waste (LLW). The waste from the drilling at SWMUs 36-002 and 36-003(a) was determined to be nonhazardous.

Contact IDW included PPE such as gloves, disposable sampling supplies, decontamination towels, and other solid waste that may have come in contact with potentially contaminated environmental media. Contact IDW was stored in 55-gal. drums placed on pallets in the fenced and locked less-than-90-day waste storage area pending characterization results. As described in the WCSF, the contact IDW was characterized using samples collected during the investigation. This waste was determined to be nonhazardous.

HE spot-test waste included filter paper, a small amount of soil, and chemicals from the HE spot-test kit. This waste was stored in a 5-gal. drum placed on a pallet in the fenced and locked less-than-90-day waste storage area pending characterization. As described in the WCSF, the HE spot-test waste was characterized using samples collected during the investigation and using the Laboratory waste profile form. This waste was determined to be nonhazardous.

Tank debris was collected and containerized in locked rolloff bins in a less-than-90-day waste storage area pending characterization. This waste stream was characterized by collecting chip samples in accordance with the approved WCSF, which is included in Appendix F. The tank debris was initially classified as hazardous waste pending characterization results. This waste was determined to be nonhazardous.

The metal pipe from AOC 12-004(b) was collected and stored in an 85-gal. drum placed on pallets in the fenced and locked less-than-90-day waste storage area pending characterization. This waste stream was characterized by collecting smear samples in accordance with the approved WCSF, which is included in Appendix F. The pipe was initially classified as hazardous waste pending characterization results. This waste was determined to be nonhazardous.

Returned radiological screening laboratory samples were collected and containerized in a 55-gal. drum in a fenced and locked less-than-90-day waste storage area pending characterization. This waste stream was characterized in accordance with the approved WCSF, which is included in Appendix F. The radiological screening laboratory samples were initially classified as hazardous waste pending characterization results. This waste was determined to be mixed LLW.

Water from the inside of the HE settling tank at SWMU 15-010(b) was collected and containerized in 300-gal. drums in a fenced and locked less-than-90-day waste storage area pending characterization. This waste stream was characterized in accordance with the approved WCSF, which is included in Appendix F. The water was initially classified as hazardous waste pending characterization results. This waste was determined to be nonhazardous.

Asphalt from SWMU 15-009(h) was stored in 55-gal. drums placed on pallets in the fenced and locked less-than-90-day waste storage area pending characterization results. As described in the WCSF, the asphalt was characterized by collecting a sample. The asphalt was determined to be LLW.

The lead shot from SWMUs 15-007(c) and 15-007(d) was collected and containerized in two 5-gal. drums placed on a pallet in the fenced and locked less-than-90-day waste storage area pending characterization results. The lead shot was determined to be mixed LLW.

Each waste stream was containerized and managed in storage areas appropriate to the type of waste. The management of IDW is described in greater detail in Appendix F. All available waste documentation, including WCSFs, WCSF amendments, and waste profile forms is provided in Appendix F.

3.3 Sample Analyses

The SMO shipped all investigation samples to off-site contract analytical laboratories for the requested analyses. The analyses requested were specified in the approved work plan (LANL 2008, 105673; NMED 2008, 104256) and were analyzed for all or a subset of the following: target analyte list (TAL) metals, total cyanide, nitrate, perchlorate, total uranium, explosive compounds, polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), VOCs, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, and tritium.

Field duplicates of investigation samples were analyzed for the same analytical suites as the corresponding investigation samples. Equipment rinsate blanks were analyzed for the same inorganic suites as the related investigation samples. Field trip blanks were analyzed only for VOCs.

3.4 Deviations

Deviations from the scope of activities defined in the approved investigation work plan (LANL 2008, 105673; NMED 2008, 104256) occurred during the implementation of the Threemile Canyon Aggregate Area investigation. Specific deviations are described in greater detail in section B-8.0 of Appendix B.

Additional samples were collected for analysis of PCBs at each SWMU and AOC to aid in defining the nature and extent of PCBs.

Eighteen planned sampling locations in the investigation work plan were adjusted because of their proximity to active utilities or were moved to place them in a drainage channel, as was intended. An additional five locations at AOC C-12-003 were moved because ground-truthing of the planned locations determined they were not located within the AOC.

Auger refusal occurred at 12 locations because of subsurface obstructions. Samples were not collected from the second planned depth at those locations.

The septic tank associated with SWMU 15-009(h) was not removed because it was determined to be immediately adjacent to active utilities. As a consequence of not removing the tank, the proposed samples from below the tank could not be collected.

The SWMU 15-010(b) HE settling tank associated with former shop building 15-8 was not removed. The contents of the tank were removed on February 25 and 26, 2010. The tank could not be removed because of facility safety concerns until the analytical results were received and an HE expert verified no HE was present in the tank. In the interim, the tank refilled with water from snowmelt. At the time of the original report, the facility had not approved the removal of the tank until the appropriate safety procedures are in place. The planned samples from under the inlet pipe, the tank inlet, the tank, and the tank outlet were not collected.

An additional five locations were not sampled because of refusal and/or active utilities.

4.0 REGULATORY CRITERIA

This section describes the criteria used for evaluating potential risk to ecological and human receptors. Regulatory criteria identified by medium in the Consent Order include cleanup standards, risk-based screening levels, and risk-based cleanup goals.

Human health risk-screening evaluations were conducted for the Threemile Canyon Aggregate Area using NMED guidance (NMED 2015, 600915). Ecological risk-screening assessments were performed using Laboratory guidance (LANL 2015, 600921).

4.1 Current and Future Land Use

The specific screening levels used in the risk evaluation and corrective-action decision process at a site depend on the current and reasonably foreseeable future land use(s). The current and reasonably foreseeable future land use(s) for a site determines the receptors and exposure scenarios used to select screening and cleanup levels. The land use within and surrounding the Threemile Canyon Aggregate Area is currently industrial and is expected to remain industrial for the reasonably foreseeable future. The recreational scenario was evaluated for several sites within former TA-12 where trail users might be exposed. The residential scenario is evaluated for comparison purposes per the Consent Order and is the decision scenario for sites that do not require future controls. For sites to be recommended for corrective action complete without controls, the residential scenario was evaluated to determine whether it was also protective of construction workers. If not, the construction worker scenario was also evaluated for these sites.

4.2 Screening Levels

Human health and ecological risk-screening evaluations were conducted for the COPCs detected in solid media at sites within the Threemile Canyon Aggregate Area. The human health risk-screening assessments (Appendix H) were performed on inorganic and organic COPCs using NMED SSLs for the industrial and residential scenarios (NMED 2015, 600915) and Laboratory SSLs for the recreational scenario (LANL 2015, 600336). When an NMED SSL was not available for a COPC, SSLs were obtained from EPA regional tables (<http://www.epa.gov/risk/risk-based-screening-table-generic-tables>) (adjusted to a risk level of 1×10^{-5} for carcinogens). Radionuclides were assessed using the Laboratory SALs for the same scenarios (LANL 2015, 600929). Surrogate SSLs were used for some COPCs for which no SSLs were available based on structural similarity or breakdown products.

NMED guidance includes total chromium SSLs for the residential and industrial scenarios (NMED 2015, 600915). Because the toxicity of chromium strongly depends on its oxidation state, NMED and EPA have SSLs for trivalent chromium and hexavalent chromium. For screening purposes, the NMED SSLs for total chromium are typically used for comparison with total chromium results unless there is a known or suspected source of hexavalent chromium at the SWMU or AOC or site conditions could alter the speciation of chromium in the environment. Total chromium screening levels are appropriate for low-level releases to soil from sources not associated with hexavalent chromium. However, NMED and EPA recommend collecting valence-specific data for chromium when chromium is likely to be an important contaminant at a site and when hexavalent chromium may exist.

There are no known sources of hexavalent chromium use (e.g., cooling towers, electroplating) at SWMUs and AOCs in the Threemile Canyon Aggregate Area. Total chromium results for all sites are screened using the NMED SSLs for total chromium.

4.3 Ecological Screening Levels

The ecological risk-screening assessments (Appendix H) were conducted using ecological screening levels (ESLs) obtained from the ECORISK Database, Version 3.3 (LANL 2015, 600921). The ESLs are based on similar species and are derived from experimentally determined no observed adverse effect levels (NOAELs), 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 3.3 (LANL 2015, 600921).

4.4 Cleanup Standards

As specified in the Consent Order, SSLs for inorganic and organic chemicals (NMED 2015, 600915) are 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 uses. SALs are used as soil cleanup levels for radionuclides (LANL 2015, 600929). Screening assessments compare COPC concentrations for each site with industrial and residential SSLs and SALs and with recreational SSLs and SALs, when appropriate.

The cleanup goals specified in Section VIII of the Consent Order are a target risk of 1×10^{-5} for carcinogens or a hazard index (HI) of 1 for noncarcinogens. For radionuclides, the target dose is 25 mrem/yr as authorized by DOE Order 458.1. The SSLs/SALs used for the risk-screening assessments in Appendix H are based on these cleanup goals.

5.0 DATA REVIEW METHODOLOGY

The purpose of the data review is to define the nature and extent of contaminant releases for each SWMU or AOC in the Threemile Canyon Aggregate Area. The nature of a contaminant release refers to the specific contaminants that are present, the affected media, and associated concentrations. The nature of contamination is defined through identification of COPCs, which is discussed in section 5.1. The identification of a chemical or radionuclide as a COPC does not mean the constituent(s) is related to the site and a result of site operations. A COPC is identified because it is present at a site based on the criteria discussed below, but it might be present because of adjacent and/or upgradient operations and/or infrastructure typical of industrial and metropolitan development. If such origins are evident, the constituents might be excluded from the data analyses and risk assessments. The extent of contamination refers to the spatial distribution of COPCs, with an emphasis on the distribution of COPCs potentially posing a risk or requiring corrective action. The process for determining the extent of contamination and for concluding no further sampling for extent is warranted is discussed in section 5.2.

5.1 Identification of COPCs

COPCs are chemicals and radionuclides that may be present as a result of releases from SWMUs or AOCs. Inorganic chemicals and some radionuclides occur naturally, and inorganic chemicals and radionuclides detected because of natural background are not considered COPCs. Similarly, some radionuclides may be present as a result of fallout from historic nuclear weapons testing, and these radionuclides are also not considered COPCs. The Laboratory has collected data on background concentrations of many inorganic chemicals, naturally occurring radionuclides and fallout radionuclides. These data have been used to develop media-specific background values (BVs) and fallout values (FVs) (LANL 1998, 059730). For inorganic chemicals and radionuclides for which BVs or FVs exist, identification of COPCs involves background comparisons, which are described in sections 5.1.1 and 5.1.2. If no BVs or FVs are available or if samples are collected where FVs are not appropriate (i.e., greater than 1-ft depth or

in rock), COPCs are identified based on detection status (i.e., if the inorganic chemical or radionuclide is detected, it is identified as a COPC unless there is information indicating it is not present as a result of a release from the SWMU or AOC).

Organic chemicals may also be present as a result of anthropogenic activities unrelated to the SWMU or AOC or, to a lesser extent, from natural sources. Because there are no background data for organic chemicals, background comparisons cannot be performed in the same manner as for inorganic chemicals or radionuclides. Therefore, organic COPCs are identified on the basis of detection status (i.e., the organic chemical is detected). When the nature of contamination is assessed, the history of site operations may be evaluated to determine whether an organic COPC is present because of a release from a SWMU or AOC or is present from a non-site-related source. Organic chemicals that are clearly present from sources other than releases from a SWMU or AOC may be eliminated as COPCs and not evaluated further.

5.1.1 Inorganic Chemical and Radionuclide Background Comparisons

The COPCs are identified for inorganic chemicals and radionuclides ~~according to LANL procedures following~~ EP-SOP-10071, Background Comparisons for Inorganic Chemicals, and EP-SOP-10073, Background Comparisons for Radionuclides. Inorganic COPCs are identified by comparing site data with BVs, ~~and maximum concentrations in a background data set and using~~ statistical comparisons, ~~and other lines of evidence,~~ as applicable (LANL 1998, 059730). ~~The upper end of the background data set may be used for comparison if one or more of the following conditions exist:~~

- ~~Statistically determined BV is significantly greater than the maximum background concentration.~~
- ~~Statistical tests cannot be performed because of insufficient data (fewer than eight samples and/or five detections per medium) or a high percentage of nondetections.~~
- ~~Sufficient numbers of samples have been collected to determine nature and extent but results are predominately nondetections.~~
- ~~Site history does not indicate the constituent is directly related to site activities or to a dominant waste stream.~~
- ~~Spatial analyses do not show a pattern or trend indicating contamination.~~
- ~~The maximum detected concentration is statistically determined to be an outlier. (Note: A sufficient number of samples must be collected to show a point is an outlier and is not indicative of a hot spot.)~~

Radionuclides are identified as COPCs based on background comparisons and statistical methods if BVs or FVs are available, ~~based on detection status if BVs or FVs have not been established,~~ ~~or based on other lines of evidence, as applicable.~~

Background data are generally available for inorganic chemicals in 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 [UTL] or the 95% upper confidence bound on the 95th quantile) or a DL. When a BV is based on a DL, there is no corresponding background data set for that analyte/media combination.

For inorganic chemicals, data are evaluated by sample media to facilitate the comparison with media-specific background data. To identify inorganic COPCs, the first step is to compare the sampling result with BVs. If sampling results are above the BV and sufficient data are available (eight or more sampling results and five or more detections), statistical tests are used to compare the site sample data

with the background data set for the appropriate media. If statistical tests cannot be performed because of insufficient data or a high percentage of nondetections, the sampling results are compared with the BV and the ~~maximum upper end of~~ background concentration for the appropriate media. If ~~at least one sampling result is concentrations are~~ above the BV ~~but no results are greater than the upper end of the background data set~~, the inorganic chemical is identified as a COPC unless lines of evidence ~~can be are~~ presented to ~~establish-determine whether~~ the inorganic chemical ~~is or~~ is not a COPC. ~~If at least one sampling result is above the BV and the upper end of the background data set, the inorganic chemical is identified as a COPC. Such lines of evidence include, but are not limited to, comparison with the maximum background concentrations, number of detections above the BV, number of nondetections in the data set, and site history. When an inorganic chemical is not detected but has a DL above the BV, the~~ The same evaluation is performed using DLs ~~when an inorganic chemical is not detected but has a DL above the BV instead of BVs~~. If no BV is available, detected inorganic chemicals are identified as COPCs.

Radionuclides are identified as COPCs based on comparisons with BVs for naturally occurring radionuclides or with FVs for fallout radionuclides. Thorium-228, thorium-230, thorium-232, uranium-234, uranium-235/236, and uranium-238 are naturally occurring radionuclides. Americium-241, cesium-137, plutonium-238, plutonium-239/240, strontium-90, and tritium are fallout radionuclides.

Naturally occurring radionuclides detected at activities above their respective BVs are identified as COPCs ~~unless lines of evidence can be presented to establish the radionuclide is not a COPC~~. If there is no associated BV or FV and the radionuclide is detected, it is retained as a COPC.

The FVs for the fallout radionuclides apply to the top 0.0 ~~to~~ -1.0 ft of soil and fill and to sediment regardless of depth. If a fallout radionuclide is detected in soil or fill samples collected below 1.0 ft or in tuff samples, the radionuclide is identified as a COPC. For soil and fill samples from 1.0 ft bgs or less, if the activity of a fallout radionuclide is greater than the FV, comparisons of the top 0.0 ~~to~~ -1.0 ft sample data are made with the fallout data set. The radionuclide is eliminated as a COPC if activities are similar to fallout activities or lines of evidence can be presented to establish the radionuclide is not a COPC. Sediment results are evaluated in the same manner, although all data are included, not just the data from 0.0–1.0 ft bgs.

The FV for tritium in surface soil (LANL 1998, 059730) is in units of pCi/mL. This FV requires using sample percent moisture to convert sample tritium data from pCi/g (as provided by analytical laboratories) to the corresponding values in units of pCi/mL. Because sample percent moisture historically has been determined using a variety of methods, often undocumented, the Laboratory has adopted the conservative approach of identifying tritium in soil as a COPC based on detection status.

Sample media encountered during investigations at Threemile Canyon Aggregate Area include soil (all soil horizons, designated by the media code ALLH or SOIL), fill material (media code FILL), alluvial sediment (media code SED), and Bandelier Tuff (media codes Qbt 1v, Qbt 1g, Qbt 2, Qbt 3, and Qbt 4). Because no separate BVs are available for fill material, fill samples are evaluated by comparison with soil BVs (LANL 1998, 059730). In this report, the discussions of site contamination in soil include fill samples along with soil samples in sample counts and comparisons with background. Fill samples are not discussed separately from soil. The units of the Upper Bandelier Tuff (Qbt 2, Qbt 3, and Qbt 4) are likewise evaluated together with respect to background, as are the units of the Lower Bandelier Tuff (Qbo, Qct, and Qbt 1g) (LANL 1998, 059730).

5.1.2 Statistical Methods Overview

A variety of statistical methods may be applied to each of the data sets. The use of any of these methods depends on how appropriate the method is for the available data. The results of the statistical tests are presented in Appendix G tables.

5.1.2.1 Distributional Comparisons

Comparisons between site-specific data and Laboratory background data are performed using a variety of statistical methods. These methods begin with a simple comparison of site data with a UTL estimated from the background data (UTL or the 95% upper confidence bound on the 95th quantile). The UTLs are used to represent the upper end of the concentration distribution and are referred to as BVs. The UTL comparisons are then 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 elevated above background levels). Nonparametric tests most commonly performed include the Gehan test (modification of the Wilcoxon Rank Sum test) and the quantile test (Gehan 1965, 055611; Gilbert and Simpson 1990, 055612).

The Gehan test is recommended when between 10% and 50% of the data sets are nondetections. It handles data sets with nondetections reported at multiple DLs in a statistically robust manner (Gehan 1965, 055611; Millard and Deverel 1988, 054953). The Gehan test is not recommended if either of the two data sets has more than 50% nondetections. If there are no nondetected concentrations in the data, the Gehan test is equivalent to the Wilcoxon Rank Sum test. The Gehan test is the preferred test because of its applicability to a majority of environmental data sets and its recognition and recommendation in EPA-sponsored workshops and publications.

The quantile test is better suited to assessing shifts in a subset of the data. The quantile test determines whether more of the observations in the top chosen quantile of the combined data set come from the site data set than would be expected by chance, given the relative sizes of the site and background data sets. If the relative proportion of the two populations being tested is different in the top chosen quantile of the data from that of the remainder of the data, the distributions may be partially shifted because of a subset of site data. This test is capable of detecting a statistical difference when only a small number of concentrations are elevated (Gilbert and Simpson 1992, 054952). The quantile test is the most useful distribution shift test where samples from a release represent a small fraction of the overall data collected. The quantile test is applied at a prespecified quantile or threshold, usually the 80th percentile. The test cannot be performed if more than 80% (or, in general, more than the chosen percentile) of the combined data are nondetected values. It can be used when the frequency of nondetections is approximately the same as the quantile being tested. For example, in a case with 75% nondetections in the combined background and site data set, application of a quantile test comparing 80th percentiles is appropriate. However, the test cannot be performed if nondetections occur in the top chosen quantile. The threshold percentage can be adjusted to accommodate the detection rate of an analyte or to look for differences further into the distribution tails. The quantile test is more powerful than the Gehan test for detecting differences when only a small percentage of the site concentrations are elevated.

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. This test is based on the maximum concentration in the background data set and the number ("n") of site concentrations that exceed the maximum concentration in the background set (Gilbert and Simpson 1990, 055612, pp. 5–8). The result (p-value) of the slippage test is the probability that "n" site samples (or more) exceed the maximum background concentration by chance alone. The test

accounts for the number of samples in each data set (number of samples from the site and number of samples from background) and determines the probability of “n” (or more) exceedances if the two data sets came from identical distributions. This test is similar to the BV comparison in that it evaluates the largest site measurements but is more useful than the BV comparison because it is based on a statistical hypothesis test, not simply on a statistic calculated from the background distribution.

Statistical tests for radionuclides are performed only in limited cases. There are no background data sets for naturally occurring radionuclides in soil or tuff, so statistics were not performed if there were any detections of uranium isotopes above BV in soil or tuff. Although there are background data sets for fallout radionuclides in soil, the background data are limited to the depth range of 0.0–1.0 ft bgs for evaluation of fallout radionuclides. Therefore, statistical tests were not performed for fallout radionuclides in soil. Fallout values are not applicable for tuff, so statistical tests cannot be performed. Background data sets are available for naturally occurring and fallout radionuclides in sediment, and background evaluations for sediment are not limited to the depth range of 0.0–1.0 ft bgs. Therefore, statistical tests can be performed for radionuclides in sediment. However, statistical tests for radionuclides in sediment were not performed for a site if there were also detections of naturally occurring radionuclides above BV in soil, detections of fallout radionuclides above BV in soil in the 0.0–1.0 ft bgs depth range, detections of fallout radionuclides in soil below 1.0 ft bgs, and/or detections of fallout radionuclides in tuff.

For all statistical tests, a p-value less than 0.05 was the criterion for accepting the null hypothesis that site sampling results are different from background.

5.1.2.2 Graphical Presentation

Box plots are provided in Appendix G for a visual representation of the data and to help illustrate the presence of outliers or other anomalous data that might affect statistical results and interpretations. The plots allow a visual comparison among data distributions. The differences of interest may include an overall shift in concentration (shift of central location) or, when the centers are nearly equal, a difference between the upper tails of the two distributions (elevated concentrations in a small fraction of one distribution). The plots may be used in conjunction with the statistical tests (distributional comparisons) described above. Unless otherwise noted, the nondetected concentrations are included in the plots at their reported DL.

The box plots produced in Appendix G of this report consist 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, 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 extend to the most extreme point that is not considered an outlier, with a maximum whisker length of 1.5 times the interquartile range, outside of which data may be evaluated for their potential to be outliers. The concentrations are plotted as points overlying the box plot. When a data set contains both detected concentrations and nondetected concentrations reported as DLs, the detected concentrations are plotted as Xs and the nondetected concentrations are plotted as Os.

5.2 Extent of Contamination

Spatial concentration trends are initially used to determine whether the extent of contamination is defined. Evaluation of spatial concentration data considers the conceptual site model of the release and subsequent migration. Specifically, the conceptual site model should define where the highest concentrations would be expected if a release had occurred and how these concentrations should vary

with distance and depth. If the results are different from the conceptual site model, it could indicate that no release has occurred or there are other sources of contamination.

In general, both laterally and vertically decreasing concentrations are used to define extent. If concentrations are increasing or not changing, other factors are considered to determine whether extent is defined or if additional extent sampling is warranted. These factors include

- the magnitude of concentrations and rate of increase compared with SSLs/SALs,
- the magnitude of concentrations of inorganic chemicals or radionuclides compared with the maximum background concentrations for the medium,
- concentrations of organic chemicals compared with estimated quantitation limits (EQLs), and
- results from nearby sampling locations.

The primary focus for defining the extent of contamination is characterizing contamination that potentially poses a potential unacceptable risk and might require additional corrective actions. As such, comparison with SSLs/SALs is used as an additional step following a determination of whether extent is defined by decreasing concentrations with depth and distance and whether concentrations are below EQLs or DLs. The initial SSL/SAL comparison uses the residential SSL/SAL (regardless of whether the current and reasonably foreseeable future land use is residential) because this value is typically the most protective. If the current and reasonably foreseeable future land use is not residential, and if the residential SSL/SAL is exceeded or otherwise similar to COPC concentrations, comparison with the relevant SSL/SAL may also be conducted. For all SWMUs and AOCs in the Threemile Canyon Aggregate Area, the current and reasonably foreseeable future land use is industrial (section 4.1).

The SSL/SAL comparison is not necessary if all COPC concentrations are decreasing with depth and distance. If, however, concentrations increase with depth and distance or do not display any obvious trends, the SSLs/SALs are used to determine whether additional sampling for extent is warranted. If the COPC concentrations are sufficiently below the SSL/SAL (e.g., the residential and/or industrial SSL/SAL is 10 times [an order of magnitude] or more than all concentrations), the COPC does not pose a potential unacceptable risk and no further sampling for extent is warranted. The validity of the assumption that the COPC does not pose a risk is confirmed with the results of the risk-screening assessment. The calculation of risk also assists in determining whether additional sampling is warranted to define the extent of contamination needing additional corrective actions.

Calcium, magnesium, potassium, and sodium may be COPCs for some sites. These constituents are essential nutrients, and their maximum concentrations are compared with NMED's essential nutrient screening levels (NMED 2015, 600915). If the maximum concentration is less than the screening level(s), no additional sampling for extent is warranted and the inorganic chemical is eliminated from further evaluation in the risk assessment.

6.0 FORMER TA-12 BACKGROUND AND FIELD INVESTIGATION RESULTS

6.1 Background of Former TA-12

6.1.1 Operational History

Former TA-12, also known as L-Site, was constructed during World War II and used as an explosives testing facility. An open area was used as the firing site where a number of shots were detonated, including one 70-kg charge (LANL 1996, 054086, p. 1-1). Figure 6.1-1 shows the site features of former TA-12.

In 1950, a radiation test bunker was constructed at former TA-12 to conduct radiation experiments on animals using a radioactive lanthanum-140 source. Because of these radiation experiments, a section of the perimeter became contaminated. In 1951, Group DE-1 began using the area, firing several shots per month (LANL 1994, 034755). By 1953, the entire site was vacated. Activities at former TA-12 ceased in the early 1950s. In 1960, the structures were decontaminated, decommissioned, and intentionally burned (LANL 1996, 054086, p. 1-1). A Laboratory group used part of the site during the Vietnam War for “Mortar Locator” experiments, which involved using an acetylene gas gun. Former TA-12 is no longer used for Laboratory operations (LANL 1994, 034755, p. 1-8).

In 1989 the Laboratory redefined TA boundaries. Most of former TA-12 is within the boundary of TA-67, and the remaining area is within the boundary of TA-15. Two former TA-12 sites in this investigation [AOCs 12-004(a) and 12-004(b)] are located in the northeast corner of TA-15. The other eight former TA-12 sites are located in the western portion of TA-67 (Figure 6.1-1). In 2000, the Cerro Grande fire moved through former TA-12, damaging or destroying vegetation and remaining surface debris (LANL 1994, 034755, p. 1-8).

The following three SWMUs and seven AOCs within the Threemile Canyon Aggregate Area are located at former TA-12 and are addressed in this supplemental investigation report:

- SWMU 12-001(a) is a belowground, steel-lined firing pit with an aboveground steel cover (structure 12-4).
- SWMU 12-001(b) is a firing pit located approximately 175 ft east of SWMU 12-001(a).
- SWMU 12-002 is an area approximately 3 ft² used on one occasion to burn scrap explosives.
- AOC 12-004(a) is the location of a lanthanum radiation experiment and its surrounding area, including a drainage.
- AOC 12-004(b) is a belowground aluminum pipe about 78 ft north of a former radiation shelter (structure 12-8).
- AOC C-12-001 is an area of potential soil contamination associated with the former trim building 12-1.
- AOC C-12-002 is an area of potential soil contamination associated with the former control building 12-2.
- AOC C-12-003 is an area of potential soil contamination associated with a former HE-storage magazine (building 12-3).
- AOC C-12-004 is an area of potential soil contamination associated with a former generator (building 12-5).
- AOC C-12-005 is the location of a former junction box (structure 12-6).

6.1.2 Summary of Releases

Potential contaminants at former TA-12 may have been released into the environment through operational releases at the firing sites, radiation experiment area, and associated facilities.

6.1.3 Current Site Usage and Status

Former TA-12 is located within TA-15 and TA-67 and is no longer used for Laboratory operations.

6.2 SWMU 12-001(a)—Firing Site Steel-Lined Pit

6.2.1 Site Description and Operational History

SWMU 12-001(a) is a decommissioned belowground steel-lined firing pit and steel cover (structure 12-4) located on the north side of Redondo Road at former TA-12 (Plate 2). The firing pit is hexagonal and measures 10.5 ft on each side × 11 ft deep. A steel cover that measures 20 ft long × 22 ft wide × 5 ft high overlays the pit. The steel cover has a 5-ft-diameter opening in its center through which explosives were lowered into the pit. The firing pit began operation in 1944 (LANL 1994, 034755, p. 5-1-1) and was used to conduct recovery shots involving uranium until the pit was decommissioned in 1953. In 1996, a voluntary corrective action removed approximately 10.5 ft³ of noncontaminated soil that had blown into the bottom of the pit; the pit remains in place (LANL 1996, 055073, p. 1).

6.2.2 Relationship to Other SWMUs and AOCs

SWMU 12-001(a) is a component of Consolidated Unit 12-001(a)-99, along with SWMUs 12-001(b) and 12-002, and AOC C-12-005. SWMU 12-001(a) is located approximately 175–200 ft west of SWMUs 12-001(b) and 12-002 and 50 ft northeast of AOC C-12-005 (Plate 2).

6.2.3 Summary of Previous Investigations

In 1993, a radiation survey was conducted outside the firing pit with a Geiger-Muller thin-window probe; no radionuclides were detected above background levels (Harris 1993, 055658, pp. 3–6; LANL 1994, 034755, p. 5-1-6). An internal survey of the firing pit was conducted in 1993; beta- and gamma-emitting radionuclides were detected above background levels. Small pieces of uranium and HE were observed in the firing pit (LANL 1994, 034755, pp. 5-1-6–5-1-7).

In 1995, Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) activities were performed at SWMU 12-001(a) (LANL 1996, 054086, p. 5-1). One sample from each of two locations was collected at the bottom of the firing pit, and one sample from each of two locations was collected from the surrounding area. All samples were analyzed for inorganic chemicals, HE, and radionuclides (LANL 1996, 055073, pp. 5-2–5-4).

In 1996, a voluntary corrective action (VCA) was conducted. During the VCA, all soil within the firing pit was removed. No additional confirmatory samples were collected after soil removal (LANL 1996, 055073, pp. 1–8; LANL 1996, 059535).

The locations of the two samples collected at the pit bottom during the 1995 RFI were removed during soil removal activities conducted as part of the 1996 VCA. Data from two samples collected in the surrounding area during the 1995 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

6.2.4 Site Contamination

6.2.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at SWMU 12-001(a). As a result, the following activities were completed as part of the 2009–2010 investigation.

- Forty-six samples were collected in 2009–2010 from 24 locations adjacent to and around the firing site and in the drainage below the firing site. At each location, samples were collected at the surface (0.0–0.1 ft bgs to 0.0–1.0 ft bgs), and at all but two locations, a subsurface sample (1.0–1.5 ft bgs to 2.0–3.0 ft bgs) was also collected. All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. Ten samples were also analyzed for PCBs.

The 2009–2010 sampling locations at SWMU 12-001(a) are shown on Plate 2. Table 6.2-1 presents the samples collected and analyses requested for SWMU 12-001(a). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

6.2.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

6.2.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 12-001(a) consist of results from 46 samples (35 soil, 8 tuff, and 3 sediment) collected from 24 locations. In addition, there are decision-level data for 34 samples (32 soil and 2 tuff) collected from 17 locations at SWMU 12-001(b) (see section 6.3.4). Because of the proximity of SWMUs 12-001(a) and 12-001(b), the combined data set for SWMUs 12-001(a) and 12-001(b) are evaluated below.

Inorganic Chemicals

A total of 80 samples (67 soil, 10 tuff, and 3 sediment) were collected at SWMUs 12-001(a) and 12-001(b) and analyzed for TAL metals, cyanide, total uranium, and perchlorate. Table 6.2-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Plate 3 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 BV (7340 mg/kg) in four samples with a maximum concentration of 11,700 mg/kg. The Gehan and quantile tests indicated site concentrations of aluminum in tuff are statistically different from background (Figure G-1 and Table G-1). Aluminum is retained as a COPC.

Antimony was detected above the soil BV (0.83 mg/kg) in 1 sample at a concentration of 1.15 mg/kg and was not detected above the soil BV or the sediment and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) but had DLs (0.886 mg/kg to 1.3 mg/kg) above BVs in 61 soil samples, 3 sediment samples, and 8 tuff samples. Antimony is retained as a COPC.

Barium was detected above the soil and Qbt 2,3,4 BVs (295 mg/kg and 46 mg/kg) in four soil samples and six tuff samples with a maximum concentration of 503 mg/kg. The Gehan and quantile tests indicated site concentrations of barium in soil are statistically different from background (Figure G-2 and Table G-2). The Gehan and quantile tests indicated site concentrations of barium in tuff are statistically different from background (Figure G-3 and Table G-1). Barium is retained as a COPC.

Cadmium was not detected above the soil and sediment BVs (0.4 mg/kg for both) but had DLs (0.514 mg/kg to 0.609 mg/kg) above BVs in 27 soil samples and 1 sediment sample. The DLs were only 0.114 mg/kg to 0.209 mg/kg above the BVs, below the highest background DL (2 mg/kg), and below or similar to the three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg). Cadmium was not detected or not detected above BVs in the other 52 samples (detected below BVs in 44 samples). Cadmium is not a COPC.

Calcium was detected above the Qbt 2,3,4 BV (2200 mg/kg) in three samples with a maximum concentration of 3240 mg/kg. The Gehan and quantile tests indicated site concentrations of calcium in tuff are statistically different from background (Figure G-4 and Table G-1). Calcium is retained as a COPC.

Chromium was detected above the soil and Qbt 2,3,4 BVs (19.3 mg/kg and 7.14 mg/kg) in 18 soil samples and 10 tuff samples with a maximum concentration of 74.3 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in soil are statistically different from background (Figure G-5 and Table G-2). The Gehan and quantile tests indicated site concentrations of chromium in tuff are statistically different from background (Figure G-6 and Table G-1). Chromium is retained as a COPC.

Cobalt was detected above the soil and Qbt 2,3,4 BVs (8.64 mg/kg and 3.14 mg/kg) in four soil samples and four tuff samples with a maximum concentration of 22.8 mg/kg. The Gehan and quantile tests indicated site concentrations of cobalt in soil are not statistically different from background (Figure G-7 and Table G-2). The Gehan and quantile tests indicated site concentrations of cobalt in tuff are statistically different from background (Figure G-8 and Table G-1). Cobalt is retained as a COPC.

Copper was detected above the soil and Qbt 2,3,4 BVs (14.7 mg/kg and 4.66 mg/kg) in two soil samples and four tuff samples with a maximum concentration of 29 mg/kg. The Gehan and quantile tests indicated site concentrations of copper in soil are statistically different from background (Figure G-9 and Table G-2). The Gehan and quantile tests indicated site concentrations of copper in tuff are statistically different from background (Figure G-10 and Table G-1). Copper is retained as a COPC.

Cyanide was detected above the Qbt 2,3,4 BV (0.5 mg/kg) in one sample at a concentration of 0.502 mg/kg. The concentration was only 0.002 mg/kg above the BV. Cyanide was not detected or was detected below BVs in the other 79 samples (detected below BVs in 9 samples). Cyanide is not a COPC.

Iron was detected above the soil and Qbt 2,3,4 BVs (21,500 mg/kg and 14,500 mg/kg) in one soil sample and two tuff samples with a maximum concentration of 22,100 mg/kg. The Gehan and quantile tests indicated site concentrations of iron in soil are statistically different from background (Figure G-11 and Table G-2). The Gehan and quantile tests indicated site concentrations of iron in tuff are statistically different from background (Figure G-12 and Table G-1). Iron is retained as a COPC.

Lead was detected above the soil and Qbt 2,3,4 BVs (22.3 mg/kg and 11.2 mg/kg) in two soil samples and two tuff samples with a maximum concentration of 41 mg/kg. The Gehan test indicated site concentrations of lead in soil are statistically different from background (Table G-2). However, the quantile and slippage tests indicated site concentrations of lead in soil are not statistically different from background (Figure G-13 and Table G-2). The Gehan and quantile tests indicated site concentrations of lead in tuff are not statistically different from background (Figure G-14 and Table G-1). Lead is not a COPC.

Magnesium was detected above the Qbt 2,3,4 BV (1690 mg/kg) in four samples with a maximum concentration of 2080 mg/kg. The Gehan and quantile tests indicated site concentrations of magnesium in tuff are statistically different from background (Figure G-15 and Table G-1). Magnesium is retained as a COPC.

Manganese was detected above the soil BV (671 mg/kg) in three samples with a maximum concentration of 2150 mg/kg. The Gehan and quantile tests indicated site concentrations of manganese in soil are statistically different from background (Figure G-16 and Table G-2). Manganese is retained as a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in three samples with a maximum concentration of 8.43 mg/kg. The quantile and slippage tests indicated site concentrations of nickel in tuff are statistically different from background (Figure G-17 and Table G-1). Nickel is retained as a COPC.

Perchlorate was detected in 13 samples with a maximum concentration of 0.00209 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the sediment and Qbt 2,3,4 BV (0.3 mg/kg for both) but had DLs (0.979 mg/kg to 1.29 mg/kg) above the BVs in 13 samples. Selenium is retained as a COPC.

Silver was detected above the soil BV (1 mg/kg) in one sample at a concentration of 1.11 mg/kg. The concentration was only 0.11 mg/kg above the BV. Silver was not detected or was detected below BVs in the other 79 samples (detected below BVs in 53 samples). Silver is not a COPC.

Uranium was detected above the soil BV (1.82 mg/kg) in 30 samples with a maximum concentration of 19.1 mg/kg. The Gehan and quantile tests indicated site concentrations of uranium in soil are statistically different from background (Figure G-18 and Table G-2). Uranium is retained as a COPC.

Vanadium was detected above the Qbt 2,3,4 BV (17 mg/kg) in four samples with a maximum concentration of 28.8 mg/kg. The Gehan and quantile tests indicated site concentrations of vanadium in tuff are statistically different from background (Figure G-19 and Table G-1). Vanadium is retained as a COPC.

Zinc was detected above the soil BV (48.8 mg/kg) in two samples with a maximum concentration of 85.6mg/kg. The Gehan and quantile tests indicated site concentrations of zinc in soil are not statistically different from background (Figure G-20 and Table G-2). Zinc is not a COPC.

Organic Chemicals

A total of 80 samples (67 soil, 10 tuff, and 3 sediment) were collected at SWMUs 12-001(a) and 12-001(b) and analyzed for explosive compounds. A total of 22 samples (19 soil, 1 sediment, and 2 tuff) were also analyzed for PCBs. Table 6.2-3 summarizes the analytical results for detected organic chemicals. Plate 4 shows the spatial distribution of detected organic chemicals.

Organic chemicals detected at SWMUs 12-001(a) and 12-001(b) include 4-amino-2,6-dinitrotoluene, HMX, PETN, RDX, and tetryl. The detected organic chemicals are retained as COPCs.

Radionuclides

A total of 80 samples (67 soil, 10 tuff, and 3 sediment) were analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. Table 6.2-4 summarizes radionuclides detected or detected above BVs/FVs. Plate 5 shows the spatial distribution of detected radionuclides.

Americium-241 was detected above the soil FV (0.013 pCi/g) in one sample at an activity of 0.0257 pCi/g. The activity was only 0.0127 pCi/g above the FV, and americium-241 was not detected in the other 79 samples. Americium-241 is not a COPC.

Cesium-137 was detected in three soil samples below 1 ft bgs and detected in one tuff sample with a maximum activity of 0.345 pCi/g. Cesium-137 is retained as a COPC.

Plutonium-239/240 was detected above the soil FV (0.054 pCi/g) in one sample and detected in one soil sample below 1 ft bgs with a maximum activity of 0.0682 pCi/g. Plutonium-239/240 is retained as a COPC.

Uranium-234 was detected above the soil BV (2.59 pCi/g) in three samples with a maximum activity of 4.15 pCi/g. Uranium-234 is retained as a COPC.

Uranium-235/236 was detected above the soil BV (0.2 pCi/g) in two samples with a maximum activity of 0.22 pCi/g. The activity was only 0.02 pCi/g above the BV, and uranium-235/236 was not detected in the other 78 samples. Uranium-235/236 is not a COPC.

Uranium-238 was detected above the soil, sediment, and Qbt 2,3,4 BVs (2.29 pCi/g, 2.29 pCi/g, and 1.93 pCi/g) in 10 soil samples, 1 sediment sample, and 1 tuff sample with a maximum activity of 4.47 pCi/g. Uranium-238 is retained as a COPC.

6.2.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMUs 12-001(a) and 12-001(b) are discussed below.

Inorganic Chemicals

Inorganic COPCs at SWMUs 12-001(a) and 12-001(b) include aluminum, antimony, barium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, perchlorate, selenium, uranium, and vanadium.

Aluminum was detected above the Qbt 2,3,4 BV in four samples with a maximum concentration of 11,700 mg/kg. Concentrations increased with depth at locations 12-610670, 12-610671, and 12-610701. Concentrations decreased with depth at location 12-610650 (the concentration in the shallow sample at location 12-610650 was 15,600 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential SSL was approximately 4.6 times the maximum concentration (the maximum concentration was 66,300 mg/kg below the residential SSL), and the industrial SSL was approximately 108 times the maximum concentration. The lateral extent of aluminum is defined, and further sampling for vertical extent is not warranted.

Antimony was detected above the soil BV in one sample at a concentration of 1.15 mg/kg. Antimony was not detected above the soil, sediment, and Qbt 2,3,4 BVs but had DLs (0.886 mg/kg to 1.3 mg/kg) above BVs in 61 soil samples, 8 tuff samples, and 3 sediment samples. Concentrations increased with depth at location 12-610694 and decreased downgradient. The residential SSL was approximately 27 times the detected concentration and 24 times the maximum DL. The lateral extent of antimony is defined, and further sampling for vertical extent is not warranted.

Barium was detected above the soil and Qbt 2,3,4 BVs in four soil samples and six tuff samples with a maximum concentration of 503 mg/kg. Concentrations increased with depth at locations 12-610647, 12-610694, 12-610670, 12-610671, and 12-610701. Concentrations decreased with depth at locations 12-610641, 12-610642, 12-610650, 12-610654, and 12-610667 (the concentration in the shallow sample at location 12-610667 was 101 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential SSL was approximately 31 times the maximum concentration. The lateral extent of barium is defined, and further sampling for vertical extent is not warranted.

Calcium was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 3240 mg/kg. Concentrations increased with depth at all locations and decreased downgradient. The NMED residential essential nutrient SSL was approximately 4100 times the maximum concentration. The lateral extent of calcium is defined, and further sampling for vertical extent is not warranted.

Chromium was detected above the soil and Qbt 2,3,4 BVs in 18 soil samples and 10 tuff samples with a maximum concentration of 74.3 mg/kg. Concentrations increased with depth at locations 12-610668, 12-610676, 12-610694, and 12-610697. Concentrations did not change substantially with depth at locations 12-610650 and 12-610673 (0.5 mg/kg and 0.2 mg/kg, respectively); the concentrations in the shallow samples at locations 12-610650 and 12-610673 were 13.7 mg/kg and 11.3 mg/kg, respectively, and below the soil BV (Appendix E, Pivot Tables). Concentrations decreased with depth at all other locations (the concentrations in the shallow samples at locations 12-610654, 12-610670, 12-610672, and 12-610701 were 15.4 mg/kg, 19.2 mg/kg, 14.5 mg/kg, and 13.3 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. As discussed in section 4.2, because there was no known use of hexavalent chromium at these sites, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential trivalent chromium SSL was approximately 1570 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Cobalt was detected above the soil and Qbt 2,3,4 BVs in four soil samples and four tuff samples with a maximum concentration of 22.8 mg/kg. Concentrations increased with depth at locations 12-610647, 12-610694, 12-610696, and 12-610671. Concentrations did not change substantially with depth at locations 12-610650, 12-610670, and 12-610701 (0.58 mg/kg, 0.65 mg/kg, and 0.52 mg/kg, respectively); the concentrations in the shallow samples at locations 12-610650, 12-610670, and 12-610701 were 5.88 mg/kg, 3.8 mg/kg, and 6.56 mg/kg, respectively, and below the soil BV (Appendix E, Pivot Tables). Concentrations decreased with depth at location 12-610695. Concentrations decreased downgradient. The industrial SSL was approximately 15 times the maximum concentration. The lateral extent of cobalt is defined, and further sampling for vertical extent is not warranted.

Copper was detected above the soil and Qbt 2,3,4 BVs in two soil samples and four tuff samples with a maximum concentration of 29 mg/kg. Concentrations did not change substantially with depth at location 12-610671 (0.38 mg/kg); the concentration in the shallow sample at location 12-610671 was 7.15 mg/kg and below the soil BV (Appendix E, Pivot Tables). Concentrations decreased with depth at locations 12-610641, 12-610643, 12-610650, 12-610670, and 12-610701 (the concentrations in the shallow samples at locations 12-610650, 12-610670, and 12-610701 were 7.92 mg/kg, 7.87 mg/kg, and 10.4 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential SSL was approximately 108 times the maximum concentration. The lateral extent of copper is defined, and further sampling for vertical extent is not warranted.

Iron was detected above the soil and Qbt 2,3,4 BVs in one soil sample and two tuff samples with a maximum concentration of 22,100 mg/kg. Concentrations increased with depth at locations 12-610670 and 12-610675 and decreased with depth at location 12-610650 (the concentration in the shallow sample at location 12-610650 was 15,000 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations

decreased downgradient. The residential and industrial SSLs were approximately 2.5 times and 41 times the maximum concentration, respectively. The lateral extent of iron is defined, and further sampling for vertical extent is not warranted.

Magnesium was detected above the Qbt 2,3,4 BV in four samples with a maximum concentration of 2080 mg/kg. Concentrations increased with depth at locations 12-610670, ~~and 12-610671, and 12-610701~~. Concentrations decreased with depth at locations ~~12-610650 and 12-610701~~ (the concentrations in the shallow samples at locations ~~12-610650 and 12-610701 were was~~ 2190 mg/kg ~~and 1980 mg/kg~~ and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The NMED residential essential nutrient SSL was approximately 160 times the maximum concentration. The lateral extent of magnesium is defined, and further sampling for vertical extent is not warranted.

Manganese was detected above the soil BV in three samples with a maximum concentration of 2150 mg/kg. Concentrations increased with depth at locations 12-610647 and 12-610694 and decreased with depth at location 12-610695. Concentrations decreased downgradient. The residential and industrial SSLs were approximately 4.9 times and 74 times the maximum concentration, respectively. The lateral extent of manganese is defined, and further sampling for vertical extent is not warranted.

Nickel was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 8.43 mg/kg. Concentrations did not change substantially with depth at locations 12-610650, 12-610670, and 12-610701 (0.75 mg/kg, 0.72 mg/kg, and 0.11 mg/kg, respectively); the concentrations in the shallow samples at locations 12-610650, 12-610670, and 12-610701 were 7.94 mg/kg, 6.08 mg/kg, and 8.54 mg/kg, respectively, and below the soil BV (Appendix E, Pivot Tables). Concentrations decreased downgradient. The residential SSL was approximately 185 times the maximum concentration. The lateral extent of nickel is defined, and further sampling for vertical extent is not warranted.

Perchlorate was detected in 13 samples with a maximum concentration of 0.00209 mg/kg. Concentrations increased with depth at locations 12-610643, 12-610655, 12-610674, and 12-610700 and were below estimated detection limits (EDLs). Concentrations decreased with depth at all other locations and decreased downgradient. The residential SSL was approximately 26,000 times the maximum concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Selenium was not detected above the sediment and Qbt 2,3,4 BVs but had DLs (0.979 mg/kg to 1.29 mg/kg) above BVs in 13 samples. Because selenium was not detected above the BVs and the residential SSL was approximately 303 times the maximum DL, further sampling for extent of selenium is not warranted.

Uranium was detected above the soil BV in 30 samples with a maximum concentration of 19.1 mg/kg. Concentrations did not change substantially with depth at location 12-610648 (0.18 mg/kg) and decreased with depth at all other locations. Concentrations decreased downgradient. The lateral and vertical extent of uranium are defined.

Vanadium was detected above the Qbt 2,3,4 BV in four samples with a maximum concentration of 28.8 mg/kg. Concentrations increased with depth at locations 12-610670 and 12-610671. Concentrations decreased with depth at locations 12-610650 and 12-610701 (the concentrations in the shallow samples at locations 12-610650 and 12-610701 were 29.6 mg/kg and 30.7 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential and industrial SSLs were approximately 14 times and 227 times the maximum concentration, respectively. The lateral extent of vanadium is defined, and further sampling for vertical extent is not warranted.

Organic Chemicals

Organic COPCs at SWMUs 12-001(a) and 12-001(b) include 4-amino-2,6-dinitrotoluene, HMX, PETN, RDX, and tetryl.

Amino-2,6-dinitrotoluene[4-] was detected in one sample at a concentration of 0.127 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of 4-amino-2,6-dinitrotoluene are defined.

HMX was detected in six samples with a maximum concentration of 11.4 mg/kg. Concentrations increased with depth at locations 12-610640 and 12-610642 and decreased with depth at location 12-610641. Concentrations decreased downgradient. The residential SSL was approximately 337 times the maximum concentration. The lateral extent of HMX is defined, and further sampling for vertical extent is not warranted.

PETN was detected in one sample at a concentration of 5.82 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of PETN are defined.

RDX was detected in eight samples with a maximum concentration of 49.4 mg/kg. Concentrations did not change substantially with depth at locations 12-610640 and 12-610642 (0.038 mg/kg and 0.173 mg/kg). Concentrations decreased with depth at locations 12-610641, 12-610643, and 12-610646 and decreased downgradient. The residential SSL was approximately 220 times the maximum concentration at location 12-610640 and 140 times the maximum concentration at location 12-610642. The lateral extent of RDX is defined, and further sampling for vertical extent is not warranted.

Tetryl was detected in one sample at a concentration of 0.333 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of tetryl are defined.

Radionuclides

Radionuclide COPCs at SWMUs 12-001(a) and 12-001(b) include cesium-137, plutonium-239/240, uranium-234, and uranium-238.

Cesium-137 was detected in three soil samples and one tuff sample with a maximum activity of 0.345 pCi/g. Activities increased with depth at location 12-610639, did not change substantially with depth at location 12-610680 (0.087 pCi/g), and decreased with depth at locations 12-610676 and 12-610679 (the activities in the shallow samples at locations 12-610676 and 12-610679 were 0.514 pCi/g and 0.15 pCi/g, respectively, and below the soil FV [Appendix E, Pivot Tables]). Activities decreased downgradient from location 12-610639 to location 12-610680 (0.014 pCi/g). The residential SAL was approximately 35 times the maximum activity. Further sampling for extent of cesium-137 is not warranted.

Plutonium-239/240 was detected in two soil samples with a maximum activity of 0.0682 pCi/g. Activities increased with depth at location 12-610639 and decreased with depth at location 12-610675. Activities decreased downgradient. The residential SAL was approximately 1160 times the maximum activity. Further sampling for extent of plutonium-239/240 is not warranted.

Uranium-234 was detected above the soil BV in three samples with a maximum activity of 4.15 pCi/g. Activities decreased with depth at all locations and decreased downgradient. The lateral and vertical extent of uranium-234 are defined.

Uranium-238 was detected above the soil, sediment, and Qbt 2,3,4 BVs in 10 soil samples, 1 sediment sample, and 1 tuff sample with a maximum activity of 4.47 pCi/g. Activities increased with depth at location 12-610676 and decreased at all other locations. Activities decreased downgradient. The residential SAL was approximately 33 times the maximum activity. Further sampling for extent of uranium-238 is not warranted.

6.2.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 8×10^{-7} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.03, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.09 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Recreational Scenario

The total excess cancer risk for the recreational scenario is 1×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.07, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.03 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 3×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is approximately 1, which is equivalent to the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.9 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Construction Worker Scenario

The residential exposure scenario is protective of construction workers for carcinogenic and radionuclide COPCs. The construction worker HI is 0.9, which is less than the NMED target HI of 1.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, recreational, ~~and~~ residential, and construction worker scenarios at SWMUs 12-001(a) and 12-001(b).

6.2.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for threatened and endangered (T&E) species), LOAEL analyses, and chemicals of potential ecological concern (COPECs) without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at SWMUs 12-001(a) and 12-001(b).

6.3 SWMU 12-001(b)—Former Firing Pit

6.3.1 Site Description and Operational History

SWMU 12-001(b) is a decommissioned firing pit located on the north side of Redondo Road at former TA-12 (Plate 2). The pit is 5 ft × 5 ft × 3 ft deep and was used for calorimetric experiments in 1945. Following World War II, the pit was used to fire HE shots involving lead and uranium. Although operations at this site ceased in the 1950s, the pit remains in place.

6.3.2 Relationship to Other SWMUs and AOCs

SWMU 12-001(b) is a component of Consolidated Unit 12-001(a)-99, along with SWMUs 12-001(a) and 12-002, and AOC C-12-005. SWMU 12-001(b) is located approximately 175 ft east of SWMU 12-001(a) and 40 ft northwest of SWMU 12-002 (Plate 2).

6.3.3 Summary of Previous Investigations

In 1993, a radiological survey detected beta- and gamma-emitting radionuclides at approximately twice background levels in the open firing pit (LANL 1994, 034755, p. 5-1-6; LANL 1997, 055675, p. 1). Small fragments of uranium and pink material were observed in the firing pit. Field HE spot-tests were conducted and fragments of pink material tested positive for RDX (Harris 1993, 055658).

In 1995, RFI activities were performed at SWMU 12-001(b) (LANL 1996, 054086, p. 5-1). Four soil samples were collected from three locations and analyzed for inorganic chemicals, HE, and radionuclides (LANL 1996, 054086, p. 5-1; LANL 1997, 055675, pp. 2–4).

Data from four samples collected during the 1995 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

6.3.4 Site Contamination

6.3.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at SWMU 12-001(b). As a result, the following activities were completed as part of the 2009–2010 investigation.

- A total of 34 samples were collected in 2009–2010 from 17 locations adjacent to and around the firing site. At each location, samples were collected at the surface (0.0–0.4 ft bgs to 0.0–1.0 ft bgs) and from the subsurface (1.5–2.5 ft bgs to 2.0–3.6 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. Eight samples were also analyzed for PCBs.

The 2009–2010 sampling locations at SWMU 12-001(b) are shown on Plate 2. Table 6.2-1 presents the samples collected and analyses requested for SWMU 12-001(b). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

6.3.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

6.3.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 12-001(b) consist of results from 34 samples (32 soil and 2 tuff) collected from 17 locations. As described in section 6.2.4, because of the proximity of SWMUs 12-001(a) and 12-001(b), these data were combined with the decision-level data for SWMU 12-001(a) and the combined data sets were evaluated for COPCs. See section 6.2.4.3 for results of the evaluation of COPCs for SWMUs 12-001(a) and 12-001(b).

6.3.4.4 Nature and Extent of Contamination

Section 6.2.4.4 discusses the nature and extent of contamination for SWMUs 12-001(a) and 12-001(b).

6.3.5 Summary of Human Health Risk Screening

The human health risk screening for SWMU 12-001(b) was conducted in conjunction with SWMU 12-001(a) and the results are presented in section 6.2.5.

6.3.6 Summary of Ecological Risk Screening

The ecological risk screening for SWMU 12-001(b) was conducted in conjunction with SWMU 12-001(a) and the results are presented in section 6.2.6.

6.4 SWMU 12-002—Potential Soil Contamination

6.4.1 Site Description and Operational History

SWMU 12-002 is an area of potential soil contamination at former TA-12 where a small quantity of scrap HE was burned on one occasion (Plate 2). In 1962, a can containing approximately 0.5 lb of HE was discovered during a property survey and was subsequently burned in a small area (approximately 3 ft²) to destroy the HE (Anderson 1962, 004860; LANL 1994, 034755, p. 6-3). The location of SWMU 12-002 now lies beneath the asphalt pavement of Redondo Road.

6.4.2 Relationship to Other SWMUs and AOCs

SWMU 12-002 is a component of Consolidated Unit 12-001(a)-99, along with SWMUs 12-001(a) and 12-001(b), and AOC C-12-005. SWMU 12-002 is located approximately 40 ft southeast of SWMU 12-001(b) (Plate 2).

6.4.3 Summary of Previous Investigations

No sampling was conducted at SWMU 12-002 before the 2009–2010 investigation.

6.4.4 Site Contamination

6.4.4.1 Soil, Rock, and Sediment Sampling

Because no previous investigations had been conducted, characterization was required to assess potential contamination at SWMU 12-002. The following activities were completed as part of the 2009–2010 investigation.

- Two samples were collected in 2009–2010 from one location where HE had previously been burned. Samples were collected at intervals of 0.4–0.8 ft bgs and 2.0–3.3 ft bgs. All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, PCBs, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium.

The 2009–2010 sampling locations at SWMU 12-002 are shown on Plate 2. Table 6.4-1 presents the samples collected and analyses requested for SWMU 12-002. The geodetic coordinates of sampling locations are presented in Table 3.2-1.

6.4.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

6.4.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 12-002 consist of two tuff samples collected from one location.

Inorganic Chemicals

Two tuff samples were collected at SWMU 12-002 and analyzed for TAL metals, cyanide, total uranium, and perchlorate. Table 6.4-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Plate 3 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 BV (7340 mg/kg) in one sample at a concentration of 14,200 mg/kg. Aluminum is retained as a COPC.

Antimony was not detected above the Qbt 2,3,4 BV (0.5 mg/kg) but had a DL (1.03 mg/kg) above the BV in one sample. Antimony is retained as a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in two samples with a maximum concentration of 191 mg/kg. Barium is retained as a COPC.

Calcium was detected above the Qbt 2,3,4 BV (2200 mg/kg) in one sample at a concentration of 2440 mg/kg. Calcium is retained as a COPC.

Chromium was detected above the Qbt 2,3,4 BV (7.14 mg/kg) in one sample at a concentration of 13.5 mg/kg. Chromium is retained as a COPC.

Cobalt was detected above the Qbt 2,3,4 BV (3.14 mg/kg) in two samples with a maximum concentration of 14.2 mg/kg. Cobalt is retained as a COPC.

Copper was detected above the Qbt 2,3,4 BV (4.66 mg/kg) in two samples with a maximum concentration of 11.1 mg/kg. Copper is retained as a COPC.

Iron was detected above the Qbt 2,3,4 BV (14,500 mg/kg) in one sample at a concentration of 18,900 mg/kg. Iron is retained as a COPC.

Lead was detected above the Qbt 2,3,4 BV (11.2 mg/kg) in one sample at a concentration of 13 mg/kg. The concentration was only 1.8 mg/kg above the BV and below the two highest tuff background concentrations (15.5 mg/kg and 14.5 mg/kg). Lead was detected below BV in the other sample. Lead is not a COPC.

Magnesium was detected above the Qbt 2,3,4 BV (1690 mg/kg) in one sample at a concentration of 2220 mg/kg. The concentration was below the two highest tuff background concentrations (2820 mg/kg and 2720 mg/kg). Magnesium was detected below BV in the other sample. Magnesium is not a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in one sample at a concentration of 9.28 mg/kg. Nickel is retained as a COPC.

Selenium was not detected above the Qbt 2,3,4 BV (0.3 mg/kg) but had DLs (1.06 mg/kg and 1.1 mg/kg) above BV in two samples. Selenium is retained as a COPC.

Vanadium was detected above the Qbt 2,3,4 BV (17 mg/kg) in one sample at a concentration of 27.1 mg/kg. Vanadium is retained as a COPC.

Organic Chemicals

Two tuff samples were collected at SWMU 12-002 and analyzed for explosive compounds and PCBs. Organic chemicals were not detected at SWMU 12-002.

Radionuclides

Two tuff samples were collected at SWMU 12-002 and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium.

Radionuclides were not detected or detected above BVs/FVs at SWMU 12-002.

6.4.4.4 Nature and Extent of Contamination

The nature and extent of inorganic COPCs at SWMU 12-002 are discussed below.

Inorganic Chemicals

Inorganic COPCs at SWMU 12-002 include aluminum, antimony, barium, calcium, chromium, cobalt, copper, iron, nickel, selenium, and vanadium.

Aluminum was detected above the Qbt 2,3,4 BV in one sample at a concentration of 14,200 mg/kg. Concentrations increased with depth but decreased laterally at locations 12-610641, 12-610646, 12-610649, and 12-610652 within SWMU 12-001(b) (Plate 3). The residential SSL was approximately 5.5 times the maximum concentration (the maximum concentration was 63,800 mg/kg below the residential SSL), and the industrial SSL was approximately 89 times the maximum concentration. The lateral extent of aluminum is defined, and further sampling for vertical extent is not warranted.

Antimony was not detected above the Qbt 2,3,4 BV but had a DL (1.03 mg/kg) above BV in one sample. The residential SSL was approximately 30 times the DL. Further sampling for extent of antimony is not warranted.

Barium was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 191 mg/kg. Concentrations increased with depth but decreased laterally at locations 12-610641, 12-610646, 12-610649, and 12-610652 within SWMU 12-001(b) (Plate 3). The residential SSL was approximately 82 times the maximum concentration. The lateral extent of barium is defined, and further sampling for vertical extent is not warranted.

Calcium was detected above the Qbt 2,3,4 BV in one sample at a concentration of 2440 mg/kg. Concentrations increased with depth but decreased laterally at locations 12-610641, 12-610646, 12-610649, and 12-610652 within SWMU 12-001(b) (Plate 3). The NMED residential essential nutrient SSL was approximately 5300 times the maximum concentration. The lateral extent of calcium is defined, and further sampling for vertical extent is not warranted.

Chromium was detected above the Qbt 2,3,4 BV in one sample at a concentration of 13.5 mg/kg. Concentrations increased with depth but decreased laterally at locations 12-610641, 12-610646, 12-610649, and 12-610652 within SWMU 12-001(b) (Plate 3). As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 8700 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Cobalt was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 14.2 mg/kg. Concentrations did not change substantially with depth (0.8 mg/kg). Concentrations decreased laterally at locations 12-610641, 12-610646, 12-610649, and 12-610652 within SWMU 12-001(b) (Plate 3). The lateral and vertical extent of cobalt are defined.

Copper was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 11.1 mg/kg. Concentrations increased with depth but decreased laterally at locations 12-610641, 12-610646, 12-610649, and 12-610652 within SWMU 12-001(b) (Plate 3). The residential SSL was approximately 280 times the maximum concentration. The lateral extent of copper is defined, and further sampling for vertical extent is not warranted.

Iron was detected above the Qbt 2,3,4 BV in one sample at a concentration of 18,900 mg/kg. Concentrations increased with depth but decreased laterally at locations 12-610641, 12-610646, 12-610649, and 12-610652 within SWMU 12-001(b) (Plate 3). The residential and industrial SSLs were approximately 2.9 times and 48 times the maximum concentration, respectively. The lateral extent of iron is defined, and further sampling for vertical extent is not warranted.

Nickel was detected above the Qbt 2,3,4 BV in one sample at a concentration of 9.28 mg/kg. Concentrations increased with depth but decreased laterally at locations 12-610641, 12-610646, 12-610649, and 12-610652 within SWMU 12-001(b) (Plate 3). The residential SSL was approximately 170 times the maximum concentration. The lateral extent of nickel is defined, and further sampling for vertical extent is not warranted.

Selenium was not detected above the Qbt 2,3,4 BV but had DLs (1.06 mg/kg and 1.1 mg/kg) above BV in two samples. Because selenium was not detected above BV and the residential SSL was approximately 355 times the maximum DL, further sampling for extent of selenium is not warranted.

Vanadium was detected above the Qbt 2,3,4 BV in one sample at a concentration of 27.1 mg/kg. Concentrations increased with depth but decreased laterally at locations 12-610641, 12-610646, 12-610649, and 12-610652 within SWMU 12-001(b) (Plate 3). The residential and industrial SSLs were approximately 14 times and 241 times the maximum concentration, respectively. The lateral extent of vanadium is defined, and further sampling for vertical extent is not warranted.

Organic Chemicals

No organic COPCs were identified at SWMU 12-002.

Radionuclides

No radionuclide COPCs were identified at SWMU 12-002.

6.4.5 Summary of Human Health Risk Screening

Industrial Scenario

No carcinogenic COPCs were identified for the industrial scenario. The HI is 0.04, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at SWMU 12-002.

Recreational Scenario

No carcinogenic COPCs were identified for the recreational scenario. The HI is 0.08, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at SWMU 12-002.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.9, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at SWMU 12-002. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, recreational, ~~and~~-residential, and construction worker scenarios at SWMU 12-002.

6.4.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at SWMU 12-002.

6.5 AOC 12-004(a)—Radiation Test Site

6.5.1 Site Description and Operational History

AOC 12-004(a) is the site of a lanthanum radiation experiment conducted at former TA-12 (Figure 6.5-1). The site originally consisted of a 6-ft × 6-ft × 6-ft soil-bermed radiation shelter (structure 12-8) and three vertical poles. The shelter and poles were constructed in a line parallel to a drainage channel that flows southwest from Redondo Road into Threemile Canyon. The northernmost pole has been removed and was located in a drainage 30 ft south of Redondo Road, the middle pole is located 58 ft south of the first pole location, and the radiation shelter and the third pole are located 40 ft south of the second pole (LANL 1996, 054086, pp. 5-18–5-24).

The site was constructed in March 1950, and experiments were conducted over a 3-wk period in the same year. Operations at the site consisted of deploying a lanthanum source from the radiation shelter by raising it with a wire strung over the three poles. The radiation source was stored in a lead container at the base of the first pole and could be deployed at various heights by raising it inside a guide tube attached to the pole. At an unspecified date between 1962 and 1966, the lead container and the plastic guide tube were removed (Blackwell 1962, 005011). The northernmost pole was removed in 1966 (Blackwell 1966, 005012). The shelter and two poles remain in place.

6.5.2 Relationship to Other SWMUs and AOCs

AOC 12-004(a) is located adjacent to AOC 12-004(b) and is approximately 1.1 miles east of the other former TA-12 SWMUs and AOCs (Plate 2).

6.5.3 Summary of Previous Investigations

A 1959 survey reported the shelter and pole closest to the road were contaminated with HE and strontium-90 (Blackwell 1959, 005773; LANL 1994, 034755, pp. 5-2-1–5-2-2).

A 1966 survey showed all structures were contaminated with beta- and gamma-emitting radionuclides (Blackwell 1966, 005012; LANL 1994, 034755, pp. 5-2-1–5-2-2). The structures were subsequently decontaminated and one pole was removed.

A 1993 radiation screening survey inside the shelter showed a cardboard box with beta- and gamma-emitting radionuclides at 10 times background levels. No other readings above instrument background levels were observed (LANL 1994, 034755, pp. 5-2-1–5-2-2).

In 1995, RFI activities were performed at AOC 12-004(a). Six surface soil samples were collected from six locations and analyzed for inorganic chemicals, HE, and radionuclides (LANL 1996, 054086, p. 5-20).

Data from six samples collected during the 1995 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

6.5.4 Site Contamination

6.5.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at AOC 12-004(a). As a result, the following activities were completed as part of the 2009–2010 investigation.

- A total of 31 samples were collected in 2009–2010 from 16 locations around former structure 12-8 and the experimental area and in the drainage to the south of the site. At each location, samples were collected at the surface (0.0–0.3 ft bgs to 0.0–1.0 ft bgs), and at all but one location, a subsurface sample (1.0–1.3 ft bgs to 1.0–3.0 ft bgs) was also collected. All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, SVOCs, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. Eight samples were also analyzed for PCBs.

The 2009–2010 sampling locations at AOC 12-004(a) are shown on Figure 6.5-1. Table 6.5-1 presents the samples collected and analyses requested for AOC 12-004(a). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

6.5.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

6.5.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at AOC 12-004(a) consist of 31 samples (10 soil, 18 tuff, and 3 sediment) collected from 16 locations.

Inorganic Chemicals

A total of 31 samples (10 soil, 18 tuff, and 3 sediment) were collected at AOC 12-004(a) and analyzed for TAL metals, cyanide, total uranium, and perchlorate. Table 6.5-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Figure 6.5-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 BV (7340 mg/kg) in three samples with a maximum concentration of 10,600 mg/kg. The Gehan and quantile tests indicated site concentrations of aluminum in tuff are statistically different from background (Figure G-21 and Table G-3). Aluminum is retained as a COPC.

Antimony was detected above the sediment and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) in 1 sediment sample and 2 tuff samples with a maximum concentration of 1.36 mg/kg and had DLs (1.01 mg/kg to 1.26 mg/kg) above BVs in 8 soil samples, 1 sediment sample, and 12 tuff samples. Antimony is retained as a COPC.

Arsenic was detected above the Qbt 2,3,4 BV (2.79 mg/kg) in one sample at a concentration of 3.14 mg/kg. The Gehan and quantile tests indicated site concentrations of arsenic in tuff are statistically different from background (Figure G-22 and Table G-3). Arsenic is retained as a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in nine samples with a maximum concentration of 214 mg/kg. The Gehan and quantile tests indicated site concentrations of barium in tuff are statistically different from background (Figure G-23 and Table G-3). Barium is retained as a COPC.

Cadmium was not detected above the soil and sediment BVs (0.4 mg/kg for both) but had DLs (0.541 mg/kg to 0.595 mg/kg) above BVs in six soil samples and two sediment samples. The DLs were only 0.141 mg/kg to 0.195 mg/kg above the BV, below the highest background DL (2 mg/kg), and below or similar to the three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg). Cadmium was not detected or not detected above BVs in the other 23 samples (detected below BVs in 5 samples). Cadmium is not a COPC.

Calcium was detected above the Qbt 2,3,4 BV (2200 mg/kg) in four samples with a maximum concentration of 4600 mg/kg. The Gehan and quantile tests indicated site concentrations of calcium in tuff are statistically different from background (Figure G-24 and Table G-3). Calcium is retained as a COPC.

Chromium was detected above the soil, sediment, and Qbt 2,3,4 BVs (19.3 mg/kg, 10.5 mg/kg, and 7.14 mg/kg) in 2 soil samples, 2 sediment samples, and 16 tuff samples with a maximum concentration of 60.4 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in soil are not statistically different from background (Figure G-25 and Table G-4). The Gehan and quantile tests indicated site concentrations of chromium in tuff are statistically different from background (Figure G-26 and Table G-3). Chromium is retained as a COPC.

Cobalt was detected above the Qbt 2,3,4 BV (3.14 mg/kg) in seven samples with a maximum concentration of 6.96 mg/kg. The Gehan and slippage tests indicated site concentrations of cobalt in tuff are statistically different from background (Figure G-27 and Table G-3). Cobalt is retained as a COPC.

Copper was detected above the Qbt 2,3,4 BV (4.66 mg/kg) in six samples with a maximum concentration of 6.76 mg/kg. The Gehan and quantile tests indicated site concentrations of copper in tuff are statistically different from background (Figure G-28 and Table G-3). Copper is retained as a COPC.

Lead was detected above the Qbt 2,3,4 BV (11.2 mg/kg) in two samples with a maximum concentration of 22.6 mg/kg. The Gehan test indicated site concentrations of lead in tuff are statistically different from background (Table G-3). However, the quantile and slippage tests indicated site concentrations of lead in tuff are not statistically different from background (Figure G-29 and Table G-3). Lead is not a COPC.

Magnesium was detected above the Qbt 2,3,4 BV (1690 mg/kg) in two samples with a maximum concentration of 2170 mg/kg. The Gehan and quantile tests indicated site concentrations of magnesium in tuff are statistically different from background (Figure G-30 and Table G-3). Magnesium is retained as a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in four samples with a maximum concentration of 10.1 mg/kg. The quantile and slippage tests indicated site concentrations of nickel in tuff are statistically different from background (Figure G-31 and Table G-3). Nickel is retained as a COPC.

Perchlorate was detected in two samples with a maximum concentration of 0.00078 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the sediment and Qbt 2,3,4 BVs (0.3 mg/kg for both) but had DLs (0.996 mg/kg to 1.26 mg/kg) above BVs in 3 sediment samples and 18 tuff samples. Selenium is retained as a COPC.

Uranium was detected above the soil, sediment, and Qbt 2,3,4 BVs (1.82 mg/kg, 2.22 mg/kg, and 2.4 mg/kg) in eight soil samples, two sediment samples, and two tuff samples with a maximum concentration of 7.12 mg/kg. The Gehan and quantile tests indicated site concentrations of uranium in soil are statistically different from background (Figure G-32 and Table G-4). The Gehan and quantile tests indicated site concentrations of uranium in tuff are not statistically different from background (Figure G-33 and Table G-3). Uranium is retained as a COPC.

Vanadium was detected above the Qbt 2,3,4 BV (17 mg/kg) in three samples with a maximum concentration of 21.6 mg/kg. The Gehan and quantile tests indicated site concentrations of vanadium in tuff are statistically different from background (Figure G-34 and Table G-3). Vanadium is retained as a COPC.

Zinc was detected above the soil BV (48.8 mg/kg) in one sample at a concentration of 60.6 mg/kg. The Gehan and slippage tests indicated site concentrations of zinc in soil are not statistically different from background (Figure G-35 and Table G-4). Zinc is not a COPC.

Organic Chemicals

A total of 31 samples (10 soil, 18 tuff, and 3 sediment) were collected at AOC 12-004(a) and analyzed for explosive compounds and SVOCs. Eight samples (three soil and five tuff) were also analyzed for PCBs. Table 6.5-3 summarizes the analytical results for detected organic chemicals. Figure 6.5-3 shows the spatial distribution of detected organic chemicals.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are a class of SVOCs frequently detected as a result of environmental sampling but generally were not released from the SWMUs or AOCs being investigated. PAHs unrelated to site activities are thus often detected in samples analyzed for the presence of site-related SVOCs.

PAHs are known to be widely distributed in the environment from a number of sources, both natural, such as forest fires, and anthropogenic, such as combustion of fossil fuels, oil drips off motor vehicles, vehicle tires, coal tar pitch, and weathering or eroding of asphalt pavement (Kose et al. 2008, 219977; Teaf 2008, 219976). PAHs from these sources generally occur as complex mixtures, not as single compounds. Individual PAH compounds can be manufactured for research purposes, and some PAHs (e.g., anthracene, fluorene, naphthalene, and pyrene) are used in dye production, the manufacture of synthetic fibers, and in plastics and pesticides.

The principal sources of PAHs in soil along parking lots, roads, and highways are vehicular exhaust and emissions, the wearing of tires, and asphalt. PAH-containing materials, such as asphalt and rubber particles, do not easily dissolve in water, preventing migration, except as suspended particles in storm water. PAH concentrations in excess of soil cleanup levels may result from common anthropogenic sources, such as runoff from asphalt parking lots.

Site Activities

AOC 12-004(a) was identified as an AOC because of possible radioactive soil contamination resulting from radiation experiments historically conducted at the site. PAHs were not used in the radiation exposure studies conducted at this site.

AOC 12-004(a) is located in an undeveloped portion of the Laboratory. This area of the Laboratory was affected by the 2000 Cerro Grande fire with low burn severity and low fire intensity (Balice et al. 2004, 601116, pp. 33–34). Surface soil at the site has been eroded, and remnants of the fire (e.g., burned wood) are not clearly visible but may still be present in soil (Appendix I, Figure I-1). Based on the fact that PAHs were not used in the radiation experiments conducted at this site, and the fact that the site was burned during the Cerro Grande fire, the low concentrations of PAHs detected in samples used to characterize this site [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, phenanthrene, and pyrene] are associated with the fire, are not related to historic Laboratory site operations, and are not COPCs.

Organic COPCs

Other organic chemicals detected at AOC 12-004(a) include benzoic acid and di-n-butylphthalate. The detected organic chemicals listed are retained as COPCs.

Radionuclides

A total of 31 samples (10 soil, 18 tuff, and 3 sediment) were collected at AOC 12-004(a) and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. Table 6.5-4 summarizes radionuclides detected or detected above BVs/FVs. Figure 6.5-4 shows the spatial distribution of detected radionuclides.

Cesium-137 was detected in five tuff samples with a maximum activity of 0.248 pCi/g. Cesium-137 is retained as a COPC.

Uranium-234 was detected above the sediment BV (2.59 pCi/g) in one sample at an activity of 3.81 pCi/g. Uranium-234 is retained as a COPC.

Uranium-235/236 was detected above the sediment and Qbt 2,3,4 BVs (0.2 pCi/g and 0.09 pCi/g) in one sediment sample and four tuff samples with a maximum activity of 0.253 pCi/g. Uranium-235/236 is retained as a COPC.

Uranium-238 was detected above the soil, sediment, and Qbt 2,3,4 BVs (2.29 pCi/g, 2.29 pCi/g, and 1.93 pCi/g) in five soil samples, two sediment samples, and one tuff sample with a maximum activity of 6.81 pCi/g. Uranium-238 is retained as a COPC.

6.5.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at AOC 12-004(a) are discussed below.

Inorganic Chemicals

Inorganic COPCs at AOC 12-004(a) include aluminum, antimony, arsenic, barium, calcium, chromium, cobalt, copper, magnesium, nickel, perchlorate, selenium, uranium, and vanadium.

Aluminum was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 10,600 mg/kg. Concentrations increased with depth at locations 12-610527 and 12-610529.

Concentrations decreased with depth at location 12-610528 (the concentration in the shallow sample at location 12-610528 was 18,300 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations increased laterally at location 12-610529 but decreased downgradient to the southwest. The residential

SSL was approximately 7.4 times the maximum concentration (the maximum concentration was 66,300 mg/kg below the residential SSL), and the industrial SSL was approximately 119 times the maximum concentration. Further sampling for extent of aluminum is not warranted.

Antimony was detected above the sediment and Qbt 2,3,4 BVs in 1 sediment sample and 2 tuff samples with a maximum concentration of 1.36 mg/kg and had DLs (1.01 mg/kg to 1.26 mg/kg) above BVs in 8 soil, 1 sediment, and 12 tuff samples. Concentrations did not change substantially with depth at location 12-610543 (0.512 mg/kg), decreased with depth at locations 12-610542 and 12-610546, and decreased downgradient. The residential SSL was approximately 23 times the maximum concentration and 25 times the maximum DL. The lateral extent of antimony is defined, and further sampling for vertical extent is not warranted.

Arsenic was detected above the Qbt 2,3,4 BV in one sample at a concentration of 3.14 mg/kg. Concentrations did not change substantially with depth (0.44 mg/kg) and increased laterally, but the maximum concentration was below the two highest Qbt 2,3,4 background concentrations (5 mg/kg and 4 mg/kg). The industrial SSL was approximately 6.8 times the maximum concentration above the BV. Further sampling for extent of arsenic is not warranted.

Barium was detected above the Qbt 2,3,4 BV in nine samples with a maximum concentration of 214 mg/kg. Concentrations did not change substantially with depth at locations 12-610528 and 12-610529 (3 mg/kg for both); the concentrations in the shallow samples at locations 12-610528 and 12-610529 were 211 mg/kg and 166 mg/kg, respectively, and below the soil BV (Appendix E, Pivot Tables). Concentrations decreased with depth at locations 12-610527, 12-610530, 12-610540, 12-610541, 12-610543, and 12-610544 (the concentrations in the shallow samples at locations 12-610530, 12-610540, 12-610541, and 12-610543 were 115 mg/kg, 73.3 mg/kg, 99.3 mg/kg, and 118 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations increased laterally from location 12-610539 to location 12-610529 and decreased downgradient to the southwest. The residential SSL was approximately 92 times the maximum concentration at location 12-610529. The vertical extent of barium is defined, and further sampling for lateral extent is not warranted.

Calcium was detected above the Qbt 2,3,4 BV in four samples with a maximum concentration of 4600 mg/kg. Concentrations increased with depth at locations 12-610528 and 12-610529. Concentrations decreased with depth at locations 12-610543 (the concentration in the shallow sample at location 12-610543 was 5100 mg/kg and below the soil BV [Appendix E, Pivot Tables]) and 12-610544. Concentrations increased laterally at location 12-610529 but decreased downgradient to the southwest. The NMED residential essential nutrient SSL was approximately 2800 times the maximum concentration. Further sampling for extent of calcium is not warranted.

Chromium was detected above the soil, sediment, and Qbt 2,3,4 BVs in 2 soil samples, 2 sediment samples, and 16 tuff samples with a maximum concentration of 60.4 mg/kg. Concentrations increased with depth at locations 12-610539, 12-610540, 12-610543, 12-610547, 12-610548, and 12-610549. However, concentrations at locations 12-610547 and 12-610548 were below the maximum Qbt 2,3,4 background concentration (13 mg/kg). Concentrations did not change substantially with depth at locations 12-610527 and 12-610530 (0.6 mg/kg and 0.1 mg/kg, respectively); the concentration in the shallow sample at location 12-610530 was 10.4 mg/kg and below the soil BV (Appendix E, Pivot Tables). Concentrations decreased with depth at locations 12-610528, 12-610529, 12-610541, 12-610542, 12-610544, and 12-610546 (the concentration in the shallow sample at location 12-610529 was 9.32 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased laterally from location 12-610539 to location 12-610529 and decreased downgradient to the southwest. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was

approximately 1940 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Cobalt was detected above the Qbt 2,3,4 BV in seven samples with a maximum concentration of 6.96 mg/kg. Concentrations decreased with depth at locations 12-610528, 12-610529, and 12-610542 (the concentrations in the shallow samples at locations 12-610528 and 12-610529 were 6.21 mg/kg and 8.12 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations did not change substantially with depth at locations 12-610530, 12-610527, and 12-610540 (1.6 mg/kg, 0.66 mg/kg, and 0.25 mg/kg, respectively); the concentrations in the shallow samples at locations 12-610530 and 12-610540 were 4.22 mg/kg and 3.96 mg/kg and below the soil BV (Appendix E, Pivot Tables). Concentrations increased laterally at location 12-610529 but decreased downgradient to the southwest. The residential and industrial SSLs were approximately 3.3 times and 50 times the maximum concentration, respectively. Further sampling for extent of cobalt is not warranted.

Copper was detected above the Qbt 2,3,4 BV in six samples with a maximum concentration of 6.76 mg/kg. Concentrations decreased or did not change substantially with depth at all locations (the concentrations in the shallow samples at locations 12-610528, 12-610529, 12-610543, and 12-610548 were 8.83 mg/kg, 7.4 mg/kg, 8.69 mg/kg, and 4.46 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations increased laterally at location 12-610529 but decreased downgradient to the southwest. The residential SSL was approximately 460 times the maximum concentration. The vertical extent of copper is defined, and further sampling for lateral extent is not warranted.

Magnesium was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 2170 mg/kg. Concentrations did not change substantially with depth at location 12-610529 (60 mg/kg) and decreased with depth at location 12-610528 (the concentrations in the shallow samples at locations 12-610528 and 12-610529 were 2570 mg/kg and 2110 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations increased laterally at location 12-610529 but decreased downgradient to the southwest. The NMED residential essential nutrient SSL was approximately 156 times the maximum concentration. The vertical extent of magnesium is defined, and further sampling for lateral extent is not warranted.

Nickel was detected above the Qbt 2,3,4 BV in four samples with a maximum concentration of 10.1 mg/kg. Concentrations did not change substantially with depth at locations 12-610529, 12-610541, and 12-610543 (0.41 mg/kg, 1.68 mg/kg, and 1.18 mg/kg, respectively); the concentrations in the shallow samples at locations 12-610529, 12-610541, and 12-610543 were 9.69 mg/kg, 8.69 mg/kg, and 7.16 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased with depth at location 12-510628 (the concentration in the shallow sample at location 12-610528 was 12 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations increased laterally at location 12-610529 but decreased downgradient to the southwest. The residential SSL was approximately 154 times the maximum concentration. The vertical extent of nickel is defined, and further sampling for lateral extent is not warranted.

Perchlorate was detected in two samples with a maximum concentration of 0.00078 mg/kg. Concentrations increased with depth and increased laterally at location 12-610529. Concentrations decreased with depth at location 12-610541 and decreased downgradient to the southwest. Both detected concentrations were less than EDLs. The residential SSL was approximately 70,000 times the maximum concentration. Further sampling for extent of perchlorate is not warranted.

Selenium was not detected above the sediment and Qbt 2,3,4 BVs but had DLs (0.996 mg/kg to 1.26 mg/kg) above BVs in 3 sediment samples and 18 tuff samples. Because selenium was not detected above the BVs and the residential SSL was approximately 310 times the maximum DL, further sampling for extent of selenium is not warranted.

Uranium was detected above the soil, sediment, and Qbt 2,3,4 BVs in eight soil samples, two sediment samples, and two tuff samples with a maximum concentration of 7.12 mg/kg. Concentrations increased with depth at location 12-610540, and only one depth was sampled at location 12-610550. Concentrations decreased with depth at all other locations. Concentrations decreased downgradient. The residential SSL was approximately 33 times the maximum concentration. The lateral extent of uranium is defined, and further sampling for vertical extent is not warranted.

Vanadium was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 21.6 mg/kg. Concentrations decreased with depth at locations 12-610527, 12-610528, and 12-610529 (the concentrations in the shallow samples at locations 12-610528 and 12-610529 were 30.3 mg/kg and 25 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations increased laterally at location 12-610529 but decreased downgradient to the southwest. The residential and industrial SSLs were approximately 18 times and 300 times the maximum concentration, respectively. The vertical extent of vanadium is defined, and further sampling for lateral extent is not warranted.

Organic Chemicals

Organic COPCs at AOC 12-004(a) include benzoic acid and di-n-butylphthalate.

Benzoic acid was detected in one sample at a concentration of 0.608 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of benzoic acid are defined.

Di-n-butylphthalate was detected in one sample at a concentration of 0.121 mg/kg. Concentrations increased with depth, but the concentration was below the EQL. Concentrations decreased downgradient. The residential SSL was approximately 51,000 times the concentration. The lateral extent of di-n-butylphthalate is defined, and further sampling for vertical extent is not warranted.

Radionuclides

Radionuclide COPCs at AOC 12-004(a) include cesium-137, uranium-234, uranium-235/236, and uranium-238.

Cesium-137 was detected in five tuff samples with a maximum activity of 0.248 pCi/g. Activities decreased with depth at all locations (the activities in the shallow samples at locations 12-610540, 12-610543, 12-610547, and 12-610549 were 0.438 pCi/g, 0.971 pCi/g, 0.483 pCi/g, and 0.35 pCi/g, respectively, and below the soil and sediment FVs [Appendix E, Pivot Tables]). Activities decreased downgradient. The lateral and vertical extent of cesium-137 are defined.

Uranium-234 was detected above the sediment BV in one sample at an activity of 3.81 pCi/g. Only one depth was sampled at location 12-610550, which was the most downgradient location. The residential SAL was approximately 77 times the maximum activity. Further sampling for extent of uranium-234 is not warranted.

Uranium-235/236 was detected above the sediment and Qbt 2,3,4 BVs in one sediment sample and four tuff samples with a maximum activity of 0.253 pCi/g. Only one depth was sampled at location 12-610550. Activities did not change substantially with depth at the other locations (0.016 pCi/g to 0.054 pCi/g); the activities in the shallow samples at locations 12-610545, 12-610547, 12-610548, and

12-610549 were 0.0918 pCi/g, 0.159 pCi/g, 0.161 pCi/g, and 0.0819 pCi/g, respectively, and below the soil and sediment BVs (Appendix E, Pivot Tables). The residential SAL was approximately 166 times the maximum activity. Further sampling for extent of uranium-235/236 is not warranted.

Uranium-238 was detected above the soil, sediment, and Qbt 2,3,4 BVs in five soil samples, two sediment samples, and one tuff sample with a maximum activity of 6.81 pCi/g. Only one depth was sampled at location 12-610550. Activities did not change substantially with depth at location 12-610548 (1.44 pCi/g) and decreased with depth at locations 12-610539, 12-610540, 12-610543, 12-610546, and 12-610547. The residential and industrial SALs were approximately 22 times and 104 times the maximum activity, respectively. Further sampling for extent of uranium-238 is not warranted.

6.5.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 5×10^{-7} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.02, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.4 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 7×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.3, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 1 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and~~ residential, and construction worker scenarios at AOC 12-004(a).

6.5.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at AOC 12-004(a).

6.6 AOC 12-004(b)—Pipe

6.6.1 Site Description and Operational History

AOC 12-004(b) consists of a former aluminum pipe located at former TA-12 at the edge of Redondo Road approximately 78 ft north of a radiation shelter (structure 12-8) (Figure 6.5-1). The pipe was set vertically in the ground and protruded 8 in. aboveground without a cover. The pipe was 7.5 in. thick in diameter and 3 ft long with an inner diameter of 18 in. The pipe was filled with soil. Remnant fragments of HE were observed at the site in 1959 (Blackwell 1959, 005773). The pipe was removed during the 2009–2010 investigation.

6.6.2 Relationship to Other SWMUs and AOCs

AOC 12-004(b) is located adjacent to AOC 12-004(a) and is approximately 1.1 miles east of the other TA-12 SWMUs and AOCs (Plate 2).

6.6.3 Summary of Previous Investigations

A 1993 radiation survey was conducted, and no radionuclides were detected above background levels (LANL 1994, 034755, p. 5-2-2).

In 1995, RFI activities were performed at AOC 12-004(b). Two samples were collected from one location next to the aluminum pipe and analyzed for inorganic chemicals, SVOCs, HE, and radionuclides (LANL 1996, 054086, p. 5-25).

Data from two samples collected during the 1995 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

6.6.4 Site Contamination

6.6.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at AOC 12-004(b). As a result, the following activities were completed as part of the 2009–2010 investigation.

- Twelve samples were collected in 2009–2010 from four locations adjacent to the pipe. At each location, samples were collected at the surface (0.0–0.5 ft bgs to 0.0–1.0 ft bgs) and from two subsurface intervals (2.0–2.3 ft bgs to 2.0–3.0 ft bgs and 5.0–5.4 ft bgs to 5.0–6.0 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, SVOCs, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. Six samples were also analyzed for PCBs.

The 2009–2010 sampling locations at AOC 12-004(b) are shown on Figure 6.5-1. Table 6.6-1 presents the samples collected and analyses requested for AOC 12-004(b). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

6.6.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

6.6.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at AOC 12-004(b) consist of 12 samples (4 soil and 8 tuff) collected from four locations.

Inorganic Chemicals

A total of 12 samples (4 soil and 8 tuff) were collected at AOC 12-004(b) and analyzed for TAL metals, cyanide, total uranium, and perchlorate. Table 6.6-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Figure 6.5-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 BV (7340 mg/kg) in three samples with a maximum concentration of 15,200 mg/kg. The Gehan and quantile tests indicated site concentrations of aluminum in tuff are statistically different from background (Figure G-36 and Table G-5). Aluminum is retained as a COPC.

Antimony was not detected above the soil and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) but had DLs (0.939 mg/kg to 1.05 mg/kg) above BVs in two soil samples and three tuff samples. Antimony is retained as a COPC.

Arsenic was detected above the Qbt 2,3,4 BV (2.79 mg/kg) in three samples with a maximum concentration of 3.8 mg/kg. The Gehan and quantile tests indicated site concentrations of arsenic in tuff are statistically different from background (Figure G-37 and Table G-5). Arsenic is retained as a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in five samples with a maximum concentration of 406 mg/kg. The Gehan and quantile tests indicated site concentrations of barium in tuff are statistically different from background (Figure G-38 and Table G-5). Barium is retained as a COPC.

Beryllium was detected above the Qbt 2,3,4 BV (1.21 mg/kg) in one sample at a concentration of 1.6 mg/kg. The Gehan and quantile tests indicated site concentrations of beryllium in tuff are not statistically different from background (Figure G-39 and Table G-5). Beryllium is not a COPC.

Cadmium was not detected above the soil BV (0.4 mg/kg) but had a DL (0.543 mg/kg) above BV in one sample. The DL was only 0.143 mg/kg above the BV, below the highest background DL (2 mg/kg), and below the three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg). Cadmium was not detected or not detected above BVs in the other 11 samples (detected below BVs in 6 samples). Cadmium is not a COPC.

Calcium was detected above the Qbt 2,3,4 BV (2200 mg/kg) in five samples with a maximum concentration of 5490 mg/kg. The Gehan and quantile tests indicated site concentrations of calcium in tuff are statistically different from background (Figure G-40 and Table G-5). Calcium is retained as a COPC.

Chromium was detected above the Qbt 2,3,4 BV (7.14 mg/kg) in seven samples with a maximum concentration of 21.3 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in tuff are statistically different from background (Figure G-41 and Table G-5). Chromium is retained as a COPC.

Cobalt was detected above the soil and Qbt 2,3,4 BVs (8.64 mg/kg and 3.14 mg/kg) in one soil sample and seven tuff samples with a maximum concentration of 9.62 mg/kg. The Gehan and slippage tests indicated site concentrations of cobalt in tuff are statistically different from background (Figure G-42 and Table G-5). Cobalt is retained as a COPC.

Copper was detected above the Qbt 2,3,4 BV (4.66 mg/kg) in five samples with a maximum concentration of 18 mg/kg. The Gehan and quantile tests indicated site concentrations of copper in tuff are statistically different from background (Figure G-43 and Table G-5). Copper is retained as a COPC.

Cyanide was not detected above the soil and Qbt 2,3,4 BVs (0.5 mg/kg for both) but had DLs (0.52 mg/kg to 0.6 mg/kg) above BVs in two soil samples and four tuff samples. The DLs were only 0.02 mg/kg to 0.1 mg/kg above the BVs, and cyanide was not detected in any sample (six samples had DLs below BVs). Cyanide is not a COPC.

Iron was detected above the soil BV (21,500 mg/kg) in one sample at a concentration of 21,700 mg/kg. The concentration was only 200 mg/kg above the BV and below the five highest soil background concentrations (36,000 mg/kg, 27,000 mg/kg, 25,000 mg/kg, 24,000 mg/kg, and 22,000 mg/kg). Iron was detected below BVs in the other 11 samples. Iron is not a COPC.

Lead was detected above the soil and Qbt 2,3,4 BVs (22.3 mg/kg and 11.2 mg/kg) in two soil samples and three tuff samples with a maximum concentration of 23.4 mg/kg. The Gehan and quantile tests indicated site concentrations of lead in tuff are statistically different from background (Figure G-44 and Table G-5). Lead is retained as a COPC.

Magnesium was detected above the Qbt 2,3,4 BV (1690 mg/kg) in three samples with a maximum concentration of 3230 mg/kg. The Gehan and quantile tests indicated site concentrations of magnesium in tuff are statistically different from background (Figure G-45 and Table G-5). Magnesium is retained as a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in four samples with a maximum concentration of 13.9 mg/kg. The quantile and slippage tests indicated site concentrations of nickel in tuff are statistically different from background (Figure G-46 and Table G-5). Nickel is retained as a COPC.

Perchlorate was detected in one sample at a concentration of 0.000832 mg/kg. Perchlorate is retained as a COPC.

Selenium was detected above the Qbt 2,3,4 BV (0.3 mg/kg) in four samples with a maximum concentration of 1.3 mg/kg and had DLs (1.01 mg/kg to 1.09 mg/kg) above the BV in four samples. Selenium is retained as a COPC.

Uranium was detected above the soil BV (1.82 mg/kg) in two samples with a maximum concentration of 5.8 mg/kg. Uranium is retained as a COPC.

Vanadium was detected above the soil and Qbt 2,3,4 BVs (39.6 mg/kg and 17 mg/kg) in one soil sample and four tuff samples with a maximum concentration of 47.5 mg/kg. The Gehan and quantile tests indicated site concentrations of vanadium in tuff are statistically different from background (Figure G-47 and Table G-5). Vanadium is retained as a COPC.

Organic Chemicals

A total of 12 samples (4 soil and 8 tuff) were collected at AOC 12-004(b) and analyzed for explosive compounds and SVOCs. Six samples (two soil and four tuff) were also analyzed for PCBs. Table 6.6-3 summarizes the analytical results for detected organic chemicals. Figure 6.5-3 shows the spatial distribution of detected organic chemicals.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons are a class of SVOCs frequently detected as a result of environmental sampling but generally were not released from the SWMUs or AOCs being investigated. PAHs unrelated to site activities are thus often detected in samples analyzed for the presence of site-related SVOCs.

PAHs are known to be widely distributed in the environment from a number of sources, both natural, such as forest fires, and anthropogenic, such as combustion of fossil fuels, oil drips off motor vehicles, vehicle tires, coal tar pitch, and weathering or eroding of asphalt pavement (Kose et al. 2008, 219977; Teaf 2008, 219976). PAHs from these sources generally occur as complex mixtures, not as single compounds. Individual PAH compounds can be manufactured for research purposes, and some PAHs (e.g., anthracene, fluorene, naphthalene, and pyrene) are used in dye production, the manufacture of synthetic fibers, and in plastics and pesticides.

The principal sources of PAHs in soil along parking lots, roads, and highways are vehicular exhaust and emissions, the wearing of tires, and asphalt. PAH-containing materials, such as asphalt and rubber particles, do not easily dissolve in water, preventing migration, except as suspended particles in storm water. PAH concentrations in excess of soil cleanup levels may result from common anthropogenic sources, such as runoff from asphalt parking lots.

Site Activities

AOC 12-004(b) was identified as an AOC because of possible radioactive soil contamination. PAHs were not used at this site.

AOC 12-004(b) is located in an undeveloped portion of the Laboratory. This area of the Laboratory was affected by the 2000 Cerro Grande fire with low burn severity and low fire intensity (Balice et al. 2004, 601116, pp. 33–34). Surface soil at and adjacent to the site has been eroded, and remnants of the fire (e.g., burned wood) are not clearly visible but may still be present in soil (Appendix I, Figure I-1). Based on the fact that PAHs were not used at this site, and the fact that the site was burned during the Cerro Grande fire, the low concentrations of PAHs detected in samples used to characterize this site [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, and indeno(1,2,3-cd)pyrene] are associated with the fire, are not related to historic Laboratory site operations, and are not COPCs.

Organic COPCs

Other organic chemicals detected at AOC 12-004(b) include Aroclor-1254 and Aroclor-1260. The detected organic chemicals listed are retained as COPCs.

Radionuclides

A total of 12 samples (4 soil and 8 tuff) were collected at AOC 12-004(b) and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. Table 6.6-4 summarizes radionuclides detected or detected above BVs/FVs. Figure 6.5-4 shows the spatial distribution of detected radionuclides.

Plutonium-238 was detected above the soil FV (0.023 pCi/g) in one sample at an activity of 0.043 pCi/g. The activity was only 0.02 pCi/g above the FV and 0.006 pCi/g above the maximum soil background activity, and plutonium-238 was not detected in the other 11 samples. Plutonium-238 is not a COPC.

6.6.4.4 Nature and Extent of Contamination

The nature and extent of inorganic and organic COPCs at AOC 12-004(b) are discussed below.

Inorganic Chemicals

Inorganic COPCs at AOC 12-004(b) include aluminum, antimony, arsenic, barium, calcium, chromium, cobalt, copper, lead, magnesium, nickel, perchlorate, selenium, uranium, and vanadium.

Aluminum was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 15,200 mg/kg. Concentrations decreased with depth in the two deepest samples at location 12-610939 and at location 12-610553. Concentrations decreased downgradient of location 12-611939 (where the maximum concentration was detected) at location 12-610528 at AOC 12-004(a) (Figure 6.5-2). The lateral and vertical extent of aluminum are defined.

Antimony was not detected above the soil and Qbt 2,3,4 BVs but had DLs (0.939 mg/kg to 1.05 mg/kg) above BVs in two soil samples and three tuff samples. Because antimony was not detected above BVs and the residential SSL was approximately 30 times the maximum DL, further sampling for extent of antimony is not warranted.

Arsenic was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 3.8 mg/kg. Concentrations did not change substantially with depth (0.3 mg/kg) in the two deeper samples at location 12-610939 and decreased with depth at location 12-611940. Concentrations decreased downgradient of location 12-611939 (where the maximum concentration was detected) at location 12-610528 at AOC 12-004(a) (Figure 6.5-2). The lateral and vertical extent of arsenic are defined.

Barium was detected above the Qbt 2,3,4 BV in five samples with a maximum concentration of 406 mg/kg. Concentrations decreased with depth at all locations. Concentrations decreased downgradient of the maximum concentration at location 12-610554. The lateral and vertical extent of barium are defined.

Calcium was detected above the Qbt 2,3,4 BV in five samples with a maximum concentration of 5490 mg/kg. Concentrations increased with depth at location 12-611939 and decreased with depth at the other three locations. Concentrations decreased downgradient of location 12-611939 (where the maximum concentration was detected) at location 12-610528 at AOC 12-004(a) (Figure 6.5-2). The NMED residential essential nutrient SSL was approximately 2400 times the maximum concentration. The lateral extent of calcium is defined, and further sampling for vertical extent is not warranted.

Chromium was detected above the Qbt 2,3,4 BV in seven samples with a maximum concentration of 21.3 mg/kg. Concentrations increased with depth at location 12-611939, did not change substantially with depth (0.5 mg/kg) at location 12-611940, and decreased with depth at locations 12-610553 and 12-610554. Concentrations decreased downgradient of the maximum concentration at location 12-610553. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 5500 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Cobalt was detected above the soil and Qbt 2,3,4 BVs in one soil sample and seven tuff samples with a maximum concentration of 9.62 mg/kg. Concentrations decreased with depth at all locations. Concentrations decreased downgradient of the maximum concentration at location 12-610553. The lateral and vertical extent of cobalt are defined.

Copper was detected above the Qbt 2,3,4 BV in five samples with a maximum concentration of 18 mg/kg. Concentrations increased with depth at location 12-611939, did not change substantially with depth (1 mg/kg) in the two deeper samples at location 12-611940, and decreased with depth at locations 12-610553 and 12-610554. Concentrations decreased downgradient of location 12-611939 (where the maximum concentration was detected) at location 12-610528 at AOC 12-004(a) (Figure 6.5-2). The residential SSL was approximately 170 times the maximum concentration. The lateral extent of copper is defined, and further sampling for vertical extent is not warranted.

Lead was detected above the soil and Qbt 2,3,4 BVs in two soil samples and three tuff samples with a maximum concentration of 23.4 mg/kg. Concentrations decreased with depth at locations 12-610553 and 12-611939 where lead was detected above BV. Concentrations did not change substantially (0.4 mg/kg) laterally at locations 12-610553 and 12-611939 and decreased downgradient of these locations. The lateral and vertical extent of lead are defined.

Magnesium was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 3230 mg/kg. Concentrations increased with depth at location 12-611939 and decreased with depth at location 12-610553. Concentrations decreased downgradient of location 12-611939 (where the maximum concentration was detected) at location 12-610528 at AOC 12-004(a) (Figure 6.5-2). The NMED residential essential nutrient SSL was approximately 105 times the maximum concentration. The lateral extent of magnesium is defined, and further sampling for vertical extent is not warranted.

Nickel was detected above the Qbt 2,3,4 BV in four samples with a maximum concentration of 13.9 mg/kg. Concentrations increased with depth at location 12-611939 and did not change substantially with depth (1.0 mg/kg) in the deeper two samples at location 12-611940. Concentrations decreased downgradient of location 12-611939 (where the maximum concentration was detected) at location 12-610528 at AOC 12-004(a) (Figure 6.5-2). The residential SSL is approximately 110 times the maximum concentration. The lateral extent of nickel is defined, and further sampling for vertical extent is not warranted.

Perchlorate was detected in one sample at a concentration of 0.000832 mg/kg, which is below the EQL. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of perchlorate are defined.

Selenium was detected above the Qbt 2,3,4 BV in four samples with a maximum concentration of 1.3 mg/kg and had DLs (1.01 mg/kg to 1.09 mg/kg) in four samples. Concentrations increased with depth at location 12-611940 and did not change substantially with depth (0.2 mg/kg) in the deeper two samples at location 12-611939. Concentrations decreased downgradient of location 12-611939 (where the maximum concentration was detected) at location 12-610528 at AOC 12-004(a) (Figure 6.5-2). The residential SSL was approximately 300 times the maximum concentration and 360 times the maximum DL. The lateral extent of selenium is defined, and further sampling for vertical extent is not warranted.

Uranium was detected above the soil BV in two samples with a maximum concentration of 5.8 mg/kg. Concentrations decreased with depth at locations 12-610553 and 12-611939 where uranium was detected above BV. Concentrations decreased downgradient of location 12-611939 (where the maximum concentration was detected) at location 12-610528 at AOC 12-004(a) (Figure 6.5-2). The lateral and vertical extent of uranium are defined.

Vanadium was detected above the soil and Qbt 2,3,4 BVs in one soil sample and four tuff samples with a maximum concentration of 47.5 mg/kg. Concentrations decreased with depth at locations 12-610553, 12-611939, and 12-611940 and decreased downgradient of location 12-610553 where the maximum concentration was detected. The lateral and vertical extent of vanadium are defined.

Organic Chemicals

Organic COPCs at AOC 12-004(b) include Aroclor-1254 and Aroclor-1260.

Aroclor-1254 was detected in one sample at a concentration of 0.015 mg/kg. The concentration was below the EQL. Concentrations decreased with depth, and Aroclor-1254 was not detected downgradient at location 12-610528 at AOC 12-004(a) (Figure 6.5-3). The lateral and vertical extent of Aroclor-1254 are defined.

Aroclor-1260 was detected in one sample at a concentration of 0.011 mg/kg. The concentration was below the EQL. Concentrations increased with depth, and Aroclor-1260 was not detected downgradient at location 12-610528 at AOC 12-004(a) (Figure 6.5-3). The residential SSL was approximately 220 times the concentration. The lateral extent of Aroclor-1260 is defined, and further sampling for vertical extent is not warranted.

Radionuclides

There were no radionuclide COPCs at AOC 12-004(b).

6.6.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 1×10^{-8} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.07, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

Residential Scenario

The total excess cancer risk for the residential scenario is 8×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.6, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and~~ residential, and construction worker scenarios at AOC 12-004(b).

6.6.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at AOC 12-004(b).

6.7 AOC C-12-001—Potential Soil Contamination Associated with Former Building 12-1

6.7.1 Site Description and Operational History

AOC C-12-001 is an area of potential soil contamination at former TA-12 associated with the former trim building (12-1) (Plate 6). The trim building was built in December 1944 and used to prepare HE for detonation experiments. The building was 16 ft long × 16 ft wide × 9 ft high and of wood-frame construction with a soil berm on three sides and on top. Activities at former TA-12 ceased in 1953, and building 12-1 was destroyed in 1960 by intentional burning. Concrete blocks and metal radiators were observed at the site in 1992 but have since been removed (LANL 1994, 034755).

6.7.2 Relationship to Other SWMUs and AOCs

AOC C-12-001 is located approximately 600 ft west of the SWMU 12-001(a) firing pit (Plate 2) and 100 ft southeast of AOC C-12-002 and 130 ft southeast of AOC C-12-004. AOC C-12-003 is approximately 200 ft to the northwest of AOC C-12-001 but is on the other side of Redondo Road.

6.7.3 Summary of Previous Investigations

A 1959 inspection reported that building 12-1 was contaminated with HE (Blackwell 1959, 005773).

In 1995, RFI activities were performed at AOC C-12-001. One sample was collected from one location and analyzed for inorganic chemicals and radionuclides (LANL 1996, 054086, pp. 5-1–5-5).

Data from the sample collected during the 1995 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

6.7.4 Site Contamination

6.7.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at AOC C-12-001. As a result, the following activities were completed as part of the 2009–2010 investigation.

- Ten samples were collected in 2009–2010 from five locations within the footprint and around former building 12-1. At each location, a sample was collected at the surface (0.0–0.5 ft bgs or 0.0–1.0 ft bgs) and from the subsurface (2.0–3.0 ft bgs to 2.4–3.0 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. Four samples were also analyzed for PCBs.

The 2009–2010 sampling locations at AOC C-12-001 are shown on Plate 6. Table 6.7-1 presents the samples collected and analyses requested for AOC C-12-001. The geodetic coordinates of sampling locations are presented in Table 3.2-1.

6.7.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

6.7.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at AOC C-12-001 consist of 10 samples (5 soil and 5 tuff) collected from 5 locations.

Inorganic Chemicals

Ten samples (5 soil and 5 tuff) were collected at AOC C-12-001 and analyzed for TAL metals, cyanide, total uranium, and perchlorate. Table 6.7-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Plate 7 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 BV (7340 mg/kg) in four samples with a maximum concentration of 10,800 mg/kg. Aluminum is retained as a COPC.

Antimony was not detected above the soil and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) but had DLs (1.04 mg/kg to 1.25 mg/kg) above BVs in five soil samples and four tuff samples. Antimony is retained as a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in five samples with a maximum concentration of 161 mg/kg. Barium is retained as a COPC.

Cadmium was not detected above the soil BV (0.4 mg/kg) but had DLs (0.548 mg/kg to 0.627 mg/kg) above BVs in five samples. The DLs were only 0.148 mg/kg to 0.227 mg/kg above the BV, below the highest background DL (2 mg/kg), and below or similar to the three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg). Cadmium was not detected in the other five samples. Cadmium is not a COPC.

Calcium was detected above the Qbt 2,3,4 BV (2200 mg/kg) in three samples with a maximum concentration of 4530 mg/kg. Calcium is retained as a COPC.

Chromium was detected above the Qbt 2,3,4 BV (7.14 mg/kg) in three samples with a maximum concentration of 27 mg/kg. Chromium is retained as a COPC.

Cobalt was detected above the Qbt 2,3,4 BV (3.14 mg/kg) in three samples with a maximum concentration of 3.67 mg/kg. Cobalt is retained as a COPC.

Copper was detected above the Qbt 2,3,4 BV (4.66 mg/kg) in one sample at a concentration of 5.36 mg/kg. The detected concentration was only 0.7 mg/kg above the BV and was below the two highest Qbt 2,3,4 background concentrations (6.2 mg/kg and 5.7 mg/kg). Copper was detected below BV in the other nine samples. Copper is not a COPC.

Magnesium was detected above the Qbt 2,3,4 BV (1690 mg/kg) in three samples with a maximum concentration of 2100 mg/kg. The maximum concentration was only 410 mg/kg above the BV and was below the two highest Qbt 2,3,4 background concentrations (2820 mg/kg and 2720 mg/kg). Magnesium was detected below BV in the other seven samples. Magnesium is not a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in two samples with a maximum concentration of 9.26 mg/kg. Nickel is retained as a COPC.

Perchlorate was detected in two samples with a maximum concentration of 0.00241 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the Qbt 2,3,4 BV (0.3 mg/kg) but had DLs (1.03 mg/kg to 1.09 mg/kg) above BV in five samples. Selenium is retained as a COPC.

Uranium was detected above the soil BV (1.82 mg/kg) in two samples with a maximum concentration of 4.07 mg/kg. Uranium is retained as a COPC.

Organic Chemicals

Ten samples (5 soil and 5 tuff) were collected at AOC C-12-001 and analyzed for explosive compounds. Four samples (2 soil and 2 tuff) were also analyzed for PCBs. Table 6.7-3 summarizes the analytical results for detected organic chemicals. Plate 8 shows the spatial distribution of detected organic chemicals.

Organic chemicals detected at AOC C-12-001 include Aroclor-1242, Aroclor-1254, and Aroclor-1260. The detected organic chemicals are retained as COPCs.

Radionuclides

Ten samples (5 soil and 5 tuff) were collected at AOC C-12-001 and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium.

Radionuclides were not detected or detected above BVs/FVs at AOC C-12-001.

6.7.4.4 Nature and Extent of Soil and Rock Contamination

The nature and extent of inorganic and organic COPCs at AOC C-12-001 are discussed below.

Inorganic Chemicals

Inorganic COPCs at AOC C-12-001 include aluminum, antimony, barium, calcium, chromium, cobalt, nickel, perchlorate, selenium, and uranium.

Aluminum was detected above the Qbt 2,3,4 BV in four samples with a maximum concentration of 10,800 mg/kg. Concentrations increased with depth at locations 12-610627 and 12-610628, did not change substantially with depth (60 mg/kg) at location 12-610626, and decreased with depth at location 12-610625 (the concentrations in the shallow samples at locations 12-610625 and 12-610626 were 9590 mg/kg and 8280 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations increased downgradient at location 12-610628. The residential SSL was approximately 7.2 times the maximum concentration (the maximum concentration was 67,200 mg/kg below the residential SSL), and the industrial SSL was approximately 117 times the maximum concentration. Further sampling for extent of aluminum is not warranted.

Antimony was not detected above the soil and Qbt 2,3,4 BVs but had DLs (1.04 mg/kg to 1.25 mg/kg) above BVs in five soil samples and four tuff samples. Because antimony was not detected above BVs and the residential SSL was approximately 25 times the maximum DL, further sampling for extent of antimony is not warranted.

Barium was detected above the Qbt 2,3,4 BV in five samples with a maximum concentration of 161 mg/kg. Concentrations increased with depth at locations 12-610627 and 12-610628, did not change substantially with depth (3 mg/kg) at location 12-610625, and decreased with depth at locations 12-610624 and 12-610626 (the concentrations in the shallow samples at locations 12-610624, 12-610625, and 12-610626 were 126 mg/kg, 135 mg/kg, and 107 mg/kg, respectively, and below the soil

BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient at location 12-610628. The residential SSL was approximately 97 times the maximum concentration. Further sampling for extent of barium is not warranted.

Calcium was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 4530 mg/kg. Concentrations increased with depth at locations 12-610625, 12-610627, and 12-610628. Concentrations decreased downgradient at location 12-610628. The NMED residential essential nutrient SSL was approximately 2900 times the maximum concentration. Further sampling for extent of calcium is not warranted.

Chromium was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 27 mg/kg. Concentrations increased with depth at locations 12-610624 and 12-610625 and decreased with depth at location 12-610628 (the concentration in the shallow sample at location 12-610628 was 9.7 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient at location 12-610628. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 4300 times the maximum concentration. Further sampling for extent of chromium is not warranted.

Cobalt was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 3.67 mg/kg. Concentrations decreased with depth at locations 12-610624, 12-610626, and 12-610628 (the concentrations in the shallow samples at locations 12-610624, 12-610626, and 12-610628 were 4.74 mg/kg, 5.2 mg/kg, and 6.26 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations did not change substantially (0.51 mg/kg) downgradient. The residential and industrial SSLs were approximately 6.2 times and 95 times the maximum concentration, respectively. Further sampling for extent of cobalt is not warranted.

Nickel was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 9.26 mg/kg. Concentrations increased with depth at location 12-610628 and decreased with depth at location 12-610625 (the concentration in the shallow sample at location 12-610625 was 9.28 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations increased downgradient at location 12-610628. The residential SSL was approximately 168 times the maximum concentration. Further sampling for extent of nickel is not warranted.

Perchlorate was detected in two samples with a maximum concentration of 0.00241 mg/kg. Concentrations increased with depth at locations 12-610625 and 12-610627 and decreased downgradient at location 12-610628. The residential SSL was approximately 23,000 times the maximum concentration. Further sampling for extent of perchlorate is not warranted.

Selenium was not detected above the Qbt 2,3,4 BV but had DLs (1.03 mg/kg to 1.09 mg/kg) above BV in five samples. Because selenium was not detected above BVs and the residential SSL was approximately 360 times the maximum DL, further sampling for extent of selenium is not warranted.

Uranium was detected above the soil BV in two samples with a maximum concentration of 4.07 mg/kg. Concentrations decreased with depth at locations 12-610625 and 12-610628 and decreased downgradient at location 12-610628. The residential SSL was approximately 57 times the maximum concentration. The lateral and vertical extent of uranium are defined.

Organic Chemicals

Organic COPCs at AOC C-12-001 include Aroclor-1242, Aroclor-1254, and Aroclor-1260.

Aroclor-1242, Aroclor-1254, and Aroclor-1260 were each detected in one sample at concentrations of 0.114 mg/kg, 0.109 mg/kg, and 0.0477 mg/kg, respectively. Concentrations decreased with depth and increased downgradient at location 12-610628. The residential SSLs for Aroclor-1242, Aroclor-1254, and Aroclor-1260 are approximately 21 times, 11 times, and 51 times the concentrations, respectively. The vertical extent of Aroclor-1242, Aroclor-1254, and Aroclor-1260 is defined, and further sampling for lateral extent is not warranted.

Radionuclides

There were no radionuclide COPCs at AOC C-12-001.

6.7.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 2×10^{-7} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.003, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-12-001.

Residential Scenario

The total excess cancer risk for the residential scenario is 2×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.5, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-12-001. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and~~ residential, and construction worker scenarios at AOC C-12-001.

6.7.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at AOC C-12-001.

6.8 AOC C-12-002—Potential Soil Contamination Associated with Former Building 12-2

6.8.1 Site Description and Operational History

AOC C-12-002 is an area of potential soil contamination at former TA-12 associated with former control building 12-2 (Plate 6). Built in 1945 of wood-frame construction, the building measured 8 ft long \times 8 ft wide \times 8 ft high, with a soil berm on three sides and on top. The structure was located south of Redondo Road. Activities at former TA-12 ceased in the early 1950s, and the control building was destroyed in 1960 by intentional burning.

6.8.2 Relationship to Other SWMUs and AOCs

AOC C-12-002 is located approximately 600 ft west of the SWMU 12-001(a) firing pit (Plate 2) and 100 ft northwest of AOC C-12-001 and 30 ft southeast of AOC C-12-004. AOC C-12-003 is approximately 150 ft to the north of AOC C-12-002 but is on the other side of Redondo Road.

6.8.3 Summary of Previous Investigations

A 1959 inspection reported that building 12-2 was contaminated with HE (Blackwell 1959, 005773).

In 1995, RFI activities were performed at AOC C-12-002. One sample was collected from one location and analyzed for total uranium (LANL 1996, 054086, pp. 5-5–5-8).

Data from the sample collected during the 1995 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

6.8.4 Site Contamination

6.8.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at AOC C-12-002. As a result, the following activities were completed as part of the 2009–2010 investigation.

- Ten samples were collected in 2009–2010 from five locations within the footprint and around former building 12-2. At each location, a sample was collected at the surface (0.0–0.5 ft bgs or 0.0–0.75 ft bgs) and from the subsurface (2.0–2.75 ft bgs or 2.0–3.0 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, PCBs, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium.

The 2009–2010 sampling locations at AOC C-12-002 are shown on Plate 6. Table 6.8-1 presents the samples collected and analyses requested for AOC C-12-002. The geodetic coordinates of sampling locations are presented in Table 3.2-1.

6.8.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

6.8.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at AOC C-12-002 consist of 10 samples (8 soil and 2 tuff) collected from 5 locations.

Inorganic Chemicals

Ten samples (8 soil and 2 tuff) were collected at AOC C-12-002 and analyzed for TAL metals, cyanide, total uranium, and perchlorate. Table 6.8-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Plate 7 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 BV (7340 mg/kg) in two samples with a maximum concentration of 11,300 mg/kg. Aluminum is retained as a COPC.

Antimony was not detected above the soil and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) but had DLs (1.03 mg/kg to 1.11 mg/kg) above BVs in eight soil samples and two tuff samples. Antimony is retained as a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in two samples with a maximum concentration of 275 mg/kg. Barium is retained as a COPC.

Cadmium was not detected above the soil BV (0.4 mg/kg) but had DLs (0.514 mg/kg to 0.554 mg/kg) above BV in six samples. The DLs were only 0.114 mg/kg to 0.154 mg/kg above the BV, below the highest background DL (2 mg/kg), and below the three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg). Cadmium was not detected or not detected above BVs in the other four samples (detected below BVs in two samples). Cadmium is not a COPC.

Calcium was detected above the Qbt 2,3,4 BV (2200 mg/kg) in one sample at a concentration of 2710 mg/kg. Calcium is retained as a COPC.

Chromium was detected above the soil and Qbt 2,3,4 BVs (19.3 mg/kg and 7.14 mg/kg) in one soil sample and two tuff samples with a maximum concentration of 23 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in soil are statistically different from background (Figure G-48 and Table G-6). Chromium is retained as a COPC.

Cobalt was detected above the soil and Qbt 2,3,4 BVs (8.64 mg/kg and 3.14 mg/kg) in one soil sample and two tuff samples with a maximum concentration of 12.1 mg/kg. The Gehan and quantile tests indicated site concentrations of cobalt in soil are not statistically different from background (Figure G-49 and Table G-6). The concentrations of cobalt above the Qbt 2,3,4 BV were above the maximum Qbt 2,3,4 background concentration. Cobalt is retained as a COPC.

Copper was detected above the Qbt 2,3,4 BV (4.66 mg/kg) in two samples with a maximum concentration of 7.21 mg/kg. Copper is retained as a COPC.

Magnesium was detected above the Qbt 2,3,4 BV (1690 mg/kg) in two samples with a maximum concentration of 2310 mg/kg. The maximum concentration is only 620 mg/kg above the BV and was below the two highest Qbt 2,3,4 background concentrations (2820 mg/kg and 2720 mg/kg). Magnesium was detected below BVs in the other eight samples. Magnesium is not a COPC.

Manganese was detected above the soil BV (671 mg/kg) in one sample at a concentration of 1070 mg/kg. The Gehan and quantile tests indicated site concentrations of manganese in soil are not statistically different from background (Figure G-50 and Table G-6). Manganese is not a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in one sample at a concentration of 7.88 mg/kg. Nickel is retained as a COPC.

Perchlorate was detected in two samples with a maximum concentration of 0.00164 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the Qbt 2,3,4 BV (0.3 mg/kg) but had DLs (1.08 mg/kg and 1.09 mg/kg) above the BV in two samples. Selenium is retained as a COPC.

Uranium was detected above the soil BV (1.82 mg/kg) in two samples with a maximum concentration of 3.13 mg/kg. The Gehan test indicated concentrations of uranium in soil are statistically different from background (Table G-6). However, the quantile and slippage tests indicated site concentrations of uranium in soil are not statistically different from background (Figure G-51 and Table G-6). Uranium is not a COPC.

Vanadium was detected above the Qbt 2,3,4 BV (17 mg/kg) in two samples with a maximum concentration of 21.5 mg/kg. Vanadium is retained as a COPC.

Organic Chemicals

Ten samples (8 soil and 2 tuff) were collected at AOC C-12-002 and analyzed for explosive compounds and PCBs.

No organic chemicals were detected at AOC C-12-002.

Radionuclides

Ten samples (8 soil and 2 tuff) were collected at AOC C-12-002 and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium.

Radionuclides were not detected or detected above BVs/FVs at AOC C-12-002.

6.8.4.4 Nature and Extent of Contamination

The nature and extent of inorganic COPCs at AOC C-12-002 is discussed below.

Inorganic Chemicals

Inorganic COPCs at AOC C-12-002 include aluminum, antimony, barium, calcium, chromium, cobalt, copper, nickel, perchlorate, selenium, and vanadium.

Aluminum was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 11,300 mg/kg. Concentrations increased with depth at locations 12-610631 and 12-610632 and increased downgradient at location 12-610632. The residential SSL was approximately 6.9 times the maximum concentration (the maximum concentration was 66,700 mg/kg below the residential SSL), and the industrial SSL was approximately 106 times the maximum concentration. Further sampling for extent of aluminum is not warranted.

Antimony was not detected above the soil and Qbt 2,3,4 BVs but had DLs (1.03 mg/kg to 1.11 mg/kg) above BVs in eight soil samples and two tuff samples. Because antimony was not detected above BVs and the residential SSL was approximately 28 times the maximum DL, further sampling for extent of antimony is not warranted.

Barium was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 275 mg/kg. Concentrations did not change substantially with depth (20 mg/kg) at location 12-610631 and decreased with depth at location 12-610632 (the concentrations in the shallow samples at locations 12-610631 and 12-610632 were 236 mg/kg and 255 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient at location 12-610631. The residential SSL was approximately 45 times the maximum concentration. The lateral extent of barium is defined, and further sampling for vertical extent is not warranted.

Calcium was detected above the Qbt 2,3,4 BV in one sample at a concentration of 2710 mg/kg. Concentrations increased with depth and decreased downgradient at location 12-610631. The NMED residential essential nutrient SSL was approximately 4800 times the maximum concentration. The lateral extent of calcium is defined, and further sampling for vertical extent is not warranted.

Chromium was detected above the soil and Qbt 2,3,4 BVs in one soil sample and two tuff samples with a maximum concentration of 23 mg/kg. Concentrations increased with depth at locations 12-610631 and 12-610633 and decreased with depth at location 12-610632 (the concentration in the shallow sample at location 12-610632 was 9.8 mg/kg and below the soil BV [Appendix E, Pivot Tables]). The concentration at location 12-610631 was below the maximum Qbt 2,3,4 background concentration (13 mg/kg). Concentrations decreased downgradient at location 12-610631. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 5100 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Cobalt was detected above the soil and Qbt 2,3,4 BVs in one soil sample and two tuff samples with a maximum concentration of 12.1 mg/kg. Concentrations increased with depth at location 12-610632, did not change substantially with depth (0.62 mg/kg) at location 12-610631 (the concentrations in the shallow samples at location 12-610631 were 4.66 mg/kg and 5.06 mg/kg and below the soil BV [Appendix E, Pivot Tables]), and decreased with depth at location 12-610633. Concentrations decreased downgradient at location 12-610631. The residential and industrial SSLs were approximately 1.9 times and 29 times the maximum concentration, respectively. The lateral extent of cobalt is defined, and further sampling for vertical extent is not warranted.

Copper was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 7.21 mg/kg. Concentrations did not change substantially with depth (0.1 mg/kg) at location 12-610632 and decreased with depth at location 12-610631 (the concentrations in the shallow samples at locations 12-610631 and 12-610632 were 8.7 mg/kg and 7.11 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient at location 12-610631. The residential SSL was approximately 430 times the maximum concentration. The lateral extent of copper is defined, and further sampling for vertical extent is not warranted.

Nickel was detected above the Qbt 2,3,4 BV in one sample at a concentration of 7.88 mg/kg. Concentrations increased with depth and decreased downgradient at location 12-610631. The residential SSL was approximately 200 times the maximum concentration. The lateral extent of nickel is defined, and further sampling for vertical extent is not warranted.

Perchlorate was detected in two samples with a maximum concentration of 0.00164 mg/kg. Concentrations increased with depth, were below EDLs, and decreased downgradient at location 12-610631. The residential SSL was approximately 33,000 times the maximum concentration. Further sampling for extent of perchlorate is not warranted.

Selenium was not detected above the Qbt 2,3,4 BV but had DLs (1.08 mg/kg and 1.09 mg/kg) above the BV in two samples. Because selenium was not detected above BVs and the residential SSL was approximately 359 times the maximum DL, further sampling for extent of selenium is not warranted.

Vanadium was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 21.5 mg/kg. Concentrations decreased with depth at locations 12-610631 and 12-610632 (the concentrations in the shallow samples at locations 12-610631 and 12-610632 were 26.9 mg/kg and 27.8 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient at location 12-610631. The lateral and vertical extent of vanadium are defined.

Organic Chemicals

There were no organic COPCs at AOC C-12-002.

Radionuclides

There were no radionuclide COPCs at AOC C-12-002.

6.8.5 Summary of Human Health Risk Screening

Industrial Scenario

No carcinogenic COPCs were identified for the industrial scenario. The HI is 0.04, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-12-002.

Residential Scenario

The total excess cancer risk for the residential scenario is 2×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.6, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-12-002. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and residential~~, and construction worker scenarios at AOC C-12-002.

6.8.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at AOC C-12-002.

6.9 AOC C-12-003—Potential Soil Contamination Associated with Former Building 12-3

6.9.1 Site Description and Operational History

AOC C-12-003 is an area of potential soil contamination associated with a former HE-storage magazine (building 12-3) at former TA-12 (Plate 6). The magazine, built in 1944 of wood-frame construction, was 6 ft long × 6 ft wide × 7 ft high, with a soil berm on three sides and on top. The building was located north of Redondo Road. Activities at former TA-12 ceased in the early 1950s, and building 12-3 was destroyed by intentional burning in 1960.

6.9.2 Relationship to Other SWMUs and AOCs

AOC C-12-003 is located approximately 600 ft west of the SWMU 12-001(a) firing pit (Plate 2) and is approximately 200 ft north of AOC C-12-001, 150 ft north of AOC C-12-002, and 130 ft north of AOC C-12-004 and on the other side of Redondo Road from these three AOCs.

6.9.3 Summary of Previous Investigations

A 1959 inspection reported that building 12-3 was contaminated with HE (Blackwell 1959, 005773).

No sampling was conducted at this AOC before 2009.

6.9.4 Site Contamination

6.9.4.1 Soil, Rock, and Sediment Sampling

Because no previous investigations had been conducted, characterization was required to assess potential contamination at AOC C-12-003. As a result, the following activities were completed as part of the 2009–2010 investigation.

- Ten samples were collected in 2009–2010 from five locations within the footprint and around former building 12-3. At each location, a sample was collected at the surface (0.0–0.5 ft bgs or 0.0–0.6 ft bgs) and from the subsurface (1.9–2.5 ft bgs to 2.5–3.0 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. In addition, four samples were analyzed for PCBs.

The 2009–2010 sampling locations at AOC C-12-003 are shown on Plate 6. Table 6.9-1 presents the samples collected and analyses requested for AOC C-12-003. The geodetic coordinates of sampling locations are presented in Table 3.2-1.

6.9.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

6.9.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at AOC C-12-003 consist of 10 samples (6 soil and 4 tuff) collected from 5 locations.

Inorganic Chemicals

Ten samples (6 soil and 4 tuff) were collected at AOC C-12-003 and analyzed for TAL metals, cyanide, total uranium, and perchlorate. Table 6.9-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Plate 7 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was detected above the soil BV (0.83 mg/kg) in one sample at a concentration of 2.74 mg/kg and had DLs (1.02 mg/kg to 2.61 mg/kg) above the soil and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) in five soil samples and four tuff samples. Antimony is retained as a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in three samples with a maximum concentration of 111 mg/kg. Barium is retained as a COPC.

Cadmium was not detected above the soil BV (0.4 mg/kg) but had DLs (0.523 mg/kg to 0.555 mg/kg) above BV in six samples. The DLs were only 0.123 mg/kg to 0.155 mg/kg above the BV, below the highest background DL (2 mg/kg), and below the three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg). Cadmium was not detected in the other four samples. Cadmium is not a COPC.

Chromium was detected above the soil and Qbt 2,3,4 BVs (19.3 mg/kg and 7.14 mg/kg) in two soil samples and two tuff samples with a maximum concentration of 104 mg/kg. Chromium is retained as a COPC.

Cobalt was detected above the Qbt 2,3,4 BV (3.14 mg/kg) in one sample at a concentration of 3.44 mg/kg. Cobalt is retained as a COPC.

Perchlorate was detected in one sample at a concentration of 0.0019 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the Qbt 2,3,4 BV (0.3 mg/kg) but had DLs (0.997 mg/kg to 1.1 mg/kg) above BV in four samples. Selenium is retained as a COPC.

Uranium was detected above the soil BV (1.82 mg/kg) in one sample at a concentration of 2.35 mg/kg. The concentration was only 0.53 mg/kg above the BV and was below the two highest soil background concentrations (2.4 mg/kg and 3.6 mg/kg). Uranium was detected below BVs in the other nine samples. Uranium is not a COPC.

Organic Chemicals

Ten samples (6 soil and 4 tuff) were collected at AOC C-12-003 and analyzed for explosive compounds. Three soil samples and one tuff sample were also analyzed for PCBs.

No organic chemicals were detected at AOC C-12-003.

Radionuclides

Ten samples (6 soil and 4 tuff) were collected at AOC C-12-003 and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium.

Radionuclides were not detected or detected above BVs/FVs at AOC C-12-003.

6.9.4.4 Nature and Extent of Contamination

The nature and extent of inorganic COPCs at AOC C-12-003 are discussed below.

Inorganic Chemicals

Inorganic COPCs at AOC C-12-003 include antimony, barium, chromium, cobalt, perchlorate, and selenium.

Antimony was detected above the soil BV in one sample at a concentration of 2.74 mg/kg and had DLs (1.02 mg/kg to 2.61 mg/kg) above the soil and Qbt 2,3,4 BVs in five soil samples and four tuff samples. Concentrations increased with depth at location 12-610634 and decreased downgradient. The residential SSL was approximately 11 times the detected concentration and 12 times the maximum DL. The industrial SSL was approximately 189 times the detected concentration and 199 times the maximum DL. The lateral extent of antimony is defined, and further sampling for vertical extent is not warranted.

Barium was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 111 mg/kg. Concentrations decreased with depth at locations 12-610635, 12-610636, and 12-610638 (the concentrations in the shallow samples at locations 12-610635, 12-610636, and 12-610638 were 106 mg/kg, 94.3 mg/kg, and 122 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations increased downgradient at location 12-610635. The residential SSL was approximately 140 times the maximum concentration. The vertical extent of barium is defined, and further sampling for lateral extent is not warranted.

Chromium was detected above the soil and Qbt 2,3,4 BVs in two soil samples and two tuff samples with a maximum concentration of 104 mg/kg. Concentrations increased with depth at locations 12-610637 and 12-610638 and decreased with depth at locations 12-610635 and 12-610636. Concentrations increased downgradient at location 12-610635. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 1100 times the maximum concentration. Further sampling for extent of chromium is not warranted.

Cobalt was detected above the Qbt 2,3,4 BV in one sample at a concentration of 3.44 mg/kg. Concentrations decreased with depth (the concentration in the shallow sample at location 12-610638 was 5.16 mg/kg and below the soil BV [Appendix E, Pivot Tables]) and decreased downgradient at location 12-610635. The lateral and vertical extent of cobalt are defined.

Perchlorate was detected in one sample at a concentration of 0.0019 mg/kg. Concentrations increased with depth and decreased downgradient at location 12-610635. The detected concentration was below the EDL, and the residential SSL was approximately 29,000 times the concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Selenium was not detected above the Qbt 2,3,4 BV but had DLs (0.997 mg/kg to 1.1 mg/kg) above BV in four samples. Because selenium was not detected above BVs and the residential SSL was approximately 355 times the maximum DL, further sampling for extent of selenium is not warranted.

Organic Chemicals

There were no organic COPCs at AOC C-12-003.

Radionuclides

There were no radionuclide COPCs at AOC C-12-003.

6.9.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 2×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.005, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-12-003.

Residential Scenario

The total excess cancer risk for the residential scenario is 5×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.3, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-12-003. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and residential,~~ and construction worker scenarios at AOC C-12-003.

6.9.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at AOC C-12-003.

6.10 AOC C-12-004—Potential Soil Contamination Associated with Former Building 12-5

6.10.1 Site Description and Operational History

AOC C-12-004 is an area of potential soil contamination at former TA-12 associated with former generator building 12-5 (Plate 6). The generator building was built of wood-frame construction of unknown dimensions. The building was originally located next to a former junction box (former structure 12-6). In 1952, the generator building was relocated 10 ft north of former control building 12-2. Activities at former TA-12 ceased in the early 1950s. Building 12-5 was destroyed by intentional burning in 1960 (LANL 1996, 054086, pp. 5-12–5-15).

6.10.2 Relationship to Other SWMUs and AOCs

AOC C-12-004 is located approximately 600 ft west of the SWMU 12-001(a) firing pit (Plate 2) and is approximately 130 ft northwest of AOC C-12-001 and 25 ft north of AOC C-12-002. AOC C-12-003 is approximately 130 ft to the north of AOC C-12-004, but is on the other side of Redondo Road.

6.10.3 Summary of Previous Investigations

A 1959 survey showed that building 12-5 was free of radioactive and HE contamination (Blackwell 1959, 005773).

In 1995, RFI activities were conducted at AOC C-12-004. One sample was collected from one location and analyzed for SVOCs (LANL 1996, 054086, p. 5-12).

Data from the sample collected during the 1995 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

6.10.4 Site Contamination

6.10.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at AOC C-12-004. As a result, the following activities were completed as part of the 2009–2010 investigation.

- Ten samples were collected in 2009–2010 from five locations within the footprint and around former building 12-5. At each location, a sample was collected at the surface (0.0–0.5 ft bgs or 0.0–0.75 ft bgs) and from the subsurface (1.75–2.7 ft bgs to 2.0–3.0 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. In addition, two samples were analyzed for PCBs.

The 2009–2010 sampling locations at AOC C-12-004 are shown on Plate 6. Table 6.10-1 presents the samples collected and analyses requested for AOC C-12-004. The geodetic coordinates of sampling locations are presented in Table 3.2-1.

6.10.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

6.10.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at AOC C-12-004 consist of 10 samples (7 soil and 3 tuff) collected from 5 locations.

Inorganic Chemicals

Ten samples (7 soil and 3 tuff) were collected at AOC C-12-004 and analyzed for TAL metals, cyanide, total uranium, and perchlorate. Table 6.10-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Plate 7 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 BV (7340 mg/kg) in three samples with a maximum concentration of 17,100 mg/kg. Aluminum is retained as a COPC.

Antimony was not detected above the soil and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) but had DLs (0.985 mg/kg to 1.21 mg/kg) above BVs in six soil samples and three tuff samples. Antimony is retained as a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in three samples with a maximum concentration of 171 mg/kg. Barium is retained as a COPC.

Cadmium was detected above the soil BV (0.4 mg/kg) in one sample at a concentration of 0.832 mg/kg and had DLs (0.505 mg/kg to 0.606 mg/kg) above the BV in six samples. The concentration was 0.432 mg/kg above the BV and below the two highest soil background concentrations (1.4 mg/kg and 2.6 mg/kg). The DLs were only 0.105 mg/kg to 0.206 mg/kg above the BV, below the highest background DL (2 mg/kg), and below the three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg). Cadmium was not detected or was detected below BVs in the other three samples (detected below BV in one sample). Cadmium is not a COPC.

Calcium was detected above the Qbt 2,3,4 BV (2200 mg/kg) in two samples with a maximum concentration of 3810 mg/kg. Calcium is retained as a COPC.

Chromium was detected above the soil and Qbt 2,3,4 BVs (19.3 mg/kg and 7.14 mg/kg) in one soil sample and three tuff samples with a maximum concentration of 33.5 mg/kg. Chromium is retained as a COPC.

Cobalt was detected above the Qbt 2,3,4 BV (3.14 mg/kg) in three samples with a maximum concentration of 6.49 mg/kg. Cobalt is retained as a COPC.

Copper was detected above the soil and Qbt 2,3,4 BVs (14.7 mg/kg and 4.66 mg/kg) in one soil sample and three tuff samples with a maximum concentration of 28.1 mg/kg. Copper is retained as a COPC.

Iron was detected above the Qbt 2,3,4 BV (14,500 mg/kg) in two samples with a maximum concentration of 15,100 mg/kg. The concentrations were 200 mg/kg and 600 mg/kg above the BV and the maximum concentration was 4400 mg/kg below the maximum Qbt 2,3,4 background concentration (19,500 mg/kg). Iron was detected below BVs in the other eight samples. Iron is not a COPC.

Lead was detected above the soil and Qbt 2,3,4 BVs (22.3 mg/kg and 11.2 mg/kg) in two soil samples and one tuff sample with a maximum concentration of 58.6 mg/kg. Lead is retained as a COPC.

Magnesium was detected above the Qbt 2,3,4 BV (1690 mg/kg) in three samples with a maximum concentration of 2500 mg/kg. The concentrations were 190 mg/kg, 630 mg/kg, and 810 mg/kg above the BV and below the highest two Qbt 2,3,4 background concentrations (2720 mg/kg and 2820 mg/kg). Magnesium was detected below BVs in the other seven samples. Magnesium is not a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in two samples with a maximum concentration of 8.43 mg/kg. Nickel is retained as a COPC.

Perchlorate was detected in three samples with a maximum concentration of 0.0012 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the Qbt 2,3,4 BV (0.3 mg/kg) but had DLs (1.07 mg/kg to 1.12 mg/kg) above BV in three samples. Selenium is retained as a COPC.

Silver was detected above the soil BV (1 mg/kg) in one sample at a concentration of 2.56 mg/kg. Silver is retained as a COPC.

Uranium was detected above the soil BV (1.82 mg/kg) in one sample at a concentration of 3.86 mg/kg and had DLs (1.91 mg/kg and 2.86 mg/kg) above BV in two samples. Uranium is retained as a COPC.

Vanadium was detected above the Qbt 2,3,4 BV (17 mg/kg) in three samples with a maximum concentration of 26.7 mg/kg. Vanadium is retained as a COPC.

Zinc was detected above the soil BV (48.8 mg/kg) in one sample at a concentration of 54.9 mg/kg. The concentration was only 6.1 mg/kg above BV and was below the four highest soil background concentrations (55 mg/kg, 57 mg/kg, 60 mg/kg, and 75.5 mg/kg). Zinc was detected below BV in the other nine samples. Zinc is not a COPC.

Organic Chemicals

Ten samples (7 soil and 3 tuff) were collected at AOC C-12-004 and analyzed for explosive compounds. Two soil samples were also analyzed for PCBs.

No organic chemicals were detected at AOC C-12-004.

Radionuclides

Ten samples (7 soil and 3 tuff) were collected at AOC C-12-004 and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium.

Radionuclides were not detected or detected above BVs/FVs at AOC C-12-004.

6.10.4.4 Nature and Extent of Contamination

The nature and extent of inorganic COPCs at AOC C-12-004 are discussed below.

Inorganic Chemicals

Inorganic COPCs at AOC C-12-004 include aluminum, antimony, barium, calcium, chromium, cobalt, copper, lead, nickel, perchlorate, selenium, silver, uranium, and vanadium.

Aluminum was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 17,100 mg/kg. Concentrations increased with depth at location 12-610573, did not change substantially with depth (800 mg/kg) at location 12-610571, and decreased with depth at location 12-610570 (the concentrations in the shallow samples at locations 12-610570 and 12-610571 were 18,500 mg/kg and 12,000 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient at location 12-610632 at AOC C-12-002 (Plate 7). The residential SSL was approximately 4.6 times the maximum concentration (the maximum concentration was 60,990 mg/kg below the residential SSL), and the industrial SSL was approximately 74 times the maximum concentration. Further sampling for extent of aluminum is not warranted.

Antimony was not detected above the soil and Qbt 2,3,4 BVs but had DLs (0.985 mg/kg to 1.21 mg/kg) above BVs in six soil samples and three tuff samples. Because antimony was not detected above BVs and the residential SSL was approximately 26 times the maximum DL, further sampling for extent of antimony is not warranted.

Barium was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 171 mg/kg. Concentrations increased with depth at location 12-610571 and decreased with depth at locations 12-610570 and 12-610573 (the concentrations in the shallow samples at locations 12-610570 and 12-610573 were 202 mg/kg and 279 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations did not change substantially (5 mg/kg) downgradient from location 12-610570 to location 12-610571, increased at location 12-610632, and decreased at location 12-610631 at AOC C-12-002 (Plate 7). The residential SSL was approximately 91 times the maximum concentration. The lateral extent of barium is defined, and further sampling for vertical extent is not warranted.

Calcium was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 3810 mg/kg. Concentrations increased with depth at location 12-610571 and decreased with depth at location 12-610573 (the concentration in the shallow sample at location 12-610573 was 2540 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations increased downgradient at location 12-610571 but decreased at location 12-610632 for AOC C-12-002 (Plate 7). The NMED residential essential nutrient SSL was approximately 3400 times the maximum concentration. The lateral extent of calcium is defined, and further sampling for vertical extent is not warranted.

Chromium was detected above soil and Qbt 2,3,4 BVs in one soil sample and three tuff samples with a maximum concentration of 33.5 mg/kg. Concentrations increased with depth at locations 12-610571 and 12-610573 and decreased with depth at location 12-610570. Concentrations at locations 12-610571 and 12-610573 were either similar to or below the maximum Qbt 2,3,4 background concentration (13 mg/kg). Concentrations decreased downgradient at location 12-610571. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 3500 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Cobalt was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 6.49 mg/kg. Concentrations increased with depth at location 12-610573 and did not change substantially with depth (0.31 mg/kg and 0.4 mg/kg) at locations 12-610570 and 12-610571 (the concentrations in the shallow samples at locations 12-610570 and 12-610571 were 5.07 mg/kg and 4.96 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations did not change substantially downgradient (0.82 mg/kg) to location 12-610571 or at locations 12-610632 and 12-610631 (overall 0.1 mg/kg) at AOC C-12-002 (Plate 7). The residential and industrial SSLs were approximately 3.5 times and 54 times the maximum concentration, respectively. Further sampling for extent of cobalt is not warranted.

Copper was detected above the soil and Qbt 2,3,4 BVs in one soil sample and three tuff samples with a maximum concentration of 28.1 mg/kg. Concentrations decreased with depth at locations 12-610569, 12-610570, 12-610571, and 12-610573 (the concentrations in the shallow samples at locations 12-610570, 12-610571, and 12-610573 were 10.4 mg/kg, 7.65 mg/kg, and 8.27 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient at location 12-610571. The lateral and vertical extent of copper are defined.

Lead was detected above the soil and Qbt 2,3,4 BVs in two soil samples and one tuff sample with a maximum concentration of 58.6 mg/kg. Concentrations decreased with depth at locations 12-610570 and 12-610572 (the concentration in the shallow sample at location 12-610570 was 13.9 mg/kg and below the soil BV [Appendix E, Pivot Tables]). The concentration at location 12-610570 was also below the maximum Qbt 2,3,4 background concentration (15.5 mg/kg). Concentrations decreased downgradient at location 12-610571. The lateral and vertical extent of lead are defined.

Nickel was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 8.43 mg/kg. Concentrations did not change substantially with depth (0.59 mg/kg and 0.86 mg/kg) at locations 12-610571 and 12-610573 (the concentrations in the shallow samples at locations 12-610571 and 12-610573 were 6.5 mg/kg and 9.29 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). The concentration at location 12-610571 was also similar to the maximum Qbt 2,3,4 background concentration (7 mg/kg). Concentrations increased downgradient at location 12-610571 and decreased further downgradient at location 12-610631 at AOC C-12-002 (Plate 7). The residential SSL was approximately 185 times the maximum concentration. The vertical extent of nickel is defined, and further sampling for lateral extent is not warranted.

Perchlorate was detected in three samples with a maximum concentration of 0.0012 mg/kg. Concentrations increased with depth at locations 12-610569, 12-610571, and 12-610572 and did not change substantially downgradient (0.0012 mg/kg). Concentrations were below EDLs, and the residential SSL was approximately 46,000 times the maximum concentration. Further sampling for extent of perchlorate is not warranted.

Selenium was not detected above the Qbt 2,3,4 BV but had DLs (1.07 mg/kg to 1.12 mg/kg) above BV in three samples. Because selenium was not detected above BVs and the residential SSL was approximately 350 times the maximum DL, further sampling for extent of selenium is not warranted.

Silver was detected above the soil BV in one sample at a concentration of 2.56 mg/kg. Concentrations decreased with depth and decreased downgradient at location 12-610571. The lateral and vertical extent of silver are defined.

Uranium was detected above the soil BV in one sample at a concentration of 3.86 mg/kg and had DLs (1.91 mg/kg and 2.86 mg/kg) above the BV in two samples. Concentrations decreased with depth and decreased downgradient at location 12-610571. The residential SSL was approximately 82 times the maximum DL. Further sampling for extent of uranium is not warranted.

Vanadium was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 26.7 mg/kg. Concentrations decreased with depth at locations 12-610570, 12-610571, and 12-610573 (the concentrations in the shallow samples at locations 12-610570, 12-610571, and 12-610573 were 28.1 mg/kg, 27.8 mg/kg, and 27.7 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient at location 12-610571. The lateral and vertical extent of vanadium are defined.

Organic Chemicals

There were no organic COPCs at AOC C-12-004.

Radionuclides

There were no radionuclide COPCs at AOC C-12-004.

6.10.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 7×10^{-7} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.1, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-12-004.

Residential Scenario

The total excess cancer risk for the residential scenario is 2×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.6, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-12-004. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and~~ residential, and construction worker scenarios at AOC C-12-004.

6.10.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at AOC C-12-004.

6.11 AOC C-12-005—Potential Soil Contamination Associated with Former Junction Box

6.11.1 Site Description and Operational History

AOC C-12-005 is the location of a former junction box (structure 12-6) at former TA-12 (Plate 2). The junction box was used to support experiments conducted at the firing pits, SWMUs 12-001(a) and 12-001(b). Constructed in 1945, the junction box was 3 ft long × 3 ft wide × 4 ft high and surrounded on three sides by a soil berm. The junction box served as a relay between former control building 12-2 and the two firing pits and housed diagnostic equipment, signal cables, and electrical power equipment. Approximately 750 ft of detonation wire connected the junction box to building 12-2. The junction box was not used after 1953 and was intentionally burned in place in 1960 (LANL 1994, 034755, p. 5-1-5).

6.11.2 Relationship to Other SWMUs and AOCs

AOC C-12-005 is a component of Consolidated Unit 12-001(a)-99, along with SWMUs 12-001(a), 12-001(b), and 12-002. AOC C-12-005 is located approximately 70 ft southwest of the SWMU 12-001(a) firing pit (Plate 2) and is on the south side of Redondo Road.

6.11.3 Summary of Previous Investigations

In 1995, RFI activities were performed at AOC C-12-005 (LANL 1996, 054086, p. 5-1–5-13). Two surface samples were collected from two locations and analyzed for total uranium (LANL 1996, 054086 p. 5-15).

Data from two samples collected during the 1995 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

6.11.4 Site Contamination

6.11.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at AOC C-12-005. As a result, the following activities were completed as part of the 2009–2010 investigation.

- Ten samples were collected in 2009–2010 from five locations adjacent to and around former structure 12-6. At each location, a sample was collected at the surface (0.0–0.4 ft bgs to 0.0–0.6 ft bgs) and from the subsurface (2.0–2.5 ft bgs to 2.0–3.6 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. In addition, two samples were analyzed for PCBs.

The 2009–2010 sampling locations at AOC C-12-005 are shown on Plate 2. Table 6.11-1 presents the samples collected and analyses requested for AOC C-12-005. The geodetic coordinates of sampling locations are presented in Table 3.2-1.

6.11.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

6.11.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at AOC C-12-005 consist of 10 soil samples collected from 5 locations.

Inorganic Chemicals

Ten soil samples were collected at AOC C-12-005 and analyzed for TAL metals, cyanide, total uranium, and perchlorate. Table 6.11-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Plate 3 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was detected above the soil BV (0.83 mg/kg) in one sample at a concentration of 3.89 mg/kg and had DLs (1.08 mg/kg to 1.32 mg/kg) above BV in nine samples. Antimony is retained as a COPC.

Cadmium was detected above the soil BV (0.4 mg/kg) in one sample at a concentration of 0.502 mg/kg and had DLs (0.546 mg/kg to 0.661 mg/kg) above BV in seven samples. The concentration was only 0.102 mg/kg above the BV; and the DLs were only 0.146 mg/kg to 0.261 mg/kg above the BV, below the highest background DL (2 mg/kg), and below the two highest soil background concentrations (1.4 mg/kg and 2.6 mg/kg). Cadmium was detected below BV in the other two samples. Cadmium is not a COPC.

Chromium was detected above the soil BV (19.3 mg/kg) in three samples with a maximum concentration of 196 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in soil are statistically different from background (Figure G-52 and Table G-7). Chromium is retained as a COPC.

Lead was detected above the soil BV (22.3 mg/kg) in one sample at a concentration of 48.2 mg/kg. The Gehan and quantile tests indicated site concentrations of lead in soil are not statistically different from background (Figure G-53 and Table G-7). Lead is not a COPC.

Perchlorate was detected in two samples with a maximum concentration of 0.00197 mg/kg. Perchlorate is retained as a COPC.

Uranium was detected above the soil BV (1.82 mg/kg) in two samples with a maximum concentration of 2.77 mg/kg. The Gehan and quantile tests indicated site concentrations of uranium in soil are statistically different from background (Figure G-54 and Table G-7). Uranium is retained as a COPC.

Organic Chemicals

Ten soil samples were collected at AOC C-12-005 and analyzed for explosive compounds. Two soil samples were also analyzed for PCBs.

No organic chemicals were detected at AOC C-12-005.

Radionuclides

Ten soil samples were collected at AOC C-12-005 and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium.

Radionuclides were not detected or detected above BVs/FVs at AOC C-12-005.

6.11.4.4 Nature and Extent of Soil and Rock Contamination

The nature and extent of inorganic COPCs at AOC C-12-005 are discussed below.

Inorganic Chemicals

Inorganic COPCs at AOC C-12-005 include antimony, chromium, perchlorate, and uranium.

Antimony was detected above the soil BV in one sample at a concentration of 3.89 mg/kg and had DLs (1.08 mg/kg to 1.32 mg/kg) above BV in nine samples. Concentrations decreased with depth and decreased downgradient. The residential and industrial SSLs were approximately 8 times and 130 times the detected concentration, respectively. The residential SSL was approximately 24 times the maximum DL. Further sampling for extent of antimony is not warranted.

Chromium was detected above the soil BV in three samples with a maximum concentration of 196 mg/kg. Concentrations decreased with depth at locations 12-610656, 12-610658, and 12-610659 and decreased downgradient. The lateral and vertical extent of chromium are defined.

Perchlorate was detected in two samples with a maximum concentration of 0.00197 mg/kg. Concentrations did not change substantially with depth (0.00073 mg/kg) and decreased downgradient. The residential SSL was approximately 27,400 times the maximum concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Uranium was detected above the soil BV in two samples with a maximum concentration of 2.77 mg/kg. Concentrations decreased with depth at locations 12-610658 and 12-610659 and decreased downgradient. The lateral and vertical extent of uranium are defined.

Organic Chemicals

There were no organic COPCs at AOC C-12-005.

Radionuclides

There were no radionuclide COPCs at AOC C-12-005.

6.11.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 4×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.008, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-12-005.

Recreational Scenario

The total excess cancer risk for the recreational scenario is 7×10^{-6} , which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The recreational HI is 0.02, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-12-005.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-5} , which is equivalent to the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.1, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-12-005. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, recreational, ~~and residential~~, and construction worker scenarios at AOC C-12-005.

6.11.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at AOC C-12-005.

7.0 TA-14 BACKGROUND AND FIELD INVESTIGATION RESULTS

7.1 Background of TA-14

7.1.1 Operational History

TA-14 was established during World War II and used by X Division to test explosives beginning in 1944 (LANL 1996, 054086, p. 1-1). This site was used primarily for close-observation work on small explosive charges. Tests were conducted in open and closed firing chambers (LANL 1996, 054086, p. 1-1). Some of these tests used radioactive materials (LANL 1994, 034755). In 1994, experimental HE was subjected to performance testing. TA-14 remains active with scheduled tests at the firing area and bullet test facility (LANL 1994, 034755, p. 1-11). In May 2000, the Cerro Grande fire moved through this area, and surface structures were damaged or destroyed, along with surface and overstory vegetation.

One AOC within the Threemile Canyon Aggregate Area is located at TA-14 and is addressed in this supplemental investigation report.

- AOC C-14-006 is an area of potential soil contamination associated with a former HE-storage magazine, former building 14-9.

7.1.2 Summary of Releases

Potential contaminants at TA-14 may have been released into the environment through operational releases associated with HE testing activities.

7.1.3 Current Site Usage and Status

TA-14 is actively used for HE testing operations and is expected to remain active for the foreseeable future. Only a small portion of TA-14 is located within Threemile Canyon Aggregate Area, and the one TA-14 site associated with the aggregate area is no longer active.

7.2 AOC C-14-006—Potential Soil Contamination Associated with Former Building 14-9

7.2.1 Site Description and Operational History

AOC C-14-006 is an area of potential soil contamination associated with an HE-storage magazine (former building 14-9) at TA-14 (Figure 7.2-1). The magazine, located 60 ft northwest of building 14-22, was constructed of wood and was 6 ft long × 6 ft wide × 6 ft high. A soil berm surrounded three sides, and soil covered the top of the structure. The magazine was built in 1945 and removed in 1952. The location of the former magazine is covered with several feet of loose fill (LANL 1996, 054086, pp. 5-61–5-64).

7.2.2 Relationship to Other SWMUs and AOCs

AOC C-14-006 is located approximately 60 ft north of SWMU 14-004(a), 60 ft west of AOC C-14-003, and 120 ft west of AOC C-14-005 (Figure 7.2-1). AOC C-14-006 is, however, located on the opposite side of Q-Site Road from these others sites and runoff from these sites would not impact AOC C-14-006.

7.2.3 Summary of Previous Investigations

No sampling was conducted at this AOC before 2009.

7.2.4 Site Contamination

7.2.4.1 Soil, Rock, and Sediment Sampling

Because no previous investigations had been conducted, characterization was required to assess potential contamination at AOC C-14-006. As a result, the following activities were completed as part of the 2009–2010 investigation.

- Ten samples were collected in 2009–2010 from five locations within the footprint and around former building 14-9. At each location, a sample was collected at the surface (0.0–0.3 ft bgs to 0.0–0.8 ft bgs) and from the subsurface (2.0–3.1 ft bgs to 2.0–4.5 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, nitrate, total uranium, perchlorate, explosive compounds, SVOCs, VOCs, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. In addition, two samples were analyzed for PCBs.

The 2009–2010 sampling locations at AOC C-14-006 are shown on Figure 7.2-1. Table 7.2-1 presents the samples collected and analyses requested for AOC C-14-006. The geodetic coordinates of sampling locations are presented in Table 3.2-1.

7.2.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

7.2.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at AOC C-14-006 consist of 10 soil samples collected from 5 locations.

Inorganic Chemicals

Ten soil samples were collected at AOC C-14-006 and analyzed for TAL metals, cyanide, nitrate, total uranium, and perchlorate. Table 7.2-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Figure 7.2-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was detected above the soil BV (0.83 mg/kg) in four samples with a maximum concentration of 1.1 mg/kg and had DLs above BV (1.17 mg/kg and 1.27 mg/kg) in two samples. The quantile and slippage tests indicated site concentrations of antimony in soil are statistically different from background (Figure G-55 and Table G-8). Antimony is retained as a COPC.

Cadmium was not detected above the soil BV (0.4 mg/kg) but had DLs (0.543 mg/kg to 0.662 mg/kg) above BV in 10 samples. The DLs were only 0.143 mg/kg to 0.262 mg/kg above the BV, below the highest background DL (2 mg/kg), and below the two highest soil background concentrations (1.4 mg/kg and 2.6 mg/kg). Cadmium is not a COPC.

Chromium was detected above the soil BV (19.3 mg/kg) in one sample at a concentration of 20.7 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in soil are statistically different from background (Figure G-56 and Table G-8). Chromium is retained as a COPC.

Nitrate was detected in seven samples with a maximum concentration of 1.82 mg/kg. Although Nitrate is naturally occurring, the AOC is a former HE storage site and HE stored at the site could be a source of nitrate. and As a result, the concentrations detected might be site related rather than reflecting only naturally occurring levels of nitrate. Nitrate is retained as not a COPC.

Perchlorate was detected in four samples with a maximum concentration of 0.00188 mg/kg. Perchlorate is retained as a COPC.

Uranium was detected above the soil BV (1.82 mg/kg) in one sample at a concentration of 1.94 mg/kg. The quantile and slippage tests indicated site concentrations of uranium in soil are not statistically different from background (Figure G-57 and Table G-8). Uranium is not a COPC.

Organic Chemicals

Ten soil samples were collected at AOC C-14-006 and analyzed for explosive compounds, SVOCs, and VOCs. Two soil samples were also analyzed for PCBs. Table 7.2-3 summarizes the analytical results for detected organic chemicals. Figure 7.2-3 shows the spatial distribution of detected organic chemicals.

Organic chemicals detected at AOC C-14-006 include acetone, 4-isopropyltoluene, TATB, and toluene. The detected organic chemicals are retained as COPCs.

Radionuclides

Ten soil samples were collected and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium.

Radionuclides were not detected or detected above BVs/FVs at AOC C-14-006.

7.2.4.4 Nature and Extent of Contamination

The nature and extent of inorganic and organic COPCs at AOC C-14-006 are discussed below.

Inorganic Chemicals

Inorganic COPCs at AOC C-14-006 include antimony, chromium, nitrate, and perchlorate.

Antimony was detected above the soil BV in four samples with a maximum concentration of 1.1 mg/kg and had DLs above BV (1.17 mg/kg and 1.27 mg/kg) in two samples. Concentrations increased with depth at location 14-610661, but the concentration was below the maximum soil background concentration (1 mg/kg). Concentrations decreased with depth at locations 14-610662 and 14-610663. Concentrations increased downgradient at location 14-610663. The residential SSL was approximately 28 times the maximum concentration and 25 times the maximum DL. Further sampling for extent of antimony is not warranted.

Chromium was detected above the soil BV in one sample at a concentration of 20.7 mg/kg. Concentrations decreased with depth and increased downgradient at location 14-610664. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 5600 times the maximum concentration. The vertical extent of chromium is defined, and further sampling for lateral extent is not warranted.

Nitrate was detected in seven samples with a maximum concentration of 1.82 mg/kg. Concentrations increased with depth at locations 14-610662, 14-610664, and 14-610665 and did not change substantially with depth (0.19 mg/kg and 0.26 mg/kg) at locations 14-610661 and 14-610663. Concentrations did not change substantially (0.52 mg/kg) downgradient. The residential SSL was approximately 69,000 times the maximum concentration. Further sampling for extent of nitrate is not warranted.

Perchlorate was detected in four samples with a maximum concentration of 0.00188 mg/kg. Concentrations increased with depth at locations 14-610661, 14-610662, and 14-610664 and decreased with depth at location 14-610663. Concentrations did not change substantially (0.00063 mg/kg) downgradient. All concentrations were below EDLs, and the residential SSL was approximately 29,000 times the maximum concentration. Further sampling for extent of perchlorate is not warranted.

Organic Chemicals

Organic COPCs at AOC C-14-006 include acetone, 4-isopropyltoluene, TATB, and toluene.

Acetone was detected in two samples with a maximum concentration of 0.00973 mg/kg. Concentrations decreased with depth at locations 14-610663 and 14-610665 and increased downgradient. The residential SSL was approximately 6,800,000 times the maximum concentration. The vertical extent of acetone is defined, and further sampling for lateral extent is not warranted.

Isopropyltoluene[4-] was detected in two samples with a maximum concentration of 0.00229 mg/kg. Concentrations decreased with depth at locations 14-610663 and 14-610665 and decreased downgradient. The lateral and vertical extent of 4-isopropyltoluene are defined.

TATB was detected in five samples with a maximum concentration of 11.3 mg/kg. Concentrations decreased with depth at all locations and increased downgradient. The residential SSL was approximately 195 times the maximum concentration. The vertical extent of TATB is defined, and further sampling for lateral extent is not warranted.

Toluene was detected in two samples with a maximum concentration of 0.000887 mg/kg. Concentrations decreased with depth at locations 14-610663 and 14-610665 and did not change substantially downgradient (0.000217 mg/kg). The residential SSL was approximately 5,900,000 times the maximum concentration. The vertical extent of toluene is defined, and further sampling for lateral extent is not warranted.

Radionuclides

There were no radionuclide COPCs at AOC C-14-006.

7.2.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 4×10^{-7} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.002, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-14-006.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.03, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified at AOC C-14-006. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and~~ residential, and construction worker scenarios at AOC C-14-006.

7.2.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at AOC C-14-006.

8.0 TA-15 BACKGROUND AND FIELD INVESTIGATION RESULTS

8.1 Background of TA-15

8.1.1 Operational History

TA-15 was established in 1945 as a firing site area. Current activities at TA-15 consist of HE research, development, and testing, mainly through hydrodynamic testing and dynamic experimentation. Many large explosive tests have taken place with the concurrent scattering of large amounts of natural uranium or depleted uranium (DU) and, to a lesser extent, beryllium and lead (LANL 1994, 040595).

Seven SWMUs and three AOCs within the Threemile Canyon Aggregate Area are located at TA-15 (Figure 8.1-1) and are addressed in this supplemental investigation report.

- AOC 15-005(c) is an outdoor container storage area located near storage building 15-41.
- SWMU 15-007(c) [part of Consolidated Unit 15-007(c)-00] is the location of a shaft (structure 15-264) that was used to conduct a single test involving approximately 2 tons of HE.
- SWMU 15-007(d) [also part of Consolidated Unit 15-007(c)-00] is the location of a shaft (structure 15-265) used to conduct a single test involving beryllium, HE, and tritium.
- SWMU 15-008(b) [part of Consolidated Unit 15-006(c)-99] is a surface disposal area located north of Firing Site R-44 [SWMU 15-006(c)] and extending along the edge of the mesa and downslope into Threemile Canyon.
- AOC 15-008(g) [part of Consolidated Unit 15-006(d)-99] is the location of a former pile of broken sandbags located at Firing Site R-45 [SWMU 15-006(d)].
- SWMU 15-009(b) is a septic system located at Firing Site R-45 that consists of a tank (structure 15-61), a seepage pit, associated drainlines, and a former outfall.
- SWMU 15-009(c) is a septic system located at Firing Site R-44 that consists of a tank (structure 15-62), associated drainlines, and an outfall.
- SWMU 15-009(h) is a septic system located near the Ector firing site [SWMU 15-006(b)] that consists of a tank (structure 15-282), associated drainlines, and a drain field.
- SWMU 15-010(b) is a settling tank (structure 15-147) located near shop building 15-8.
- AOC 15-014(h) consists of three outfalls that served a laboratory and an office (building 15-40).

Figure 8.1-1 shows the site features of the SWMUs and AOCs at TA-15.

8.1.2 Summary of Releases

Potential contaminants at TA-15 may have been released into the environment through operational releases at the surface and subsurface firing sites and associated facilities, which include a storage area, surface disposal areas, septic systems, tanks, and outfalls.

8.1.3 Current Site Usage and Status

TA-15 is actively used for HE testing operations and is expected to remain active for the foreseeable future. Although the TA-15 firing sites addressed in this supplemental investigation report are no longer active, other firing sites within TA-15 are active and investigation is deferred per Table IV-2 of the Consent Order.

8.2 AOC 15-005(c)—Container Storage Area (R-41)

8.2.1 Site Description and Operational History

AOC 15-005(c) is the location of a former container storage area at building 15-41 (R-41), located at TA-15 near Firing Site C (Figures 8.1-1 and 8.2-1). The area was used to store containers of scrap HE and chem-wipes contaminated with acetone, ethanol, and mineral oil. The ground surface on the northern, western, and eastern sides of building 15-41 is unpaved, and an asphalt road (Priscilla Road) runs along the south side of the building. The date the storage area began to be used is not known; however, it was deactivated in April 1996.

8.2.2 Relationship to Other SWMUs and AOCs

AOC 15-005(c) is located to the west and upgradient of all other SWMUs and AOCs addressed in this supplemental investigation report, except for SWMU 15-010(b) and AOC 15-014(h), which are more than 1500 ft to the northwest.

8.2.3 Summary of Previous Investigations

RFI activities were performed at AOC 15-005(c) in 1995 and reported in November 1995 (LANL 1995, 050294). Four samples were collected from two locations and analyzed for inorganic chemicals.

Data from four samples collected during the 1995 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

8.2.4 Site Contamination

8.2.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at AOC 15-005(c). As a result, the following activities were completed as part of the 2009–2010 investigation.

- A total of 20 samples were collected in 2009–2010 from 10 locations adjacent to and around the former storage area near building 15-41 and in the drainage below the site. At each location, samples were collected at the surface (0.0–0.5 ft bgs or 0.0–0.7 ft bgs) and from the subsurface (1.0–2.0 ft bgs to 2.0–4.0 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, SVOCs, VOCs, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. Ten samples were also analyzed for PCBs.

The 2009–2010 sampling locations at AOC 15-005(c) are shown on Figure 8.2-1. Table 8.2-1 presents the samples collected and analyses requested for AOC 15-005(c). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

8.2.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

8.2.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at AOC 15-005(c) consist of 20 samples (14 soil and 6 sediment) collected from 10 locations.

Inorganic Chemicals

A total of 20 samples (14 soil and 6 sediment) were collected at AOC 15-005(c) and analyzed for TAL metals, cyanide, total uranium, and perchlorate. Table 8.2-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Figure 8.2-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was detected above the soil BV (0.83 mg/kg) in four samples with a maximum concentration of 1.22 mg/kg and had DLs (1.08 mg/kg to 1.41 mg/kg) above the soil and sediment BVs (0.83 mg/kg) in five soil samples and six sediment samples. The quantile test indicated site concentrations of antimony in soil are statistically different from background concentrations (Figure G-58 and Table G-9). Antimony is retained as a COPC.

Barium was detected above the sediment BV (127 mg/kg) in six samples with a maximum concentration of 214 mg/kg. Barium is retained as a COPC.

Cadmium was not detected above the soil and sediment BVs (0.4 mg/kg for both) but had DLs (0.536 mg/kg to 0.767 mg/kg) above BVs in 14 soil samples and 6 sediment samples. The DLs were only 0.136 mg/kg to 0.367 mg/kg above the BVs, below the highest background DL (2 mg/kg), and below the two or three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg). Cadmium was not detected in any samples. Cadmium is not a COPC.

Chromium was detected above the sediment BV (10.5 mg/kg) in three samples with a maximum concentration of 12.1 mg/kg. Chromium is retained as a COPC.

Cobalt was detected above the soil and sediment BVs (8.64 mg/kg and 4.73 mg/kg) in one soil sample and five sediment samples with a maximum concentration of 9.87 mg/kg. The Gehan and quantile tests indicated site concentrations of cobalt in soil are not statistically different from background (Figure G-59 and Table G-9). The five concentrations in sediment are above the highest sediment background concentration (4.2 mg/kg). Cobalt is retained as a COPC.

Copper was detected above the sediment BV (11.2 mg/kg) in three samples with a maximum concentration of 30.6 mg/kg. Copper is retained as a COPC.

Iron was detected above the sediment BV (13,800 mg/kg) in two samples with a maximum concentration of 14,800 mg/kg. Iron is retained as a COPC.

Lead was detected above the soil BV (22.3 mg/kg) in two samples with a maximum concentration of 69.6 mg/kg. The Gehan and slippage tests indicated site concentrations of lead in soil are statistically different from background (Figure G-60 and Table G-9). Lead is retained as a COPC.

Manganese was detected above the soil BV (671 mg/kg) in one sample at a concentration of 693 mg/kg. The Gehan and quantile tests indicated site concentrations of manganese in soil are not statistically different from background (Figure G-61 and Table G-9). Manganese is not a COPC.

Perchlorate was detected in four samples with a maximum concentration of 0.00149 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the sediment BV (0.3 mg/kg) but had DLs (1.16 mg/kg to 1.28 mg/kg) above BV in six samples. Selenium is retained as a COPC.

Uranium was detected above the soil and sediment BVs (1.82 mg/kg and 2.22 mg/kg) in eight soil samples and three sediment samples with a maximum concentration of 17.4 mg/kg. The Gehan and quantile tests indicated site concentrations of uranium in soil are statistically different from background (Figure G-62 and Table G-9). Uranium is retained as a COPC.

Vanadium was detected above the sediment BV (19.7 mg/kg) in six samples with a maximum concentration of 31.8 mg/kg. Vanadium is retained as a COPC.

Organic Chemicals

A total of 20 samples (14 soil and 6 sediment) were collected at AOC 15-005(c) and analyzed for explosive compounds, SVOCs, and VOCs. Ten samples (four soil and six sediment) were also analyzed for PCBs. Table 8.2-3 summarizes the analytical results for detected organic chemicals. Figure 8.2-3 shows the spatial distribution of detected organic chemicals.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons are a class of SVOCs frequently detected as a result of environmental sampling but generally were not released from the SWMUs or AOCs being investigated. PAHs unrelated to site activities are thus often detected in samples analyzed for the presence of site-related SVOCs.

PAHs are known to be widely distributed in the environment from a number of sources, both natural, such as forest fires, and anthropogenic, such as combustion of fossil fuels, oil drips off motor vehicles, vehicle tires, coal tar pitch, and weathering or eroding of asphalt pavement (Kose et al. 2008, 219977; Teaf 2008, 219976). PAHs from these sources generally occur as complex mixtures, not as single compounds. Individual PAH compounds can be manufactured for research purposes, and some PAHs (e.g., anthracene, fluorene, naphthalene, and pyrene) are used in dye production, the manufacture of synthetic fibers, and in plastics and pesticides.

The principal sources of PAHs in soil along parking lots, roads, and highways are vehicular exhaust and emissions, the wearing of tires, and asphalt. PAH-containing materials, such as asphalt and rubber particles, do not easily dissolve in water, preventing migration, except as suspended particles in storm water. PAH concentrations in excess of soil cleanup levels may result from common anthropogenic sources, such as runoff from asphalt parking lots.

Site Activities

AOC 15-005(c) was identified as an AOC because of possible soil contamination resulting from releases of the explosives stored at the site. PAHs were not present in the materials stored at this site.

AOC 15-005(c) is located adjacent to a paved parking/storage area and paved road (Priscilla Road) (Appendix I, Figures I-2 and I-3). The asphalt is weathered, and the AOC receives runoff from the weathered asphalt. PAHs were detected in samples from location 15-610562, which is adjacent to a creosote-treated power pole (Appendix I, Figure I-4), which is another source of PAHs. Because (1) the PAHs were not present in the explosives stored at this AOC, (2) the area receives runoff from weathered asphalt, and (3) one sample location is next to a creosote-treated power pole, the concentrations of PAHs detected in samples used to characterize this site [benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(b)fluoranthene, chrysene, fluoranthene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene] are not related to historic Laboratory site operations and are not COPCs.

Organic COPCs

Other organic chemicals detected at AOC 15-005(c) include acetone; bis(2-ethylhexyl)phthalate; ethylbenzene; 4-isopropyltoluene; toluene; and 1,3-xylene+1,4-xylene. The detected organic chemicals listed are retained as COPCs.

Radionuclides

A total of 20 samples (14 soil and 6 sediment) were collected at AOC 15-005(c) and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. Table 8.2-4 summarizes radionuclides detected or detected above BVs/FVs. Figure 8.2-4 shows the spatial distribution of detected radionuclides.

Uranium-234 was detected above soil and sediment BVs (2.59 pCi/g for both) in five soil samples and two sediment samples with a maximum activity of 7.59 pCi/g. Uranium-234 is retained as a COPC.

Uranium-235/236 was detected above soil and sediment BVs (0.2 pCi/g for both) in four soil samples and one sediment sample with a maximum activity of 0.405 pCi/g. Uranium-235/236 is retained as a COPC.

Uranium-238 was detected above soil and sediment BVs (2.29 pCi/g for both) in seven soil samples and three sediment samples with a maximum activity of 7.77 pCi/g. Uranium-238 is retained as a COPC.

8.2.2.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at AOC 15-005(c) are discussed below.

Inorganic Chemicals

Inorganic COPCs at AOC 15-005(c) include antimony, barium, chromium, cobalt, copper, iron, lead, perchlorate, selenium, uranium, and vanadium.

Antimony was detected above the soil BV in four samples with a maximum concentration of 1.22 mg/kg and had DLs (1.08 mg/kg to 1.41 mg/kg) above the soil and sediment BVs in five soil samples and six sediment samples. Concentrations did not change substantially with depth at locations 15-610562 and 15-610564 (0.72 mg/kg and 0.01 mg/kg) and decreased with depth at location 15-610563. Concentrations decreased downgradient. The residential SSL was approximately 26 times the maximum concentration and 22 times the maximum DL. The lateral extent of antimony is defined, and further sampling for vertical extent is not warranted.

Barium was detected above the sediment BV in six samples with a maximum concentration of 214 mg/kg. Concentrations did not change substantially with depth at locations 15-610555, 15-610556, and 15-610557 (12 mg/kg, 18 mg/kg, and 7 mg/kg). Concentrations did not change in surface samples and decreased in subsurface samples downgradient from location 15-610556 to location 15-610555. The residential SSL was approximately 73 times the maximum concentration. The lateral extent of barium is defined, and further sampling for vertical extent is not warranted.

Chromium was detected above the sediment BV in three samples with a maximum concentration of 12.1 mg/kg. Concentrations did not change substantially with depth at location 15-610556 (0.9 mg/kg) (the concentration in the shallow sample at location 15-610556 was 9.8 mg/kg and below the soil BV [Appendix E, Pivot Tables]) and decreased with depth at location 15-610555. Concentrations increased in the surface samples downgradient from location 15-610556 to location 15-610555. As discussed in

section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 9770 times the maximum concentration. Further sampling for extent of chromium is not warranted.

Cobalt was detected above the soil and sediment BVs in one soil sample and five sediment samples with a maximum concentration of 9.87 mg/kg. Concentrations did not change substantially at locations 15-610555 and 15-610556 (0.43 mg/kg and 0.51 mg/kg) and decreased with depth at locations 15-610557 and 15-610561. Concentrations decreased downgradient. The lateral and vertical extent of cobalt are defined.

Copper was detected above the sediment BV in three samples with a maximum concentration of 30.6 mg/kg. Concentrations decreased with depth at locations 15-610555 and 15-610556 and increased downgradient from location 15-610556 to location 15-610555. The residential SSL was approximately 103 times the maximum concentration. The vertical extent of copper is defined, and further sampling for lateral extent is not warranted.

Iron was detected above the sediment BV in two samples with a maximum concentration of 14,800 mg/kg. Concentrations increased with depth at location 15-610556 and decreased with depth at location 15-610555 and did not change substantially (600 mg/kg) downgradient from location 15-610556 to location 15-610555. The residential SSL was approximately 3.7 times the maximum concentration (the maximum concentration was 40,000 mg/kg below the residential SSL), and the industrial SSL was approximately 61 times the maximum concentration. The lateral extent of iron is defined, and further sampling for vertical extent is not warranted.

Lead was detected above the soil BV in two samples with a maximum concentration of 69.6 mg/kg. Concentrations decreased with depth at locations 15-610559 and 15-610564 and decreased downgradient. The lateral and vertical extent of lead are defined.

Perchlorate was detected in four samples with a maximum concentration of 0.00149 mg/kg. Concentrations increased with depth at locations 15-610559 and 15-610561 but were below the EDLs. Concentrations decreased with depth at location 15-610564 and decreased downgradient. The residential SSL was approximately 37,000 times the maximum concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Selenium was not detected above the sediment BV but had DLs (1.16 mg/kg to 1.28 mg/kg) above BV in six samples. Because selenium was not detected above BVs in any samples and the residential SSL was approximately 305 times the maximum DL, further sampling for extent of selenium is not warranted.

Uranium was detected above the soil and sediment BVs in eight soil samples and three sediment samples with a maximum concentration of 17.4 mg/kg. Concentrations decreased with depth at all locations and decreased downgradient. The lateral and vertical extent of uranium are defined.

Vanadium was detected above the sediment BV in six samples with a maximum concentration of 31.8 mg/kg. Concentrations did not change substantially with depth at location 15-610556 (1.6 mg/kg) and decreased with depth at locations 15-610555 and 15-610557. Concentrations increased slightly (5 mg/kg) downgradient from location 15-610556 to location 15-610555. The residential and industrial SSLs were approximately 12 times and 206 times the maximum concentration, respectively. Further sampling for extent of vanadium is not warranted.

Organic Chemicals

Organic COPCs at AOC 15-005(c) include acetone; bis(2-ethylhexyl)phthalate; ethylbenzene; 4-isopropyltoluene; toluene; and 1,3-xylene+1,4-xylene.

Acetone was detected in two samples with a maximum concentration of 0.0188 mg/kg. Concentrations decreased with depth at both locations and decreased downgradient. The lateral and vertical extent of acetone are defined.

Bis(2-ethylhexyl)phthalate was detected in one sample at a concentration of 0.0995 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of bis(2-ethylhexyl)phthalate are defined.

Ethylbenzene was detected in two samples with a maximum concentration of 0.00063 mg/kg. Concentrations decreased with depth at location 15-610558, and the concentration was below the EQL at location 15-610556. The residential SSL was approximately 120,000 times the maximum concentration. Concentrations decreased downgradient. The lateral extent of ethylbenzene is defined, and further sampling for vertical extent is not warranted.

Isopropyltoluene[4-] was detected in two samples with a maximum concentration of 0.00151 mg/kg. Concentrations decreased with depth at both locations and decreased downgradient. The lateral and vertical extent of 4-isopropyltoluene are defined.

Toluene was detected in two samples with a maximum concentration of 0.000754 mg/kg. Concentrations decreased with depth at both locations and decreased downgradient. The lateral and vertical extent of toluene are defined.

Xylene[1,3-]+1,4-xylene was detected in five samples with a maximum concentration of 0.000984 mg/kg. The concentration did not change substantially with depth at location 15-610556 (0.000082 mg/kg) and was below the EQL. Concentrations decreased with depth at the other locations and decreased downgradient. The residential SSL was approximately 885,000 times the maximum concentration. The lateral extent of 1,3-xylene+1,4-xylene is defined, and further sampling for vertical extent is not warranted.

Radionuclides

Radionuclide COPCs at AOC 15-005(c) include uranium-234, uranium-235/236, and uranium-238.

Uranium-234 was detected above soil and sediment BVs in five soil samples and two sediment samples with a maximum activity of 7.59 pCi/g. Activities decreased with depth at all locations and decreased downgradient. The lateral and vertical extent of uranium-234 are defined.

Uranium-235/236 was detected above soil and sediment BVs in four soil samples and one sediment sample with a maximum activity of 0.405 pCi/g. Activities decreased with depth at all locations and decreased downgradient. The lateral and vertical extent of uranium-235/236 are defined.

Uranium-238 was detected above soil and sediment BVs in seven soil samples and three sediment samples with a maximum activity of 7.77 pCi/g. Activities decreased with depth at all locations and decreased downgradient. The lateral and vertical extent of uranium-238 are defined.

8.2.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 2×10^{-7} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.1, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.3 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.8, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 1 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and~~ residential, and construction worker scenarios at AOC 15-005(c).

8.2.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at AOC 15-005(c).

8.3 SWMU 15-007(c)—Shaft

8.3.1 Site Description and Operational History

SWMU 15-007(c) is an underground shaft (structure 15-264) located at TA-15 approximately 300 ft east of building 15-263 and 100 ft north of underground shaft 15-265 [SWMU 15-007(d)] (Plate 9). The shaft, 6 ft in diameter by 120 ft deep, is situated within a 20- × 20-ft concrete pad and covered with a wooden lid. In 1972, the shaft was used to conduct a single underground test involving approximately 2 tons of HE, the only material used in the test (LANL 1993, 020946, p. 5-9). This test was designed to determine the ability of tuff to absorb the explosion. The explosion was confined to the bottom of the shaft by filling the shaft with layers of magnetite, cement, sand grout, bentonite, sand, and gravel. Before 2010, 0.25-in.-diameter lead shot was scattered on the surface of the concrete pad and on the soil on three sides of the pad. The source of the lead shot was probably bags of lead shot used for instrument shielding during the experiment (LANL 1997, 056562, p. 1).

The lead shot was removed from the concrete pad and from the surface of the surrounding soil during the 2009–2010 investigation.

8.3.2 Relationship to Other SWMUs and AOCs

SWMU 15-007(c) is a component of Consolidated Unit 15-007(c)-00, along with SWMU 15-007(d). SWMU 15-007(c) is located adjacent to SWMU 15-007(d), which is another underground test shaft, and these sites are approximately 300 ft east and downgradient of the R-45 firing site (Figure 8.1-1).

8.3.3 Summary of Previous Investigations

No sampling was conducted at this SWMU before 2009.

8.3.4 Site Contamination

8.3.4.1 Soil, Rock, and Sediment Sampling

Because no previous investigations had been conducted, characterization was required to assess potential contamination at SWMU 15-007(c). As a result, the following activities were completed as part of the 2009–2010 investigation.

- A total of 44 samples were collected in 2009–2010 from 22 locations around the shaft. At each location, a sample was collected at the surface (0.0–0.5 ft bgs) and from the subsurface (1.0–1.5 ft bgs to 1.0–2.1 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, perchlorate, and explosive compounds. In addition, six samples were analyzed for PCBs.
- Thirty-nine samples were collected in 2009–2010 from three boreholes around the area where the shallower samples were collected. At each location, 13 samples were collected from the depth interval 3.5 ft bgs to 182.5 ft bgs. All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, perchlorate, explosive compounds, and tritium. In addition, 27 samples were analyzed for PCBs.
- All investigation samples were field-screened for gross-alpha and -beta radioactivity. Field-screening results were recorded on borehole logs and/or corresponding SCLs. Borehole logs are presented in Appendix C, and SCLs/COC forms are included in Appendix E.

The 2009–2010 sampling locations at SWMU 15-007(c) are shown on Plate 9. Table 8.3-1 presents the samples collected and analyses requested for SWMU 15-007(c). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

8.3.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

8.3.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 15-007(c) consist of 83 samples (37 soil and 46 tuff) collected from 25 locations.

Inorganic Chemicals

A total of 83 samples (37 soil and 46 tuff) were collected at SWMU 15-007(c) and analyzed for TAL metals, cyanide, and perchlorate. Table 8.3-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Plate 10 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 and Qbt 1g, Qct, Qbo BVs (7340 mg/kg and 3560 mg/kg) in ~~five~~^{six} Qbt 3 samples and two Qbt 1g samples with a maximum concentration of 20,800 mg/kg. The Gehan and quantile tests indicated site concentrations of aluminum in Qbt 2,3,4 are not statistically different from background (Figure G-63 and Table G-10). There were too few Qbt 1g samples to perform statistical comparisons. The Qbt 1g samples were all collected from the three deep boreholes at locations 15-610816, 15-610817, and 15-610818. Aluminum concentrations in deep borehole samples were similar for the upper tuff (Qbt 2,3,4) and lower tuff (Qbt 1g, Qct, Qbo) units. Concentrations in Qbt 3 and Qbt 2 samples ranged from 256 mg/kg to 6720 mg/kg for 33 samples collected over the interval 3.5 ft bgs to 157.5 ft bgs. Concentrations in Qbt 1g samples ranged from 714 mg/kg to 4670 mg/kg for six samples collected over the interval 169 ft bgs to 182.5 ft bgs. Aluminum was detected above BV only in 2 of 39 deep borehole samples. Because (1) concentrations are similar in the upper and lower tuff units, (2) the concentrations in the upper tuff units are not statistically different from background, and (3) there was a low frequency of detection above BV in deep borehole samples, aluminum is not a COPC.

Antimony was detected above the soil BV (0.83 mg/kg) in two samples with a maximum concentration of 243 mg/kg and had DLs (0.898 mg/kg to 5.13 mg/kg) above the soil, Qbt 2,3,4, and Qbt 1g, Qct, Qbo BVs (0.83 mg/kg, 0.5 mg/kg, and 0.5 mg/kg) in 30 soil samples, 38 Qbt 2 and Qbt 3 samples, and 6 Qbt 1g samples. Antimony is retained as a COPC.

Arsenic was detected above the Qbt 2,3,4 and Qbt 1g, Qct, Qbo BVs (2.79 mg/kg and 0.56 mg/kg) in two Qbt 3 samples and two Qbt 1g samples with a maximum concentration of 3.2 mg/kg. The Gehan and quantile tests indicated site concentrations of arsenic in Qbt 2,3,4 are not statistically different from background (Figure G-64 and Table G-10). The concentrations detected above BV in Qbt 1g were equivalent to the highest background concentration (0.7 mg/kg). Arsenic was not detected or not detected above BVs in the other 79 samples (detected below BVs in 70 samples). Arsenic is not a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in eight samples with a maximum concentration of 223 mg/kg. The Gehan and quantile tests indicated site concentrations of barium in Qbt 2,3,4 are not statistically different from background (Figure G-65 and Table G-10). Barium is not a COPC.

Beryllium was detected above the Qbt 2,3,4 and Qbt 1g, Qct, Qbo BVs (1.21 mg/kg and 1.44 mg/kg) in four Qbt 2 and Qbt 3 samples and two Qbt 1g samples. The Gehan and quantile tests indicated site concentrations of beryllium in Qbt 2,3,4 are not statistically different from background (Figure G-66 and Table G-10). There were too few Qbt 1g samples to perform statistical comparisons. The Qbt 1g samples were collected from the three deep boreholes at locations 15-610816, 15-610817, and 15-610818. Beryllium concentrations in deep borehole tuff samples were similar for the upper tuff (Qbt 2,3,4) and lower tuff (Qbt 1g, Qct, Qbo) units. Concentrations in Qbt 3 and Qbt 2 samples ranged from 0.212 mg/kg to 8.68 mg/kg for 33 samples collected over the interval 3.5 ft bgs to 157.5 ft bgs. Concentrations in Qbt 1g samples ranged from 0.267 mg/kg to 3.14 mg/kg for six samples collected over the interval 169 ft bgs to 182.5 ft bgs. Beryllium was detected above BV only in 6 of 39 deep borehole samples. Because (1) concentrations are similar in the upper and lower tuff units, (2) the concentrations in the upper tuff units are not statistically different from background, and (3) there was a low frequency of detection above BV in deep borehole samples, beryllium is not a COPC.

Cadmium was not detected above the soil and Qbt 1g, Qct, Qbo BVs (0.4 mg/kg for both) but had DLs (0.527 mg/kg to 0.779 mg/kg) above BVs in 19 soil samples and 4 tuff samples. The DLs were only 0.127 mg/kg to 0.379 mg/kg above the BVs, below the highest background DL (2 mg/kg), and below the two or three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg). Cadmium was not detected or not detected above BVs in the other 60 samples (detected below BVs in 36 samples). Cadmium is not a COPC.

Calcium was detected above the Qbt 2,3,4 BV (2200 mg/kg) in six samples with a maximum concentration of 3510 mg/kg. The Gehan and quantile tests indicated site concentrations of calcium in Qbt 2,3,4 are not statistically different from background (Figure G-67 and Table G-10). Calcium is not a COPC.

Chromium was detected above the soil, Qbt 2,3,4, and Qbt 1g, Qct, Qbo BVs (19.3 mg/kg, 7.14 mg/kg, and 2.6 mg/kg) in 9 soil samples, 11 Qbt 3 and Qbt 2 samples, and 3 Qbt 1g samples with a maximum concentration of 151 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in soil and Qbt 2,3,4 are statistically different from background (Figure G-68 and Table G-11; Figure G-69 and Table G-10). Chromium is retained as a COPC.

Cobalt was detected above the Qbt 2,3,4 BV (3.14 mg/kg) in eight samples with a maximum concentration of 7.48 mg/kg. The Gehan and quantile tests indicated site concentrations of cobalt in Qbt 2,3,4 are not statistically different from background (Figure G-70 and Table G-10). Cobalt is not a COPC.

Copper was detected above the Qbt 2,3,4 BV (4.66 mg/kg) in nine samples with a maximum concentration of 10.2 mg/kg. The Gehan and slippage tests indicated site concentrations of copper in Qbt 2,3,4 are statistically different from background (Figure G-71 and Table G-10). Copper is retained as a COPC.

Iron was detected above the Qbt 2,3,4 and the Qbt 1g, Qct, Qbo BVs (14,500 mg/kg and 3700 mg/kg) in three Qbt 3 samples and six Qbt 1g samples with a maximum concentration of 17,300 mg/kg. The Gehan test indicated site concentrations of iron in Qbt 2,3,4 are statistically different from background (Table G-10). However, the quantile and slippage tests indicated site concentrations of iron in Qbt 2,3,4 are not statistically different from background (Figure G-72 and Table G-10). There were too few Qbt 1g samples to perform statistical comparisons. The Qbt 1g samples were collected from the three deep boreholes at locations 15-610816, 15-610817, and 15-610818. Iron concentrations in deep borehole tuff samples were similar for the upper tuff (Qbt 2,3,4) and lower tuff (Qbt 1g, Qct, Qbo) units. Concentrations in Qbt 3 and Qbt 2 samples ranged from 4620 mg/kg to 11,500 mg/kg for 33 samples collected over the interval 3.5 ft bgs to 157.5 ft bgs. Concentrations in Qbt 1g samples ranged from 5950 mg/kg to 7600 mg/kg for six samples collected over the interval 169 ft bgs to 182.5 ft bgs. Iron was detected above BV only in 6 of 39 deep borehole samples. Because (1) concentrations are similar in the upper and lower tuff units, (2) the concentrations in the upper tuff units are not statistically different from background, and (3) there was a low frequency of detection above BV in deep borehole samples, iron is not a COPC.

Lead was detected above the soil and Qbt 2,3,4 BVs (22.3 mg/kg and 11.2 mg/kg) in eight soil samples and eight tuff samples with a maximum concentration of 63,700 mg/kg. The Gehan and slippage tests indicated site concentrations of lead in soil are statistically different from background (Figure G-73 and Table G-11). The Gehan and quantile tests indicated that site concentrations of lead in tuff are not statistically different from background (Figure G-74 and Table G-10). Lead is retained as a COPC.

Magnesium was detected above the Qbt 2,3,4 and Qbt 1g, Qct, Qbo BVs (1690 mg/kg and 739 mg/kg) in seven Qbt 3 samples and one Qbt 1g sample with a maximum concentration of 3080 mg/kg. The Gehan and quantile tests indicated site concentrations of magnesium in Qbt 2,3,4 are not statistically different from background (Figure G-75 and Table G-10). There were too few Qbt 1g samples to perform statistical comparisons. The Qbt 1g samples were collected from the three deep boreholes at locations 15-610816, 15-610817, and 15-610818. Magnesium concentrations in deep borehole tuff samples were similar for the upper tuff (Qbt 2,3,4) and lower tuff (Qbt 1g, Qct, Qbo) units. Concentrations in Qbt 3 and Qbt 2 samples ranged from 55 mg/kg to 1480 mg/kg for 33 samples collected over the interval 3.5 ft bgs to 157.5 ft bgs. Concentrations in Qbt 1g samples ranged from 84.3 mg/kg to 777 mg/kg for six samples collected over the interval 169 ft bgs to 182.5 ft bgs. Magnesium was detected above BV in only 1 of 39 deep borehole

samples. Because (1) concentrations are similar in the upper and lower tuff units, (2) the concentrations in the upper tuff units are not statistically different from background, and (3) there was a low frequency of detection above BV in deep borehole samples, magnesium is not a COPC.

Manganese was detected above the Qbt 2,3,4 and Qbt 1g, Qct, Qbo BVs (482 mg/kg and 189 mg/kg) in one Qbt 3 and six Qbt 1g samples with a maximum concentration of 614 mg/kg. The Gehan and quantile tests indicated site concentrations of manganese in Qbt 2,3,4 are not statistically different from background (Figure G-76 and Table G-10). There were too few Qbt 1g samples to perform statistical comparisons. The Qbt 1g samples were all collected from the three deep boreholes at locations 15-610816, 15-610817, and 15-610818. Manganese concentrations in deep borehole tuff samples were similar for the upper tuff (Qbt 2,3,4) and lower tuff (Qbt 1g, Qct, Qbo) units. Concentrations in Qbt 3 and Qbt 2 samples ranged from 95.1 mg/kg to 614 mg/kg for 33 samples collected over the interval 3.5 ft bgs to 157.5 ft bgs. Concentrations in Qbt 1g samples ranged from 243 mg/kg to 334 mg/kg for six samples collected over the interval 169 ft bgs to 182.5 ft bgs. Manganese was detected above BV in only 7 of 39 deep borehole samples. Because (1) concentrations are similar in the upper and lower tuff units, (2) the concentrations in the upper tuff units are not statistically different from background, and (3) there was a low frequency of detection above BV in deep borehole samples, manganese is not a COPC.

Nickel was detected above the soil, Qbt 2,3,4, and Qbt 1g, Qct, Qbo BVs (15.4 mg/kg, 6.58 mg/kg, and 2 mg/kg) in one soil sample, six Qbt 3 samples, and two Qbt 1g samples with a maximum concentration of 16.8 mg/kg. The Gehan and quantile tests indicated site concentrations of nickel in soil are statistically different from background (Figure G-77 and Table G-11). The slippage test indicated site concentrations of nickel in Qbt 2,3,4 are statistically different from background (Figure G-78 and Table G-10). Nickel is retained as a COPC.

Perchlorate was detected in 11 samples with a maximum concentration of 0.00213 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the soil, Qbt 2,3,4, and Qbt 1g, Qct, Qbo BVs (1.52 mg/kg, 0.3 mg/kg, and 0.3 mg/kg) but had DLs (0.933 mg/kg to 2.11 mg/kg) above BVs in 1 soil sample, 40 Qbt 3 and Qbt 2 samples, and 6 Qbt 1g samples. Selenium is retained as a COPC.

Silver was detected above the soil BV (1 mg/kg) in one sample at a concentration of 14.7 mg/kg. Silver is retained as a COPC.

Vanadium was detected above the Qbt 2,3,4 and Qbt 1g, Qct, Qbo BVs (17 mg/kg and 4.59 mg/kg) in six Qbt 3 samples and two Qbt 1g samples with a maximum concentration of 33.1 mg/kg. The Gehan and quantile tests indicated site concentrations of vanadium in Qbt 2,3,4 are not statistically different from background (Figure G-79 and Table G-10). There were too few Qbt 1g samples to perform statistical comparisons. The Qbt 1g samples were all collected from the three deep boreholes at locations 15-610816, 15-610817, and 15-610818. Vanadium concentrations in deep borehole tuff samples were similar for the upper tuff (Qbt 2,3,4) and lower tuff (Qbt 1g, Qct, Qbo) units. Concentrations in Qbt 3 and Qbt 2 samples ranged from 1.42 mg/kg to 12.2 mg/kg for 33 samples collected over the interval 3.5 ft bgs to 157.5 ft bgs. Concentrations in Qbt 1g samples ranged from 1.76 mg/kg to 5.7 mg/kg for six samples collected over the interval 169 ft bgs to 182.5 ft bgs. Vanadium was detected above BV in only 2 of 39 deep borehole samples. Because (1) concentrations are similar in the upper and lower tuff units, (2) the concentrations in the upper tuff units are not statistically different from background, and (3) there was a low frequency of detection above BV in deep borehole samples, vanadium is not a COPC.

Zinc was detected above the soil and Qbt 1g, Qct, Qbo BVs (48.8 mg/kg and 40 mg/kg) in five soil samples and six tuff samples with a maximum concentration of 206 mg/kg. The Gehan and slippage tests indicated site concentrations of zinc in soil are statistically different from background (Figure G-80 and Table G-11). Zinc is retained as a COPC.

Organic Chemicals

A total of 83 samples (37 soil and 46 tuff) were collected at SWMU 15-007(c) and analyzed for explosive compounds, SVOCs, and VOCs. Thirty-three samples (5 soil and 28 tuff) were also analyzed for PCBs. Table 8.3-3 summarizes the analytical results for detected organic chemicals. Plate 11 shows the spatial distribution of detected organic chemicals.

Organic chemicals detected at SWMU 15-007(c) include Aroclor-1242, Aroclor-1254, and TATB. The detected organic chemicals are retained as COPCs.

Radionuclides

Thirty-nine tuff samples were collected at SWMU 15-007(c) and analyzed for tritium. Table 8.3-4 presents the radionuclides detected or detected above BVs/FVs. Plate 12 shows the spatial distribution of detected radionuclides.

Tritium was detected in 32 samples with a maximum activity of 476 pCi/g. Tritium is retained as a COPC.

8.3.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMU 15-007(c) are discussed below.

Inorganic Chemicals

Inorganic COPCs at SWMU 15-007(c) include antimony, chromium, copper, lead, nickel, perchlorate, selenium, silver, and zinc.

Antimony was detected above the soil BV in two samples with a maximum concentration of 243 mg/kg and had DLs (0.898 mg/kg to 5.13 mg/kg) above the soil, Qbt 2,3,4, and Qbt 1g, Qct, Qbo BVs in 30 soil samples, 38 Qbt 2 and Qbt 3 samples, and 6 Qbt 1g samples. Concentrations increased with depth at location 15-610813 and decreased with depth at location 15-610814, where the maximum concentration was detected. Concentrations decreased laterally. The residential SSL was approximately 18 times the concentration at location 15-610813. The residential and industrial SSLs were approximately 6 times and 101 times the maximum DL, respectively. The lateral extent of antimony is defined, and further sampling for vertical extent is not warranted.

Chromium was detected above the soil, Qbt 2,3,4, and Qbt 1g, Qct, Qbo BVs in 9 soil samples, 11 Qbt 3 and Qbt 2 samples, and 3 Qbt 1g samples with a maximum concentration of 151 mg/kg. Concentrations increased with depth at locations 15-610792, 15-610797, 15-610798, 15-610803, 15-610807, and 15-610814. Concentrations did not change substantially with depth (0.6 mg/kg) at location 15-610794 and decreased with depth at locations 15-610799, 15-610801, 15-610802, 15-610804, 15-610805, 15-610808, 15-610809, 15-610816, 15-610817, and 15-610818 (the concentrations in the shallow samples at locations 15-610794, 15-610801, 15-610808, and 15-610809 were 13.7 mg/kg, 13.1 mg/kg, 15.6 mg/kg and 14.5 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased laterally. As discussed in section 4.2, because there was no known use of hexavalent chromium at this

site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 775 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Copper was detected above the Qbt 2,3,4 BV in nine samples with a maximum concentration of 10.2 mg/kg. Concentrations increased with depth at location 15-610798 and did not change substantially with depth at locations 15-610798, 15-610801, 15-610809, and 15-610814 (0.52 mg/kg, 0.67 mg/kg, 0.22 mg/kg, and 0.12 mg/kg, respectively); the concentrations in the shallow samples at locations 15-610798, 15-610801, 15-610809, and 12-610814 were 6.29 mg/kg, 7.24 mg/kg, 7.56 mg/kg, and 9.11 mg/kg, respectively, and below the soil BV (Appendix E, Pivot Tables). Concentrations decreased with depth at locations 15-610794, 15-610808, and 15-610816 (the concentrations in the shallow samples at locations 15-610794 and 15-610808 were 9.54 mg/kg and 10 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased laterally. The residential SSL was approximately 307 times the maximum concentration. The lateral extent of copper is defined, and further sampling for vertical extent is not warranted.

Lead was detected above the soil and Qbt 2,3,4 BVs in eight soil samples and eight tuff samples with a maximum concentration of 63,700 mg/kg. Concentrations increased with depth at locations 15-610798, 15-610802, and 15-610813. The concentration at location 15-610798 was below the maximum Qbt 2,3,4 background concentration (15.5 mg/kg). Concentrations decreased with depth at all other locations (the concentrations in the shallow samples at locations 15-610807 and 15-610808 were 18.2 mg/kg and 16.5 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased laterally. The residential and industrial SSLs were approximately 2 times and 4 times the concentrations in the deeper samples at locations 15-610802 and 15-610813 (180 mg/kg and 200 mg/kg, respectively). The lateral extent of lead is defined, and vertical extent at locations 15-610802 and 15-610813 is not defined.

Nickel was detected above the soil, Qbt 2,3,4, and Qbt 1g, Qct, Qbo BVs in one soil sample, six Qbt 3 samples, and two Qbt 1g samples with a maximum concentration of 16.8 mg/kg. Concentrations increased with depth at locations 15-610797, 15-610798, 15-610807, and 15-610814. Concentrations did not change substantially with depth (0.91 mg/kg) at location 15-610794 and decreased with depth at locations 15-610801, 15-610808, and 15-610816 (the concentrations in the shallow samples at locations 15-610794, 15-610801, and 15-610808 were 10.6 mg/kg, 9.26 mg/kg, and 11.1 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased laterally. The residential SSL was approximately 93 times the maximum concentration. The lateral extent of nickel is defined, and further sampling for vertical extent is not warranted.

Perchlorate was detected in 11 samples with a maximum concentration of 0.00213 mg/kg. Concentrations increased with depth at locations 15-610804, 15-610807, and 15-610814 but were below the EDLs. Concentrations decreased with depth at locations 15-610816 and 15-610817 and decreased laterally. The residential SSL was approximately 32,000 times the maximum concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Selenium was not detected above the soil, Qbt 2,3,4, and Qbt 1g, Qct, Qbo BVs but had DLs (0.933 mg/kg to 2.11 mg/kg) above BVs in 1 soil sample, 40 Qbt 3 and Qbt 2 samples, and 6 Qbt 1g samples. Because selenium was not detected above BVs and the residential SSL was approximately 185 times the maximum DL, further sampling for extent of selenium is not warranted.

Silver was detected above the soil BV in one sample at a concentration of 14.7 mg/kg. Concentrations decreased with depth and laterally. The lateral and vertical extent of silver are defined.

Zinc was detected above the soil and Qbt 1g, Qct, Qbo BVs in five soil samples and six tuff samples with a maximum concentration of 206 mg/kg. Concentrations increased with depth at locations 15-610792 and 15-610797 but were below the maximum soil background concentration (75.5 mg/kg). Concentrations at locations 15-610816, 15-610817, and 15-610818 ranged from 40.7 mg/kg to 59.4 mg/kg, 33.8 mg/kg to 52.4 mg/kg, and 23.4 mg/kg to 46.8 mg/kg, respectively. Concentrations decreased with depth at locations 15-610802 and 15-610814 and decreased laterally. The residential SSL was approximately 114 times the maximum concentration. The lateral extent of zinc is defined, and further sampling for vertical extent is not warranted.

Organic Chemicals

Organic COPCs at SWMU 15-007(c) include Aroclor-1242, Aroclor-1254, and TATB.

Aroclor-1242 was detected in one sample at a concentration of 0.0034 mg/kg. Concentrations decreased with depth and decreased laterally at location 15-610820 at SWMU 15-007(d) (Plate 11). The lateral and vertical extent of Aroclor-1242 are defined.

Aroclor-1254 was detected in one sample at concentration of 0.0055 mg/kg. Concentrations decreased with depth and decreased laterally. The lateral and vertical extent of Aroclor-1254 are defined.

TATB was detected in three samples at a maximum concentration of 0.496 mg/kg. Concentrations decreased with depth at all locations and decreased laterally. The lateral and vertical extent of TATB are defined.

Radionuclides

Radionuclide COPCs at SWMU 15-007(c) include tritium.

Tritium was detected in 32 samples with a maximum activity of 476 pCi/g. Activities decreased with depth at all locations. Tritium was analyzed only in the deep boreholes, which were located around the area where the shaft was located and the shallower samples were collected. The residential SAL was approximately 6.4 times, 6.7 times, and 1.8 times the maximum activities at locations 15-610816, 15-610817, and 15-610818, respectively. The industrial SAL was approximately 18,100 times, 18,900 times, and 5000 times the maximum activities at locations 15-610816, 15-610817, and 15-610818, respectively. The vertical extent of tritium is defined, and further sampling for lateral extent is not warranted.

8.3.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 4×10^{-7} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 20, which is above the NMED target HI of 1 (NMED 2015, 600915). The elevated HI is from lead. No radionuclide COPCs were identified for the industrial scenario.

Residential Scenario

The total excess cancer risk for the residential scenario is 3×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 26, which is above the NMED target HI of 1 (NMED 2015, 600915). The elevated HI is from antimony and lead. The total dose is 0.1 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Based on the risk-screening assessment results, no potential unacceptable cancer risks or doses exist for the industrial and residential scenarios. There are potential unacceptable noncancer risks for the industrial and residential scenarios at SWMU 15-007(c).

8.3.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at SWMU 15-007(c).

8.4 SWMU 15-007(d)—Shaft

8.4.1 Site Description and Operational History

SWMU 15-007(d) is an underground shaft (structure 15-265) located at TA-15 approximately 300 ft east of building 15-263 and 100 ft south of underground shaft 15-264 [SWMU 15-007(c)] (Plate 9). The shaft, 6 ft in diameter by 120 ft deep, is situated within a 20- × 20-ft concrete pad and covered with a wooden lid. The shaft was used in 1972 to conduct a single test involving beryllium, tritium, and approximately 500 lb of HE. This test was designed to determine the ability of tuff to absorb the explosion. The explosion was confined to the bottom of the shaft by filling the shaft with layers of magnetite, cement, sand grout, bentonite, sand, and gravel (LANL 1993, 020946, p. 5-9).

Contrary to the site description provided for SWMU 15-007(d) in all previous documents, the site description for the SWMU 15-007(d) shaft in the investigation report (LANL 2010, 111324.14) stated that lead shot was scattered on the concrete pad at the surface of the shaft and in the surrounding soil at SWMU 15-007(d). The investigation report is incorrect: previous documentation substantiates that scattered lead shot has never been present at the SWMU 15-007(d) shaft. Site visits made to the shaft after the investigation report was written have confirmed no lead shot is present at the site.

8.4.2 Relationship to Other SWMUs and AOCs

SWMU 15-007(d) is a component of Consolidated Unit 15-007(c)-00, along with SWMU 15-007(c). SWMU 15-007(d) is located adjacent to and approximately 150 ft from SWMU 15-007(c), which is another underground test shaft, and these sites are approximately 300 ft east and downgradient of the R-45 firing site (Figure 8.1-1).

8.4.3 Summary of Previous Investigations

No sampling was conducted at this SWMU before 2009.

8.4.4 Site Contamination

8.4.4.1 Soil, Rock, and Sediment Sampling

Because no previous investigations had been conducted, characterization was required to assess potential contamination at SWMU 15-007(d). As a result, the following activities were completed as part of the 2009–2010 investigation.

- Twenty-six samples were collected in 2009–2010 from two boreholes approximately 70 ft southeast and southwest of the shaft. Because less HE was used at SWMU 15-0074(d) than at SWMU 15-0074(c) and there was less chance for release from the shaft, surface samples were not collected. The two boreholes were sampled to define vertical extent at locations around the borehole. At each location, 13 samples were collected from the depth interval 4.0 ft bgs to 182.5 ft bgs. All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, perchlorate, explosive compounds, PCBs, and tritium.
- All investigation samples were field-screened for gross-alpha and -beta radioactivity. Field-screening results were recorded on borehole logs and/or corresponding SCLs. Borehole logs are presented in Appendix C, and SCLs/COC forms are included in Appendix E.

The 2009–2010 sampling locations at SWMU 15-007(d) are shown on Plate 9. Table 8.4-1 presents the samples collected and analyses requested for SWMU 15-007(d). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

8.4.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

8.4.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 15-007(d) consist of 26 tuff samples collected from 2 locations.

Inorganic Chemicals

Twenty-six tuff samples were collected at SWMU 15-007(d) and analyzed for TAL metals, cyanide, and perchlorate. Table 8.4-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Plate 10 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was not detected above the Qbt 2,3,4, Qbt 1v, and Qbt 1g, Qct, Qbo BVs (0.5 mg/kg for all) but had DLs (0.947 mg/kg to 4.69 mg/kg) above BVs in 23 Qbt 2 and Qbt 3 samples, 1 Qbt 1v sample, and 2 Qbt 1g samples. Antimony is retained as a COPC.

Beryllium was detected above the Qbt 2,3,4 BV (1.44 mg/kg) in one sample at a concentration of 1.67 mg/kg. The Gehan and quantile tests indicated site concentrations of beryllium in tuff are not statistically different from background (Figure G-81 and Table G-12). Beryllium is not a COPC.

Cadmium was not detected above the Qbt 1v and Qbt 1g, Qct, Qbo BVs (0.4 mg/kg for both) but had DLs (0.501 mg/kg to 0.512 mg/kg) above BVs in one Qbt 1v sample and two Qbt 1g samples. The DLs are only 0.101 mg/kg to 0.112 mg/kg above the BVs. There are no background data for cadmium in units

Qbt 1v, Qbt 1g, Qct, and Qbo, and the BVs are based on detection limits. Cadmium was not detected or not detected above BVs in 23 Qbt 2 and Qbt 3 samples (detected below BV in 6 samples). Cadmium is not a COPC.

Chromium was detected above the Qbt 1v and Qbt 2,3,4 BVs (2.24 mg/kg and 7.14 mg/kg) in four samples with a maximum concentration of 18.7 mg/kg. The Gehan test indicated site concentrations of ~~beryllium~~ chromium in tuff are statistically different from background (Table G-12). However, the quantile and slippage tests indicated site concentrations of chromium in tuff are not statistically different from background (Figure G-82 and Table G-12). Chromium is not a COPC.

Iron was detected above the Qbt 1g, Qct, Qbo BV (3700 mg/kg) in two samples with a maximum concentration of 5910 mg/kg. Iron was detected below BV in 24 Qbt 1v, Qbt 2, and Qbt 3 samples. The iron concentrations detected in the two Qbt 1g samples (5890 mg/kg and 5910 mg/kg) were within the range detected in the upper (Qbt 2,3,4) and middle (Qbt 1v) tuff units (4910 mg/kg to 9480 mg/kg). Iron is not a COPC.

Manganese was detected above the Qbt 1g, Qct, Qbo BV (189 mg/kg) in two samples with a maximum concentration of 282 mg/kg. Manganese was detected below BV in 24 Qbt 1v, Qbt 2, and Qbt 3 samples. The manganese concentrations detected in the two Qbt 1g samples (268 mg/kg and 282 mg/kg) were within the range detected in the upper (Qbt 2,3,4) and middle (Qbt 1v) tuff units (147 mg/kg to 394 mg/kg). Manganese is not a COPC.

Perchlorate was detected in two samples with a maximum concentration of 0.00237 mg/kg. Perchlorate is retained as a COPC.

Selenium was detected above the Qbt 1g, Qct, Qbo and Qbt 2,3,4 BVs (0.3 mg/kg for all) in one Qbt 1g sample and one Qbt 2 sample with a maximum concentration of 0.549 mg/kg and had DLs (0.928 mg/kg to 1.02 mg/kg) above BVs in 22 Qbt 2 and Qbt 3 samples, 1 Qbt 1v sample, and 2 Qbt 1g samples. Selenium is retained as a COPC.

Zinc was detected above the Qbt 1g, Qct, Qbo BV (40 mg/kg) in two samples with a maximum concentration of 42.4 mg/kg. The zinc concentrations detected the 2 Qbt 1g samples (40.8 mg/kg and 42.4 mg/kg) were within the range detected in the upper (Qbt 2,3,4) and middle (Qbt 1v) tuff units (31.7 mg/kg to 57.9 mg/kg). Zinc is not a COPC.

Organic Chemicals

Twenty-six tuff samples were collected at SWMU 15-007(d) and analyzed for explosive compounds and PCBs. Table 8.4-3 summarizes the analytical results for detected organic chemicals. Plate 11 shows the spatial distribution of detected organic chemicals.

Organic chemicals detected at SWMU 15-007(d) include Aroclor-1242 and Aroclor-1254. The detected organic chemicals are retained as COPCs.

Radionuclides

Twenty-six tuff samples were collected at SWMU 15-007(d) and analyzed for tritium. Table 8.4-4 presents the radionuclides detected or detected above BVs/FVs. Plate 12 shows the spatial distribution of detected radionuclides.

Tritium was detected in 26 samples with a maximum activity of 114 pCi/g. Tritium is retained as a COPC.

8.4.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMU 15-007(d) are discussed below. As noted in section 8.4.4.1, samples were collected to define vertical extent, and lateral extent is not evaluated.

Inorganic Chemicals

Inorganic COPCs at SWMU 15-007(d) include antimony, perchlorate, and selenium.

Antimony was not detected above the Qbt 2,3,4, Qbt 1v, and Qbt 1g, Qct, Qbo BVs but had DLs (0.947 mg/kg to 4.69 mg/kg) above the BVs in 23 Qbt 2 and Qbt 3 samples, 1 Qbt 1v sample, and 2 Qbt 1g samples. Because antimony was not detected above BVs and the residential and industrial SSLs were approximately 6.7 and 110 times the maximum DL, respectively, further sampling for extent of antimony is not warranted.

Perchlorate was detected in two samples with a maximum concentration of 0.00237 mg/kg. Concentrations decreased with depth. The residential SSL was approximately 23,000 times the maximum concentration. The vertical extent of perchlorate is defined.

Selenium was detected above the Qbt 1g, Qct, Qbo and Qbt 2, 3, 4 BVs (0.3 mg/kg for all) in one Qbt 1g sample and one Qbt 2 sample with a maximum concentration of 0.549 mg/kg and had DLs (0.928 mg/kg to 1.02 mg/kg) above BVs in 22 Qbt 2 and Qbt 3 samples, 1 Qbt 1v sample, and 2 Qbt 1g samples. Concentrations were 0.213 mg/kg and 0.249 mg/kg above the BVs and did not change substantially with depth at location 15-610819 (0.036 mg/kg). The residential SSL was approximately 712 times the maximum concentration above BV and approximately 384 times the maximum DL. Further sampling for extent of selenium is not warranted.

Organic Chemicals

Organic COPCs at SWMU 15-007(d) include Aroclor-1242 and Aroclor-1254.

Aroclor-1242 was detected in one sample at a concentration of 0.0032 mg/kg. Concentrations decreased with depth and were below the EQLs. The residential SSL was approximately 760 times the concentration. The vertical extent of Aroclor-1242 is defined.

Aroclor-1254 was detected in one sample at a concentration of 0.0018 mg/kg. Concentrations decreased with depth and were below the EQL. The residential SSL was approximately 630 times the concentration. The vertical extent of Aroclor-1254 is defined.

Radionuclides

Radionuclide COPCs at SWMU 15-007(d) include tritium.

Tritium was detected in 26 samples with a maximum activity of 114 pCi/g. Activities decreased with depth at all locations. The residential and industrial SALs were approximately 15 times and 17,600 times the maximum activity, respectively. The vertical extent tritium is defined.

8.4.5 Summary of Human Health Risk Screening

Industrial Scenario

Samples were not collected from the 0.0–1.0 ft depth interval, and the industrial scenario was not evaluated for SWMU 15-007(d).

Residential Scenario

No carcinogenic COPCs were identified for the residential scenario. The residential HI is 0.03, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.09 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the residential and construction worker scenarios at SWMU 15-007(d).

8.4.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at SWMU 15-007(d).

8.5 SWMU 15-008(b)—Surface Disposal Area

8.5.1 Site Description and Operational History

SWMU 15-008(b) is a surface disposal area located at TA-15, north of Firing Site R-44 [SWMU 15-006(c)] and extending along the edge of the mesa and downslope into Threemile Canyon (Plate 13). The surface disposal area covers approximately 8.5 acres. Soil and debris generated from activities at the R-44 firing site were disposed of at SWMU 15-008(b). Activities at the firing site began in 1951. The firing site was used extensively until 1978 and sporadically until 1992 when firing site activities ceased (LANL 1993, 020946, p. 6-8; LANL 1995, 050294, p. 4-73).

8.5.2 Relationship to Other SWMUs and AOCs

SWMU 15-008(b) is a component of Consolidated Unit 15-006(c)-99, along with SWMU 15-006(c), whose investigation is deferred per Table IV-2 of the Consent Order. SWMU 15-008(b) is located adjacent to the R-44 firing site [SWMU 15-006(c)] and is approximately 100 ft north of SWMU 15-009(c), though on the other side of a berm from that site. The nearest upgradient site is SWMU 15-009(h), which is approximately 650 ft to the west (Figure 8.1-1).

8.5.3 Summary of Previous Investigations

During 1994 RFI activities, 24 samples were collected from 18 locations and analyzed for inorganic chemicals, HE, and radionuclides (LANL 1995, 050294).

An expedited cleanup (EC) was performed in July, 2000, following the Cerro Grande fire. The EC activities included removing 20 yd³ of firing site debris from the SWMU and surrounding area and emplacing erosion-control features, such as straw wattles, rock check dams, and silt fencing (LANL 2001, 071342, pp. 22–23). No sampling was conducted as part of this EC.

Data from eight samples collected from four locations during the 1994 RFI meet current data-validation standards and are decision-level data included in this report. However, data from all other samples collected in 1994 are screening-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

8.5.4 Site Contamination

8.5.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at SWMU 15-008(b). As a result, the following activities were completed as part of the 2009–2010 investigation.

- A total of 163 samples were collected in 2009–2010 from 82 locations within and around the disposal area and on the canyon slope to the north. At all but one location, samples were collected at the surface (0.0–0.3 ft bgs to 0.0–1.0 ft bgs) and from the subsurface (1.0–1.5 ft bgs to 3.0–4.2 ft bgs). At the remaining location, only a surface sample (0.0–0.4 ft bgs) was collected. All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. Forty samples were also analyzed for PCBs.

The 2009–2010 sampling locations at SWMU 15-008(b) are shown on Plate 13. Table 8.5-1 presents the samples collected and analyses requested for SWMU 15-008(b), including the 1994 RFI samples. The geodetic coordinates of sampling locations are presented in Table 3.2-1.

8.5.4.2 Soil, Rock, and Sediment Field-Screening Results

Some radiological field-screening results exceeded twice the daily site background levels. A few locations were moved slightly so samples could be collected without exceeding the limits of the radiation work permit. No other changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

8.5.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 15-008(b) consist of 171 samples (90 soil, 19 sediment, and 62 tuff) collected from 86 locations.

Inorganic Chemicals

A total of 171 samples (90 soil, 19 sediment, and 62 tuff) were collected at SWMU 15-008(b) and analyzed for TAL metals and total uranium. A total of 163 samples (82 soil, 19 sediment, and 62 tuff) were also analyzed for cyanide and perchlorate. Table 8.5-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Plate 14 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 BV (7340 mg/kg) in five samples with a maximum concentration of 10,200 mg/kg. The Gehan test indicated site concentrations of aluminum in tuff are statistically different from background (Table G-13). However, the quantile and slippage tests indicated site concentrations of aluminum in tuff are not statistically different from background (Figure G-83 and Table G-13). Aluminum is not a COPC.

Antimony was detected above the soil, sediment, and Qbt 2,3,4 BVs (0.83 mg/kg, 0.83 mg/kg, and 0.5 mg/kg) in 23 soil samples, 21 sediment samples, and 123 tuff samples with a maximum concentration of 256 mg/kg. Antimony also had DLs (0.578 mg/kg to 8.6 mg/kg) above BVs in 62 soil samples, 17 sediment samples, and 46 tuff samples. The quantile and slippage tests indicated site concentrations of antimony in soil are statistically different from background (Figure G-84 and Table G-14). Antimony is retained as a COPC.

Arsenic was detected above the sediment and Qbt 2,3,4 BVs (3.98 mg/kg and 2.79 mg/kg) in one sediment sample and three tuff samples with a maximum concentration of 5.91 mg/kg. The Gehan and quantile tests indicated site concentrations of arsenic in sediment are not statistically different from background (Figure G-85 and Table G-15). The Gehan and quantile tests indicated site concentrations of arsenic in tuff are statistically different from background (Figure G-86 and Table G-13). Arsenic is retained as a COPC.

Barium was detected above the soil and Qbt 2,3,4 BVs (295 mg/kg and 46 mg/kg) in 1 soil sample and 27 tuff samples with a maximum concentration of 344 mg/kg. The Gehan and quantile tests indicated site concentrations of barium in soil are not statistically different from background (Figure G-87 and Table G-14). The Gehan and quantile tests indicated site concentrations of barium in tuff are statistically different from background (Figure G-88 and Table G-13). Barium is retained as a COPC.

Beryllium was detected above the soil, sediment, and Qbt 2,3,4 BVs (1.83 mg/kg, 1.31 mg/kg, and 1.21 mg/kg) in 35 soil samples, 11 sediment samples, and 16 tuff samples with a maximum concentration of 47.5 mg/kg. The Gehan and quantile tests indicated site concentrations of beryllium in soil, sediment, and tuff are statistically different from background (Figure G-89 and Table G-14, Figure G-90 and Table G-15, and Figure G-91 and Table G-13, respectively). Beryllium is retained as a COPC.

Cadmium was detected above the soil and sediment BVs (0.4 mg/kg for both) in 13 soil samples and 2 sediment samples with a maximum concentration of 7.98 mg/kg. Cadmium also had DLs (0.402 mg/kg to 0.768 mg/kg) above BVs in 55 soil samples and 8 sediment samples. The quantile and slippage tests indicated site concentrations of cadmium in sediment are statistically different from background (Figure G-92 and Table G-15). Cadmium is retained as a COPC.

Calcium was detected above the soil and Qbt 2,3,4 BVs (6120 mg/kg and 2200 mg/kg) in three soil samples and nine tuff samples with a maximum concentration of 27,600 mg/kg. The Gehan and quantile tests indicated site concentrations of calcium in soil are not statistically different from background (Figure G-93 and Table G-14). The Gehan and quantile tests indicated site concentrations of calcium in tuff are statistically different from background (Figure G-94 and Table G-13). Calcium is retained as a COPC.

Chromium was detected above the soil, sediment, and Qbt 2,3,4 BVs (19.3 mg/kg, 10.5 mg/kg, and 7.14 mg/kg) in 13 soil samples, 8 sediment samples, and 47 tuff samples with a maximum concentration of 55.8 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in soil, sediment, and tuff are statistically different from background (Figure G-95 and Table G-14, Figure G-96 and Table G-15, and Figure G-97 and Table G-13, respectively). Chromium is retained as a COPC.

Cobalt was detected above the soil, sediment, and Qbt 2,3,4 BVs (8.64 mg/kg, 4.73 mg/kg, and 3.14 mg/kg) in 5 soil samples, 1 sediment sample, and 42 tuff samples with a maximum concentration of 17.1 mg/kg. The Gehan and quantile tests indicated site concentrations of cobalt in soil and sediment are not statistically different from background (Figure G-98 and Table G-14, and Figure G-99 and Table G-15, respectively). The Gehan and slippage tests indicated site concentrations of cobalt in tuff are statistically different from background (Figure G-100 and Table G-13). Cobalt is retained as a COPC.

Copper was detected above the soil, sediment, and Qbt 2,3,4 BVs (14.7 mg/kg, 11.2 mg/kg, and 4.66 mg/kg) in 44 soil samples, 12 sediment samples, and 39 tuff samples with a maximum concentration of 36,400 mg/kg. The Gehan and quantile tests indicated site concentrations of copper in soil, sediment, and tuff are statistically different from background (Figure G-101 and Table G-14, Figure G-102 and Table G-15, and Figure G-103 and Table G-13, respectively). Copper is retained as a COPC.

Cyanide was detected above the soil BV (0.5 mg/kg) in one sample at a concentration of 0.555 mg/kg. The detected concentration was only 0.055 mg/kg above the BV. Cyanide was not detected or was detected below BV in 162 other samples (detected below BV in 21 samples). Cyanide is not a COPC.

Iron was detected above the sediment and Qbt 2,3,4 BVs (13,800 mg/kg and 14,500 mg/kg) in four sediment samples and four tuff samples with a maximum concentration of 22,300 mg/kg. The Gehan and quantile tests indicated site concentrations of iron in sediment are statistically different from background (Figure G-104 and Table G-15). The Gehan test indicated site concentrations of iron in tuff are statistically different from background (Table G-13). However, the quantile and slippage tests indicated site concentrations of iron in tuff are not statistically different from background (Figure G-105 and Table G-13). Iron is retained as a COPC.

Lead was detected above the soil, sediment, and Qbt 2,3,4 BVs (22.3 mg/kg, 19.7 mg/kg, and 11.2 mg/kg) in 48 soil samples, 8 sediment samples, and 22 tuff samples with a maximum concentration of ~~2870~~ **138,000** mg/kg. The Gehan and quantile tests indicated site concentrations of lead in soil, sediment, and tuff are statistically different from background (Figure G-106 and Table G-14, Figure G-107 and Table G-15, and Figure G-108 and Table G-13, respectively). Lead is retained as a COPC.

Magnesium was detected above the sediment and Qbt 2,3,4 BVs (2370 mg/kg and 1690 mg/kg) in one sediment sample and three tuff samples with a maximum concentration of ~~22,300~~ **2870** mg/kg. The Gehan and quantile tests indicated site concentrations of magnesium in sediment are not statistically different from background (Figure G-109 and Table G-15). The Gehan test indicated site concentrations of magnesium in tuff are statistically different from background (Table G-13). However, the quantile and slippage tests indicated site concentrations of magnesium in tuff are not statistically different from background (Figure G-110 and Table G-13). Magnesium is not a COPC.

Manganese was detected above the soil and sediment BVs (671 mg/kg and 543 mg/kg) in one soil sample and one sediment sample with a maximum concentration of 765 mg/kg. The Gehan and quantile tests indicated site concentrations of manganese in soil and sediment are not statistically different from background (Figure G-111 and Table G-14, and Figure G-112 and Table G-15, respectively). Manganese is not a COPC.

Mercury was detected above the soil BV (0.1 mg/kg) in two samples with a maximum concentration of 1.1 mg/kg and had DLs (0.11 mg/kg) above the BV in five samples. The concentrations were 0.01 mg/kg and 1.0 mg/kg above BV, and the DLs were 0.01 mg/kg above the BV. Mercury was not detected or was detected below BV in 164 other samples (detected below BV in 133 samples). Mercury is not a COPC.

Nickel was detected above the soil, sediment, and Qbt 2,3,4 BVs (15.4 mg/kg, 9.38 mg/kg, and 6.58 mg/kg) in 3 soil samples, 3 sediment samples, and 15 tuff samples with a maximum concentration of 21 mg/kg. The Gehan and quantile tests indicated site concentrations of nickel in soil and sediment are not statistically different from background (Figure G-113 and Table G-14, and Figure G-114 and Table G-15, respectively). The quantile and slippage tests indicated site concentrations of nickel in tuff are statistically different from background (Figure G-115 and Table G-13). Nickel is retained as a COPC.

Perchlorate was detected in 15 samples with a maximum concentration of 0.00243 mg/kg. Perchlorate is retained as a COPC.

Selenium was detected above the Qbt 2,3,4 BV (0.3 mg/kg) in 3 samples with a maximum concentration of 0.67 mg/kg and had DLs (0.54 mg/kg to 1.86 mg/kg) above the soil and sediment BVs (1.52 mg/kg and 0.3 mg/kg) and the Qbt 2,3,4 BV in 6 soil samples, 19 sediment samples, and 59 tuff samples. Selenium is retained as a COPC.

Silver was detected above the soil, sediment, and Qbt 2,3,4 BVs (1 mg/kg for all) in eight soil samples, one sediment sample, and two tuff samples with a maximum concentration of 6.95 mg/kg. Silver also had a DL (1.1 mg/kg) above the soil BV in one sample. The maximum concentration is substantially above BV. Silver is retained as a COPC.

Uranium was detected above the soil, sediment, and Qbt 2,3,4 BVs (1.82 mg/kg, 2.22 mg/kg, and 2.4 mg/kg) in 79 soil samples, 19 sediment samples, and 28 tuff samples with a maximum concentration of 659 mg/kg. The Gehan and quantile tests indicated site concentrations of uranium in soil, sediment, and tuff are statistically different from background (Figure G-116 and Table G-14, Figure G-117 and Table G-15, and Figure G-118 and Table G-13, respectively). Uranium is retained as a COPC.

Vanadium was detected above the sediment and Qbt 2,3,4 BVs (19.7 mg/kg and 17 mg/kg) in four sediment samples and two tuff samples with a maximum concentration of 34.8 mg/kg. The Gehan and slippage tests indicated site concentrations of vanadium in sediment are statistically different from background (Figure G-119 and Table G-15). The Gehan and quantile tests indicated site concentrations of vanadium in tuff are statistically different from background (Figure G-120 and Table G-13). Vanadium is retained as a COPC.

Zinc was detected above the soil and sediment BVs (48.8 mg/kg and 60.2 mg/kg) in 27 soil samples and 2 sediment samples with a maximum concentration of 13,300 mg/kg. The Gehan and quantile tests indicated site concentrations of zinc in soil and sediment are statistically different from background (Figure G-121 and Table G-14, and Figure G-122 and Table G-15, respectively). Zinc is retained as a COPC.

Organic Chemicals

A total of 163 samples (82 soil, 19 sediment, and 62 tuff) were collected at SWMU 15-008(b) and analyzed for explosive compounds. Forty samples (17 soil, 6 sediment, and 17 tuff) were also analyzed for PCBs. Table 8.5-3 summarizes the analytical results for detected organic chemicals. Plate 15 shows the spatial distribution of detected organic chemicals.

Organic chemicals detected at SWMU 15-008(b) include Aroclor-1242, Aroclor-1254, Aroclor-1260, Aroclor-1268, HMX, RDX, TATB, and TNT. The detected organic chemicals are retained as COPCs.

Radionuclides

A total of 163 samples (82 soil, 19 sediment, and 62 tuff) were collected at SWMU 15-008(b) and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium. Table 8.5-4 presents the radionuclides detected or detected above BVs/FVs. Plate 16 shows the spatial distribution of detected radionuclides.

Americium-241 was detected above the soil FV (0.013 pCi/g) in six samples and detected in one tuff sample with a maximum activity of 0.0769 pCi/g. Americium-241 is retained as a COPC.

Cesium-137 was detected above the soil FV (1.65 pCi/g) in two samples, was detected below 1 ft bgs in four soil samples, and was detected in four tuff samples with a maximum activity of 1.96 pCi/g. Cesium-137 is retained as a COPC.

Plutonium-239/240 was detected above the soil FV (0.054 pCi/g) in 10 samples, was detected below 1 ft bgs in 1 soil sample, and was detected in 1 tuff sample with a maximum activity of 0.333 pCi/g. Plutonium-239/240 is retained as a COPC.

Tritium was detected in 67 soil samples and 57 tuff samples and was detected above the sediment FV (0.093 pCi/g) in 18 samples with a maximum activity of 199 pCi/g. Tritium is retained as a COPC.

Uranium-234 was detected above soil, sediment, and Qbt 2,3,4 BVs (2.59 pCi/g, 2.59 pCi/g, and 1.98 pCi/g) in 38 soil samples, 13 sediment samples, and 13 tuff samples with a maximum activity of 43.4 pCi/g. Uranium-234 is retained as a COPC.

Uranium-235/236 was detected above soil, sediment, and Qbt 2,3,4 BVs (2.59 pCi/g, 2.59 pCi/g, and 1.98 pCi/g) in 37 soil samples, 15 sediment samples, and 20 tuff samples with a maximum activity of 6.57 pCi/g. Uranium-235/236 is retained as a COPC.

Uranium-238 was detected above soil, sediment, and Qbt 2,3,4 BVs (2.59 pCi/g, 2.59 pCi/g, and 1.98 pCi/g) in 59 soil samples, 17 sediment samples, and 24 tuff samples with a maximum activity of 291 pCi/g. Uranium-238 is retained as a COPC.

8.5.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMU 15-008(b) are discussed below.

Inorganic Chemicals

Inorganic COPCs at SWMU 15-008(b) include antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, nickel, perchlorate, selenium, silver, uranium, vanadium, and zinc.

Antimony was detected above the soil, sediment, and Qbt 2,3,4 BVs in 23 soil samples, 21 sediment samples, and 123 tuff samples with a maximum concentration of 256 mg/kg and had DLs (0.578 mg/kg to 8.6 mg/kg) above BVs in 62 soil samples, 17 sediment samples, and 46 tuff samples. Concentrations increased with depth at location 15-610723, did not change substantially with depth (0.26 mg/kg) at location 15-610724, and decreased with depth at all other locations. Concentrations decreased downgradient. The residential SSL was approximately 16 times the maximum concentration at location 15-610723, where vertical extent is not defined. The residential and industrial SSLs were approximately 3.6 times and 60 times the maximum DL, respectively. The lateral extent of antimony is defined, and further sampling for vertical extent is not warranted.

Arsenic was detected above the sediment and Qbt 2,3,4 BVs in one sediment sample and three tuff samples with a maximum concentration of 5.91 mg/kg. Concentrations increased with depth at all locations and decreased downgradient. The maximum concentration was 0.91 mg/kg above the maximum Qbt 2,3,4 background concentration (5 mg/kg), while the other tuff concentrations were below the maximum background concentration. The sediment concentration was only 0.98 mg/kg above the sediment BV. The industrial SSL was approximately 3.6 times to 7.5 times the concentrations above BVs, and arsenic does not pose a potential unacceptable risk under the industrial and residential scenarios (Appendix H). The lateral extent of arsenic is defined, and further sampling for vertical extent is not warranted.

Barium was detected above the soil and Qbt 2,3,4 BVs in 1 soil sample and 27 tuff samples with a maximum concentration of 344 mg/kg. Concentrations increased with depth at locations 15-610705, 15-610713, 15-610714, 15-610726, 15-610728, 15-610730, 15-610736, 15-610741, 15-610745, 15-610751, 15-610760, and 15-610781. Concentrations did not change substantially with depth (1.3 mg/kg and 1.8 mg/kg, respectively) at locations 15-610750 and 15-610776 and decreased with depth at all other locations (the concentrations in the shallow samples at locations 15-610711, 15-610723, 15-610725, 15-610734, 15-610735, 15-610739, 15-610743, 15-610746, 15-610747, 15-610750, 15-610755, 15-610763, 15-610774, and 15-610776 were 77.6 mg/kg, 101 mg/kg, 122 mg/kg, 157 mg/kg, 105 mg/kg, 82.6 mg/kg, 112 mg/kg, 89 mg/kg, 73.4 mg/kg, 46.5 mg/kg, 70.5 mg/kg, 91.7 mg/kg, 86.2 mg/kg, and 52.3 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient of the maximum concentration at location 15-610781. The residential SSL was approximately 45 times the maximum concentration. The lateral extent of barium is defined, and further sampling for vertical extent is not warranted.

Beryllium was detected above the soil, sediment, and Qbt 2,3,4 BVs in 35 soil samples, 11 sediment samples, and 16 tuff samples with a maximum concentration of 47.5 mg/kg. Concentrations increased with depth at locations 15-610747, 15-610760, and 15-610781 and did not change substantially with depth (0.33 mg/kg, 0.01 mg/kg, 0.26 mg/kg, and 0.08 mg/kg, respectively) at locations 15-610705, 15-610717, 15-610718, and 15-610752 (the concentration in the shallow sample at location 15-610752 was 1.51 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient of the maximum concentration at location 15-610732. The residential and industrial SSLs were approximately 3.3 times and 54 times the maximum concentration, respectively. The lateral extent of beryllium is defined, and further sampling for vertical extent is not warranted.

Cadmium was detected above the soil and sediment BVs in 13 soil samples and 2 sediment samples with a maximum concentration of 7.98 mg/kg and had DLs (0.402 mg/kg to 0.768 mg/kg) above BVs in 55 soil samples and 8 sediment samples. Concentrations decreased with depth at all locations and decreased downgradient of the maximum concentration at location 15-610712. The residential SSL was approximately 92 times the maximum DL. The lateral and vertical extent of cadmium are defined.

Calcium was detected above the soil and Qbt 2,3,4 BVs in three soil samples and nine tuff samples with a maximum concentration of 27,600 mg/kg. Concentrations increased with depth at locations 15-610713, 15-610725, 15-610728, 15-610736, 15-610739, 15-610747, and 15-610760, and only one depth was sampled at location 15-610762. Concentrations decreased with depth at locations 15-610715, 15-610722, and 15-610726 (the concentration in the shallow sample at location 15-610726 was 2930 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The NMED residential essential nutrient SSL was approximately 470 times the maximum concentration. The lateral extent of calcium is defined, and further sampling for vertical extent is not warranted.

Chromium was detected above the soil, sediment, and Qbt 2,3,4 BVs in 13 soil samples, 8 sediment samples, and 47 tuff samples with a maximum concentration of 55.8 mg/kg. Concentrations increased with depth at locations 15-610708, 15-610709, 15-610710, 15-610712, 15-610714, 15-610715, 15-610717, 15-610718, 15-610719, 15-610721, [15-610728](#), 15-610730, 15-610731, 15-610732, 15-610734, 15-610736, 15-610738, 15-610739, 15-610740, 15-610741, 15-610742, 15-610743, 15-610745, 15-610746, 15-610747, 15-610753, 15-610760, 15-610763, 15-610765, and 15-610781. Concentrations did not change substantially with depth (0.45 mg/kg, 0.4 mg/kg, 0.8 mg/kg, 0.03 mg/kg, 0.11 mg/kg, 0.59 mg/kg, and 0.6 mg/kg, respectively) at locations 15-610729, 15-610749, 15-610751, 15-610755, 15-610774, 15-610779, and 15-610780 and decreased with depth at locations 15-02502, 15-610707, 15-610711, 15-610713, 15-610716, 15-610726, 15-610733, 15-610735, 15-610737, 15-610752, 15-610754, 15-610756, 15-610757, 15-610759, 15-610770, 15-610771, 15-610773, 15-610782, and 15-610783 (the concentrations in the shallow samples at locations 15-610707, 15-610711, 15-610713, 15-610726, 15-610729, 15-610733, 15-610749, 15-610751, 15-610752, 15-610755, 15-610757, 15-610759, 15-610774, 15-610779, and 15-610780 were 10.3 mg/kg, 12.7 mg/kg, 15 mg/kg, 11.6 mg/kg, 8.28 mg/kg, 12.6 mg/kg, 11.9 mg/kg, 12.7 mg/kg, 17.8 mg/kg, 9.15 mg/kg, 11.1 mg/kg, 18.3 mg/kg, 7.29 mg/kg, 7.79 mg/kg, and 9.09 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 2100 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Cobalt was detected above the soil, sediment, and Qbt 2,3,4 BVs in 5 soil samples, 1 sediment sample, and 42 tuff samples with a maximum concentration of 17.1 mg/kg. Concentrations increased with depth at locations 15-610704, 15-610706, 15-610709, 15-610710, 15-610712, 15-610723, 15-610724, 15-610726, 15-610730, 15-610731, 15-610732, 15-610736, 15-610741, 15-610742, 15-610749, 15-610750, 15-610751, 15-610752, 15-610755, 15-610757, and 15-610758. Concentrations did not change substantially with depth (0.48 mg/kg, 0.45 mg/kg, 0.32 mg/kg, 0.57 mg/kg, 0.17 mg/kg, 0.71 mg/kg, 0.13 mg/kg, 0.68 mg/kg, 0.1 mg/kg, and 0.72 mg/kg, respectively) at locations 15-610707, 15-610708, 15-610713, 15-610714, 15-610719, 15-610734, 15-610735, 15-610740, 15-610761, and 15-610763 and decreased with depth at locations 15-610711, 15-610715, 15-610738, 15-610743, 15-610745, 15-610753, 15-610756, 15-610759, 15-610760, 15-610764, 15-610765, and 15-610773 (the concentrations in the shallow samples at locations 15-610707, 15-610708, 15-610711, 15-610713, 15-610734, 15-610735, 15-610740, 15-610743, 15-610753, 15-610756, 15-610759, 15-610761, 15-610763, and 15-610764 were 3.12 mg/kg, 3.41 mg/kg, 6.09 mg/kg, 8.08 mg/kg, 7.19 mg/kg, 3.39 mg/kg, 3.6 mg/kg, 5.66 mg/kg, 5.55 mg/kg, 4.18 mg/kg, 4.71 mg/kg, 4.77 mg/kg, 3.69 mg/kg, and 5.95 mg/kg, respectively, and below the soil FV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential and industrial SSLs were approximately 1.4 times and 20 times the maximum concentration, respectively. Further sampling for extent of cobalt is not warranted.

Copper was detected above the soil, sediment, and Qbt 2,3,4 BVs in 44 soil samples, 12 sediment samples, and 39 tuff samples with a maximum concentration of 36,400 mg/kg. Concentrations increased with depth at locations 15-02502, 15-610726, [15-610730](#), 15-610741, and 15-610752, and only one depth was sampled at location 15-610762. Concentrations did not change substantially with depth (0.79 mg/kg) at location 15-610719 and decreased with depth at all other locations (the concentrations in the shallow samples at locations 15-610713, 15-610717, 15-610719, 15-610736, 15-610760, 15-610763, and 15-610765 were 11.9 mg/kg, 7.13 mg/kg, 5.52 mg/kg, 10.4 mg/kg, 11.1 mg/kg, 9.88 mg/kg, and 6.89 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential and industrial SSLs were approximately 2.2 times and 37 times the maximum concentration

in the deeper samples where concentrations increased with depth (1410 mg/kg at location 15-610752). The lateral extent of copper is defined, and further sampling for vertical extent is not warranted.

Iron was detected above the sediment and Qbt 2,3,4 BVs in four sediment samples and four tuff samples with a maximum concentration of 22,300 mg/kg. Concentrations increased with depth at locations 15-610718, 15-610730, and 15-610734; did not change substantially with depth (50 mg/kg) at location 15-610726; and decreased with depth at locations 15-610719 and 15-610773. Concentrations decreased downgradient. The residential SSL was approximately 2.5 times the maximum concentration (the maximum concentration was 32,500 mg/kg below the residential SSL), and the industrial SSL was approximately 41 times the maximum concentration. The lateral extent of iron is defined, and further sampling for vertical extent is not warranted.

Lead was detected above the soil, sediment, and Qbt 2,3,4 BVs in 48 soil samples, 8 sediment samples, and 22 tuff samples with a maximum concentration of ~~2870~~ 138,000 mg/kg. Concentrations did not change substantially with depth (10 mg/kg and 9 mg/kg) at locations 15-610705 and 15-610723, and only one depth was sampled at location 15-610762. Concentrations decreased with depth at all other locations. Concentrations decreased downgradient. The residential and industrial SSLs were approximately 9.4 and 18.7 times the concentration at location 15-610762, where only a surface sample was collected. The lateral extent of lead is defined, and further sampling for vertical extent is not warranted.

Nickel was detected above the soil, sediment, and Qbt 2,3,4 BVs in 3 soil samples, 3 sediment samples, and 15 tuff samples with a maximum concentration of 21 mg/kg. Concentrations increased with depth at locations 15-610714, 15-610718, 15-610719, 15-610728, 15-610730, 15-610736, 15-610741, 15-610751, 15-610760, 15-610763, 15-610764, and 15-610765. Concentrations did not change substantially with depth (0.74 mg/kg and 0.7 mg/kg) at locations 15-610713 and 15-610747, respectively, and decreased with depth at locations 15-02502, 15-610705, 15-610726, 15-610739, 15-610746, and 15-610771 (concentrations in the shallow samples at locations 15-610713, 15-610739, 15-610746, and 15-610747 were 6.73 mg/kg, 12 mg/kg, 8.47 mg/kg, and 6.47 mg/kg, respectively and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential SSL was approximately 74 times the maximum concentration. The lateral extent of nickel is defined, and further sampling for vertical extent is not warranted.

Perchlorate was detected in 15 samples with a maximum concentration of 0.00243 mg/kg. Concentrations increased with depth at locations 15-610713, 15-610715, 15-610718, 15-610728, 15-610730, 15-610736, 15-610739, 15-610747, 15-610750, 15-610760, 15-610761, 15-610769, and 15-610782 and did not change substantially with depth (0.00006 mg/kg) at location 15-610779. All but one concentration were below EDLs. Concentrations decreased downgradient. The residential SSL was approximately 22,000 times the maximum concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Selenium was detected above the Qbt 2,3,4 BV in 3 samples with a maximum concentration of 0.67 mg/kg and had DLs (0.54 mg/kg to 1.86 mg/kg) above the soil, sediment, and Qbt 2,3,4 BVs in 6 soil samples, 19 sediment samples, and 59 tuff samples. Concentrations increased with depth at locations 15-610713, 15-610714, and 15-610747, but all detected concentrations were below EDLs. Concentrations decreased downgradient. The residential SSL was approximately 558 times the maximum concentration and approximately 210 times the maximum DL. The lateral extent of selenium is defined, and further sampling for vertical extent is not warranted.

Silver was detected above the soil, sediment, and Qbt 2,3,4 BVs in eight soil samples, one sediment sample, and two tuff samples with a maximum concentration of 6.95 mg/kg and had a DL (1.1 mg/kg) above the soil BV in one sample. Concentrations increased with depth at locations 15-610729 and 15-610730 and decreased with depth at all other locations. Concentrations decreased downgradient. The residential SSL was approximately 59 times the maximum concentration. The lateral extent of silver is defined, and further sampling for vertical extent is not warranted.

Uranium was detected above the soil, sediment, and Qbt 2,3,4 BVs in 79 soil samples, 19 sediment samples, and 28 tuff samples with a maximum concentration of 659 mg/kg. Concentrations increased with depth at locations 15-610705, 15-610723, 15-610748, 15-610778, and 15-610784, and only one depth was sampled at location 15-610762. The residential SSL was approximately 4 times and the industrial SSL was approximately 67 times the concentration at location 15-610762. Concentrations decreased with depth at all other locations. Concentrations decreased downgradient. The industrial SSL was 21 times the maximum concentration at locations 15-610705, 15-610762, 15-610778, and 15-610784 and 7.6 times and 9.6 times the concentrations in the deeper samples at locations 15-610723 and 15-610748, respectively. The lateral extent of uranium is defined, and the vertical extent at locations 15-610723 and 15-610748 is not defined. Further sampling for vertical extent is warranted at location 15-610723 but not at location 15-610748, where vertical extent of all uranium isotopes is defined (see below).

Vanadium was detected above the sediment and Qbt 2,3,4 BVs in four sediment samples and two tuff samples with a maximum concentration of 34.8 mg/kg. Concentrations increased with depth at locations 15-610718 and 15-610751 and decreased with depth at locations 15-610719 and 15-610772. Concentrations decreased downgradient. The residential and industrial SSLs were approximately 11 times and approximately 188 times the maximum concentration, respectively. The lateral extent of vanadium is defined, and further sampling for vertical extent is not warranted.

Zinc was detected above the soil and sediment BVs in 27 soil samples and 2 sediment samples with a maximum concentration of 13,300 mg/kg. Concentrations increased with depth at location 15-610754, and only one depth was sampled at location 15-610762. Concentrations decreased with depth at all other locations. Concentrations decreased downgradient. The residential SSL was approximately 369 times the maximum concentration at locations 15-610754 and 15-610762. The lateral extent of zinc is defined, and further sampling for vertical extent is not warranted.

Organic Chemicals

Organic COPCs at SWMU 15-008(b) include Aroclor-1242, Aroclor-1254, Aroclor-1260, Aroclor-1268, HMX, RDX, TATB, and TNT.

Aroclor-1242 was detected in one sample at a concentration of 0.282 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of Aroclor-1242 are defined.

Aroclor-1254 was detected in 20 samples with a maximum concentration of 0.143 mg/kg. Concentrations increased with depth at locations 15-610716 and 15-610720; did not change substantially with depth (0.005 mg/kg to 0.14 mg/kg) at locations 15-610705, 15-610706, 15-610707, 15-610714, and 15-610718; and decreased with depth at all other locations. Concentrations decreased downgradient. The residential SSL was approximately 520 times the maximum concentration at location 15-610716 and approximately 137 times the maximum concentration at location 15-610720. The lateral extent of Aroclor-1254 is defined, and further sampling for vertical extent is not warranted.

Aroclor-1260 was detected in 16 samples with a maximum concentration of 0.0608 mg/kg. Concentrations increased with depth at location 15-610720; did not change substantially with depth (0.0046 mg/kg to 0.058 mg/kg) at locations 15-610705, 15-610706, 15-610714, and 15-610718; and decreased with depth at all other locations. Concentrations decreased downgradient. The residential SSL was approximately 460 times the concentration at location 16-610720 and approximately 40 times the maximum concentration. The lateral extent of Aroclor-1260 is defined, and further sampling for vertical extent is not warranted.

Aroclor-1268 was detected in three samples with a maximum concentration of 0.0205 mg/kg. Concentrations decreased with depth at location 15-610715, did not change substantially with depth (0.016 mg/kg) at location 15-610714, and decreased downgradient. The lateral and vertical extent of Aroclor-1268 are defined.

HMX was detected in 17 samples with a maximum concentration of 35.4 mg/kg. Concentrations decreased with depth at all locations and decreased downgradient. The lateral and vertical extent of HMX are defined.

RDX was detected in six samples with a maximum concentration of 7.72 mg/kg. Concentrations decreased with depth at all locations and decreased downgradient. The lateral and vertical extent of RDX are defined.

TATB was detected in 13 samples with a maximum concentration of 28.6 mg/kg. Concentrations decreased with depth at all locations and decreased downgradient. The lateral and vertical extent of TATB are defined.

TNT was detected in two samples with a maximum concentration of 0.205 mg/kg. Concentrations decreased with depth at both locations and decreased downgradient. The lateral and vertical extent of TNT are defined.

Radionuclides

Radionuclide COPCs at SWMU 15-008(b) include americium-241, cesium-137, plutonium-239/240, tritium, uranium-234, uranium-235/236, and uranium-238.

Americium-241 was detected above the soil FV in six samples and detected in one tuff sample with a maximum activity of 0.0769 pCi/g. Activities decreased with depth at all locations except 15-610749 and decreased downgradient. The residential SAL was approximately 1080 times the maximum activity. The lateral extent of americium-241 is defined, and further sampling for vertical extent is not warranted.

Cesium-137 was detected above the soil FV in two samples, was detected below 1 ft bgs in four soil samples, and was detected in four tuff samples with a maximum activity of 1.96 pCi/g. Activities increased with depth at locations 15-610748 and 15-610784, and only one depth was sampled at location 15-610762. Activities decreased with depth at locations 15-610720, 15-610730, 15-610731, 15-610742, 15-610757, and 15-610758 (activities in shallow samples at locations 15-610720, 15-610742, 15-610757, and 15-610758 were 0.673 pCi/g, 0.842 pCi/g, 0.472 pCi/g, and 0.401 pCi/g, respectively, and below the soil FV [Appendix E, Pivot Tables]). Activities decreased downgradient. The residential SAL was approximately 84 times and 34 times the activities at locations 15-610748 and 15-610784, respectively. The residential and industrial SALs were approximately 6 times and 21 times the maximum activity, respectively. Further sampling for extent of cesium-137 is not warranted.

Plutonium-239/240 was detected above the soil FV in 10 samples, was detected below 1 ft bgs in 1 soil sample, and was detected in 1 tuff sample with a maximum activity of 0.333 pCi/g. Activities increased with depth at location 15-610749, and only one depth was sampled at location 15-610762. Activities decreased with depth at all other locations (the activity in the shallow sample at location 15-610720 was 0.0317 pCi/g and below the soil FV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential SAL was approximately 260 times the maximum activity at location 15-610749 and approximately 238 times the maximum activity. The lateral extent of plutonium-239/240 is defined, and further sampling for vertical extent is not warranted.

Tritium was detected in 67 soil samples and 57 tuff samples and was detected above the sediment FV in 18 samples with a maximum activity of 199 pCi/g. Activities increased with depth at locations 15-610709, 15-610710, 15-610713, 15-610728, 15-610739, 15-610741, 15-610748, 15-610749, 15-610765, and 15-610784, and only one depth was sampled at location 15-610762. Activities did not change substantially with depth (0.026 pCi/g, 0.036 pCi/g, 0.043 pCi/g, and 0.032 pCi/g) at locations 15-610734, 15-610735, 15-610736, and 15-610755. Activities decreased with depth at all other locations and decreased downgradient. The residential and industrial SALs were approximately 8.6 times and 12,300 times the maximum activity, respectively. The lateral extent of tritium is defined, and further sampling for vertical extent is not warranted.

Uranium-234 was detected above soil, sediment, and Qbt 2,3,4 BVs in 38 soil samples, 13 sediment samples, and 13 tuff samples with a maximum activity of 43.4 pCi/g. Activities increased with depth at location 15-610784 and did not change substantially with depth (0.3 pCi/g and 0.4 pCi/g) at locations 15-610723 and 15-610747. Only one depth was sampled at location 15-610762 (the residential SAL was approximately 47 times the activity at this location). Activities decreased with depth at all other locations and decreased downgradient. The residential SAL was approximately 105 times the activity at location 15-610784. The lateral extent of uranium-234 is defined, and further sampling for vertical extent is not warranted.

Uranium-235/236 was detected above soil, sediment, and Qbt 2,3,4 BVs in 37 soil samples, 15 sediment samples, and 20 tuff samples with a maximum activity of 6.57 pCi/g. Activities increased with depth at location 15-610723, and only one depth was sampled at location 15-610762. The residential SAL was approximately 71 times the activity at location 15-610762. Activities did not change substantially with depth (1 pCi/g or less) at 13 locations and decreased with depth at all other locations (the activity in the shallow sample at location 15-610747 was 0.138 pCi/g and below the soil BV [Appendix E, Pivot Tables]). Activities decreased downgradient. The residential SAL was approximately 13 times and the industrial SAL was approximately 49 times the maximum activity at location 15-610723. The lateral extent of uranium-235/236 is defined, and further sampling for vertical extent is not warranted.

Uranium-238 was detected above soil, sediment, and Qbt 2,3,4 BVs in 59 soil samples, 17 sediment samples, and 24 tuff samples with a maximum activity of 291 pCi/g. Activities increased with depth at locations 15-610723, 15-610747, and 15-610784, and only one depth was sampled at location 15-610762. The residential SAL was approximately 7 times and the industrial SAL was approximately 31 times the activity at location 15-610762. Activities did not change substantially with depth (0.13 pCi/g) at location 15-610726, decreased with depth at all other locations, and decreased downgradient. The residential and industrial SALs were approximately 4.3 times and 20 times the maximum activity at location 15-610747 and approximately 28 times and 134 times the maximum activity at location 15-610784. The industrial SAL was approximately 3.8 times the maximum activity at location 15-610723. The lateral extent of uranium-238 is defined, and vertical extent at location 15-610723 is not defined.

8.5.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 9×10^{-7} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 11, which is above the NMED target HI of 1 (NMED 2015, 600915). The elevated HI is from lead. The total dose is 2 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 8×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 12, which is above the NMED target HI of 1 (NMED 2015, 600915). The elevated HI is from lead. The total dose is 8 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Based on the risk-screening assessment results, no potential unacceptable cancer risks and doses exist for the industrial and residential scenarios at SWMU 15-008(b). There are potential unacceptable noncancer risks for the industrial and residential scenarios at SWMU 15-008(b).

8.5.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the American kestrel, desert cottontail, red fox, and Mexican spotted owl exist at SWMU 15-008(b). There is the potential for adverse effects to the American robin, montane shrew, deer mouse, earthworm, and plant at SWMU 15-008(b).

8.6 AOC 15-008(g)—Surface Disposal Associated with Firing Site R-45

8.6.1 Site Description and Operational History

AOC 15-008(g) is the location of a former pile of broken sandbags located in TA-15 at Firing Site R-45 [SWMU 15-006(d)] (Figure 8.6-1). The sandbags were used as shielding for the explosives tests carried out at the firing site (LANL 1996, 054977, p. 5-103). Firing Site R-45 was constructed in 1951 and was used until 1992 for experiments involving small amounts of explosives. The sandbags had been removed from the site.

8.6.2 Relationship to Other SWMUs and AOCs

AOC 15-008(g) is a component of Consolidated Unit 15-006(d)-99, along with SWMU 15-006(d), whose investigation is deferred per Table IV-2 of the Consent Order. AOC 15-008(g) is located adjacent to the R-45 firing site [SWMU 15-006(d)], and is approximately 100 ft north of SWMU 15-009(b), though on the other side of a berm from that site. SWMUs 15-007(c) and 15-007(d) are approximately 300 ft to the east and downgradient (Figure 8.1-1).

8.6.3 Summary of Previous Investigations

As part of RFI activities in 1995, a radiological survey of the site was conducted, and one surface sample was collected from one location. The sample was submitted for analyses of inorganic chemicals and HE (LANL 1996, 054977, p. 5-104).

Data from the sample collected during the 1995 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

8.6.4 Site Contamination

8.6.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at AOC 15-008(g). As a result, the following activities were completed as part of the 2009–2010 investigation.

- Eight samples were collected in 2009–2010 from four locations within and around AOC 15-008(g). At each location, samples were collected at the surface (0.0–0.5 ft bgs) and from the subsurface (2.0–2.5 ft bgs to 2.0–4.0 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, perchlorate, explosive compounds, americium-241, gamma-emitting radionuclides, tritium, isotopic plutonium, and isotopic uranium. Two samples were also analyzed for PCBs.

The 2009–2010 sampling locations at AOC 15-008(g) are shown on Figure 8.6-1. Table 8.6-1 presents the samples collected and analyses requested for AOC 15-008(g). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

8.6.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

8.6.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at AOC 15-008(g) consist of eight samples (six soil and two tuff) collected from four locations.

Inorganic Chemicals

Eight samples (six soil and two tuff) were collected at AOC 15-008(g) and analyzed for TAL metals, cyanide, perchlorate, and total uranium. Table 8.6-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Figure 8.6-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was detected above the soil and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) in one soil sample and one tuff sample with a maximum concentration of 3.77 mg/kg and had DLs (1.01 mg/kg to 1.24 mg/kg) above BVs in five soil samples and one tuff sample. Antimony is retained as a COPC.

Cadmium was not detected above the soil BV (0.4 mg/kg) but had DLs (0.508 mg/kg to 0.621 mg/kg) above the BV in six samples. The DLs were only 0.108 mg/kg to 0.221 mg/kg above the BV, below the highest background DL (2 mg/kg), and below or similar to the three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg). Cadmium was not detected in any samples. Cadmium is not a COPC.

Calcium was detected above the Qbt 2,3,4 BV (2200 mg/kg) in one sample at a concentration of 2810 mg/kg. Calcium is retained as a COPC.

Chromium was detected above the soil BV (19.3 mg/kg) in one sample at a concentration of 25.4 mg/kg. The concentration is 6.1 mg/kg above the BV and below the two highest soil background concentrations (26 mg/kg and 36.5 mg/kg). Chromium was detected below BVs in the other seven samples. Chromium is not a COPC.

Cobalt was detected above the soil BV (8.64 mg/kg) in one sample at a concentration of 14 mg/kg. Cobalt is retained as a COPC.

Copper was detected above the soil BV (14.7 mg/kg) in three samples with a maximum concentration of 41.3 mg/kg. Copper is retained as a COPC.

Lead was detected above the soil BV (22.3 mg/kg) in two samples with a maximum concentration of 370 mg/kg. Lead is retained as a COPC.

Selenium was not detected above the Qbt 2,3,4 BV (0.3 mg/kg) but had DLs (1.13 mg/kg) above the BV in two samples. Selenium is retained as a COPC.

Uranium was detected above the soil and Qbt 2,3,4 BVs (1.82 mg/kg and 2.4 mg/kg) in four soil samples and two tuff samples with a maximum concentration of 7.77 mg/kg. Uranium is retained as a COPC.

Organic Chemicals

Eight samples (six soil and two tuff) were collected at AOC 15-008(g) and analyzed for explosive compounds. Two soil samples were also analyzed for PCBs. Table 8.6-3 summarizes the analytical results for detected organic chemicals. Figure 8.6-3 shows the spatial distribution of detected organic chemicals.

Organic chemicals detected at AOC 15-008(g) include TATB. The detected organic chemical is retained as a COPC.

Radionuclides

Eight samples (six soil and two tuff) were collected at AOC 15-008(g) and analyzed for americium-241, gamma-emitting radionuclides, tritium, isotopic plutonium, and isotopic uranium. Table 8.6-4 presents the radionuclides detected or detected above BVs/FVs. Figure 8.6-4 shows the spatial distribution of detected radionuclides.

Tritium was detected in three samples with a maximum activity of 0.037 pCi/g. Tritium is retained as a COPC.

Uranium-238 was detected above the soil BV (2.29 pCi/g) in three samples with a maximum activity of 4.14 pCi/g. Uranium-238 is retained as a COPC.

8.6.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at AOC 15-008(g) are discussed below.

Inorganic Chemicals

Inorganic COPCs at AOC 15-008(g) include antimony, calcium, cobalt, copper, lead, selenium, and uranium.

Antimony was detected above the soil and Qbt 2,3,4 BVs in one soil sample and one tuff sample with a maximum concentration of 3.77 mg/kg and had DLs (1.01 mg/kg to 1.24 mg/kg) above the BVs in five soil samples and one tuff sample. Concentrations increased with depth at location 15-610566 and decreased with depth at location 15-610568. Concentrations increased laterally at location 15-610568 but decreased downgradient. The residential and industrial SSLs were approximately 8.3 times and 138 times the maximum concentration, and the residential SSL was approximately 25 times the maximum DL. Further sampling for extent of antimony is not warranted.

Calcium was detected above the Qbt 2,3,4 BV in one sample at a concentration of 2810 mg/kg. Concentrations did not change substantially with depth (150 mg/kg) at location 15-610566 (the concentration in the shallow sample at location 15-610566 was 2960 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased laterally and downgradient. The NMED residential essential nutrient SSL was approximately 4600 times the maximum concentration. The lateral extent of calcium is defined, and further sampling for vertical extent is not warranted.

Cobalt was detected above the soil BV in one sample at a concentration of 14 mg/kg. Concentrations decreased with depth and downgradient but increased laterally at location 15-610568. The residential and industrial SSLs were approximately 1.6 times and 25 times the maximum concentration, respectively. The vertical extent of cobalt is defined, and further sampling for lateral extent is not warranted.

Copper was detected above the soil BV in three samples with a maximum concentration of 41.3 mg/kg. Concentrations decreased with depth at all locations and decreased laterally and downgradient. The lateral and vertical extent of copper are defined.

Lead was detected above the soil BV in two samples with a maximum concentration of 370 mg/kg. Concentrations decreased with depth at both locations and decreased downgradient but increased laterally at location 15-610568. The residential SSL was approximately 1.1 times the maximum concentration and the industrial SSL was approximately 2.2 times the maximum concentration at location 15-610568. The vertical extent of lead is defined, and lateral extent at location 15-610568 is not defined.

Selenium was not detected above the Qbt 2,3,4 BV but had DLs (1.13 mg/kg) above the BV in two samples. Because selenium was not detected above BV and the residential SSL was approximately 346 times the maximum DL, further sampling for extent of selenium is not warranted.

Uranium was detected above the soil and Qbt 2,3,4 BVs in four soil samples and two tuff samples with a maximum concentration of 7.77 mg/kg. Concentrations increased with depth at location 15-610565, did not change substantially with depth (0.56 mg/kg and 0.23 mg/kg) at locations 15-610566 and 15-610568, and decreased with depth at location 15-610567. Concentrations decreased or did not change substantially laterally (0.1 mg/kg to 0.23 mg/kg) at location 15-610568 and increased downgradient at location 15-610565. The residential SSL was approximately 30 times the maximum concentration. Further sampling for extent of uranium is not warranted.

Organic Chemicals

Organic COPCs at AOC 15-008(g) include TATB.

TATB was detected in six samples with a maximum concentration of 27.3 mg/kg. Concentrations increased with depth at locations 15-610566, 15-610567, and 15-610568 and decreased with depth at location 15-610565. Concentrations increased laterally and downgradient. The residential SSL was approximately 81 times the maximum concentration. Further sampling for extent of TATB is not warranted.

Radionuclides

Radionuclide COPCs at AOC 15-008(g) include tritium and uranium-238.

Tritium was detected in three samples with a maximum activity of 0.037 pCi/g. Activities increased with depth at locations 15-610566 and 15-610568 and decreased with depth at location 15-610565. Activities did not change substantially (0.011 pCi/g to 0.021 pCi/g) laterally and downgradient. The residential SAL was approximately 46,000 times the maximum activity. Further sampling for extent of tritium is not warranted.

Uranium-238 was detected above the soil BV in three samples with a maximum activity of 4.14 pCi/g. Activities increased with depth at location 15-610565 and decreased with depth at locations 15-610566 and 15-610568. Activities decreased laterally and downgradient. The residential SAL was approximately 36 times the maximum activity. The lateral extent of uranium-238 is defined, and further sampling for vertical extent is not warranted.

8.6.5 Summary of Human Health Risk Screening

Industrial Scenario

No carcinogenic COPCs were identified for the industrial scenario. The HI is 0.5, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

No carcinogenic COPCs were identified for the residential scenario. The HI is approximately 1, which is equivalent to the NMED target HI of 1 (NMED 2015, 600915). The HI is primarily from lead. The lead EPC is less than the residential SSL, and the HI without lead is 0.6. The total dose is 0.5 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and~~ residential, and construction worker scenarios at AOC 15-008(g).

8.6.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at AOC 15-008(g).

8.7 SWMU 15-009(b)—Septic System

8.7.1 Site Description and Operational History

SWMU 15-009(b) is a septic system located at Firing Site R-45 at TA-15. The septic system consists of a former septic tank (structure 15-61), a seepage pit, associated drainlines, and a former outfall (Figure 8.7-1). The septic tank was constructed in 1951 of reinforced concrete with a 540-gal. capacity. This septic system served restroom facilities in the firing site control building 15-45. The septic tank originally discharged to an outfall located approximately 20 ft southeast of the septic tank. In the 1970s, a seepage pit measuring approximately 4 ft in diameter × 50 ft deep, was constructed to receive discharges from the septic tank. A 2003 engineering drawing shows the outfall pipe has been plugged (LANL 2003, 102118).

The septic tank (structure 15-61) was removed in 2010 during the 2009–2010 investigation, but the drainlines and seepage pit remain in place.

8.7.2 Relationship to Other SWMUs and AOCs

SWMU 15-009(b) is located approximately 100 ft south of Firing Site R-45 [SWMU 15-006(d)] and AOC 15-008(g), though on the other side of a berm from those sites. SWMUs 15-007(c) and 15-007(d) are located approximately 300 ft to the east (Figure 8.1-1).

8.7.3 Summary of Previous Investigations

No sampling was conducted at this SWMU before 2009.

8.7.4 Site Contamination

8.7.4.1 Soil, Rock, and Sediment Sampling

Because no previous investigations had been conducted, characterization was required to assess potential contamination at SWMU 15-009(b). As a result, the following activities were completed as part of the 2009–2010 investigation.

- Twenty samples were collected in 2009–2010 from nine locations. Eight samples were collected from four locations beneath the inlet drainline, septic tank inlet and outlet, and septic tank. Samples were collected from two depth intervals (7.0–8.0 ft bgs or 15.0–16.0 ft bgs and 12.0–13.0 ft bgs or 17.0–18.0 ft bgs) at each location. Eight samples were collected from four locations in the drainage below the septic tank outfall. Samples were collected from two depth intervals (0.0–0.3 ft bgs to 0.0–1.0 ft bgs and 1.0–1.5 ft bgs or 1.0–2.0 ft bgs). Four samples were collected from a borehole adjacent to the seepage pit. Samples were collected at intervals of 47.5–50.0 ft bgs, 58.5–60.0 ft bgs, 68.5–70.0 ft bgs, and 78.5–80.0 ft bgs. All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, nitrate, perchlorate, total uranium, explosive compounds, SVOCs, VOCs, americium-241, gamma-emitting radionuclides, tritium, isotopic plutonium, and isotopic uranium. Eight samples were also analyzed for PCBs.
- All investigation samples were field-screened for gross-alpha and -beta radioactivity. Field-screening results were recorded on borehole logs and/or corresponding SCLs. Borehole logs are presented in Appendix C, and SCLs/COC forms are included in Appendix E.

The 2009–2010 sampling locations at SWMU 15-009(b) are shown on Figure 8.7-1. Table 8.7-1 presents the samples collected and analyses requested for SWMU 15-009(b). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

8.7.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

8.7.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 15-009(b) consist of 20 samples (8 soil, 5 sediment, and 7 tuff) collected from 9 locations.

Inorganic Chemicals

A total of 20 samples (8 soil, 5 sediment, and 7 tuff) were collected at SWMU 15-009(b) and analyzed for TAL metals, cyanide, nitrate, perchlorate, and total uranium. Table 8.7-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Figure 8.7-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was not detected above the soil, sediment, and Qbt 2,3,4 BVs (0.83 mg/kg, 0.83 mg/kg, and 0.5 mg/kg) but had DLs (0.787 mg/kg to 1.44 mg/kg) above the BVs in three soil samples, four sediment samples, and seven tuff samples. Antimony is retained as a COPC.

Barium was detected above the sediment and Qbt 2,3,4 BVs (127 mg/kg and 46 mg/kg) in one sediment sample and one tuff sample with a maximum concentration of 134 mg/kg. Barium is retained as a COPC.

Cadmium was not detected above the soil and sediment BVs (0.4 mg/kg for both) but had DLs (0.556 mg/kg to 0.757 mg/kg) above the BVs in one soil sample and five sediment samples. Cadmium is retained as a COPC.

Calcium was detected above the soil BV (6120 mg/kg) in one sample at a concentration of 6640 mg/kg. The Gehan and quantile tests indicated site concentrations of calcium in soil are not statistically different from background (Figure G-123 and Table G-16). Calcium is not a COPC.

Chromium was detected above the sediment and Qbt 2,3,4 BVs (10.5 mg/kg and 7.14 mg/kg) in one sediment sample and two tuff samples with a maximum concentration of 19.1 mg/kg. Chromium is retained as a COPC.

Copper was detected above the sediment and Qbt 2,3,4 BVs (11.2 mg/kg and 4.66 mg/kg) in one sediment sample and one tuff sample with a maximum concentration of 17.8 mg/kg. Copper is retained as a COPC.

Cyanide was detected above the sediment BV (0.82 mg/kg) in one sample at a concentration of 1.22 mg/kg. Cyanide is retained as a COPC.

Lead was detected above the sediment BV (19.7 mg/kg) in one sample at a concentration of 28.2 mg/kg. Lead is retained as a COPC.

Nitrate was detected in three samples at a maximum concentration of 2.76 mg/kg. ~~Although Nitrate is naturally occurring, the SWMU is a septic system that managed sanitary wastewater. and As a result, the concentrations detected may be site related rather than reflecting only naturally occurring levels of nitrate.~~ Nitrate is ~~not retained as~~ a COPC.

Perchlorate was detected in four samples with a maximum concentration of 0.00247 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above sediment and Qbt 2,3,4 BVs (0.3 mg/kg for both) but had DLs (0.669 mg/kg to 1.59 mg/kg) above BVs in five sediment samples and seven tuff samples. Selenium is retained as a COPC.

Uranium was detected above the soil, sediment, and Qbt 2,3,4 BVs (1.82 mg/kg, 2.22 mg/kg, and 2.4 mg/kg) in five soil samples, four sediment samples, and two tuff samples with a maximum concentration of 615 mg/kg. The Gehan and quantile tests indicated site concentrations of uranium in soil are statistically different from background (Figure G-124 and Table G-16). Uranium is retained as a COPC.

Zinc was detected above soil BV (48.8 mg/kg) in four samples with a maximum concentration of 114 mg/kg. The Gehan and quantile tests indicated site concentrations of zinc in soil are statistically different from background (Figure G-125 and Table G-16). Zinc is retained as a COPC.

Organic Chemicals

A total of 20 samples (8 soil, 5 sediment, and 7 tuff) were collected at SWMU 15-009(b) and analyzed for explosive compounds, SVOCs, and VOCs. Eight samples (two soil, one sediment, and five tuff) were also analyzed for PCBs. Table 8.7-3 summarizes the analytical results for detected organic chemicals. Figure 8.7-3 shows the spatial distribution of detected organic chemicals.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons are a class of SVOCs frequently detected as a result of environmental sampling but generally were not released from the SWMUs or AOCs being investigated. PAHs unrelated to site activities are thus often detected in samples analyzed for the presence of site-related SVOCs.

PAHs are known to be widely distributed in the environment from a number of sources, both natural, such as forest fires, and anthropogenic, such as combustion of fossil fuels, oil drips off motor vehicles, vehicle tires, coal tar pitch, and weathering or eroding of asphalt pavement (Kose et al. 2008, 219977; Teaf 2008, 219976). PAHs from these sources generally occur as complex mixtures, not as single compounds. Individual PAH compounds can be manufactured for research purposes, and some PAHs (e.g., anthracene, fluorene, naphthalene, and pyrene) are used in dye production, the manufacture of synthetic fibers, and in plastics and pesticides.

The principal sources of PAHs in soil along parking lots, roads, and highways are vehicular exhaust and emissions, the wearing of tires, and asphalt. PAH-containing materials, such as asphalt and rubber particles, do not easily dissolve in water, preventing migration, except as suspended particles in storm water. PAH concentrations in excess of soil cleanup levels may result from common anthropogenic sources, such as runoff from asphalt parking lots.

Site Activities

SWMU 15-009(b) was identified as a SWMU because of possible soil contamination resulting from releases from the R-45 firing site control building to the septic tank and associated outfall and seepage pit. PAHs were not used in the firing site control building.

SWMU 15-009(b) is located adjacent to a paved parking/storage area and paved road providing access to the control building (Appendix I, Figures I-5 and I-6). The asphalt in these areas is weathered, and runoff from the asphalt flows to the area where samples were collected. Although PAHs were detected in samples collected from depth at this site, sampling was performed during septic tank removal and samples were collected from a backhoe bucket during sampling, making cross contamination from the surface likely. Based on the fact that PAHs were not used in the building associated with the septic tank, and the fact that the sampled area receives storm-water runoff from weathered asphalt, the low concentrations of PAHs detected in samples used to characterize this site [acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, fluorene, indeno(1.2.3-cd)pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene] are associated with the weathered asphalt, are not related to historic Laboratory site operations, and are not COPCs.

Organic COPCs

Other organic chemicals detected at SWMU 15-009(b) include acetone; Aroclor-1242; Aroclor-1254; Aroclor-1260; 2-butanone; 4-isopropyltoluene; methylene chloride; toluene; 1,2,4-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene. The detected organic chemicals listed are retained as COPCs.

Radionuclides

A total of 20 samples (8 soil, 5 sediment, and 7 tuff) were collected at SWMU 15-009(b) and analyzed for americium-241, gamma-emitting radionuclides, tritium, isotopic plutonium, and isotopic uranium. Table 8.7-4 presents the radionuclides detected or detected above BVs/FVs. Figure 8.7-4 shows the spatial distribution of detected radionuclides.

Cesium-137 was detected above the sediment FV (0.9 pCi/g) in one sample and was detected below 1 ft bgs in three soil samples with a maximum activity of 2.54 pCi/g. Cesium-137 is retained as a COPC.

Plutonium-239/240 was detected above the sediment FV (0.068 pCi/g) in one sample at an activity of 0.134 pCi/g. Plutonium-239/240 is retained as a COPC.

Tritium was detected above the sediment FV (0.093 pCi/g) in one sample and was detected in eight soil samples and seven tuff samples with a maximum activity of 0.263 pCi/g. Tritium is retained as a COPC.

Uranium-234 was detected above the soil and sediment BVs (2.59 pCi/g for both) in one soil sample and four sediment samples with a maximum activity of 303 pCi/g. Uranium-234 is retained as a COPC.

Uranium-235/236 was detected above the sediment BV (0.2 pCi/g) in four samples with a maximum activity of 20.3 pCi/g. Uranium-235/236 is retained as a COPC.

Uranium-238 was detected above the soil and sediment BVs (2.29 pCi/g for both) in one soil sample and four sediment samples with a maximum activity of 311 pCi/g. Uranium-238 is retained as a COPC.

8.7.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMU 15-009(b) are discussed below.

Inorganic Chemicals

Inorganic COPCs at SWMU 15-009(b) include antimony, barium, cadmium, chromium, copper, cyanide, lead, nitrate, perchlorate, selenium, uranium, and zinc.

Antimony was not detected above the soil, sediment, and Qbt 2,3,4 BVs but had DLs (0.787 mg/kg to 1.44 mg/kg) above BVs in three soil samples, four sediment samples, and seven tuff samples. Because antimony was not detected above BVs and the residential SSL was approximately 22 times the maximum DL, further sampling for extent of antimony is not warranted.

Barium was detected above the sediment and Qbt 2,3,4 BVs in one sediment sample and one tuff sample with a maximum concentration of 134 mg/kg. Concentrations increased with depth at location 15-610833 and decreased with depth at location 15-610831. Concentrations increased downgradient. The residential SSL was approximately 116 times the maximum concentration. Further sampling for extent of barium is not warranted.

Cadmium was not detected above the soil and sediment BVs but had DLs (0.556 mg/kg to 0.757 mg/kg) above BVs in one soil sample and five sediment samples. Because cadmium was not detected above BVs and the residential SSL was approximately 93 times the maximum DL, further sampling for extent of cadmium is not warranted.

Chromium was detected above the sediment and Qbt 2,3,4 BVs in one sediment sample and two tuff samples with a maximum concentration of 19.1 mg/kg. Concentrations increased with depth at locations 15-610829 and 15-610833 and decreased downgradient. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 6100 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Copper was detected above the sediment and Qbt 2,3,4 BVs in one sediment sample and one tuff sample with a maximum concentration of 17.8 mg/kg. Concentrations increased with depth at location 15-610833 and decreased with depth at location 15-610831. The concentration at location 15-610833 was below the maximum Qbt 2,3,4 background concentration (6.2 mg/kg). Concentrations increased downgradient. The residential SSL was approximately 176 times the maximum concentration. Further sampling for extent of copper is not warranted.

Cyanide was detected above the sediment BV in one sample at a concentration of 1.22 mg/kg. Concentrations decreased with depth and increased downgradient. The residential and industrial SSLs were approximately 9.2 times and 52 times the maximum concentration, respectively. The vertical extent of cyanide is defined, and further sampling for lateral extent is not warranted.

Lead was detected above the sediment BV in one sample at a concentration of 28.2 mg/kg. Concentrations decreased with depth and increased downgradient. The downgradient concentration at location 15-610831 was only 0.2 mg/kg above the maximum soil background concentration (28 mg/kg). The residential and industrial SSLs were approximately 14 times and 238 times the maximum concentration, respectively. The vertical extent of lead is defined, and further sampling for lateral extent is not warranted.

Nitrate was detected in three samples at a maximum concentration of 2.76 mg/kg. Concentrations increased with depth at locations 15-610829 and 15-610830, decreased with depth at location 15-610832, and decreased downgradient. The residential SSL was approximately 45,000 times the maximum concentration. Lateral extent of nitrate is defined, and further sampling for vertical extent is not warranted.

Perchlorate was detected in four samples with a maximum concentration of 0.00247 mg/kg. Concentrations increased with depth at location 15-610829 but were below the EDL. Concentrations decreased with depth at location 15-610834 and did not change substantially with depth (0.00141 mg/kg) at location 15-610836. Concentrations decreased downgradient. The residential SSL was approximately 22,000 times the maximum concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Selenium was not detected above the sediment and Qbt 2,3,4 BVs but had DLs (0.669 mg/kg to 1.59 mg/kg) above BVs in five sediment samples and seven tuff samples. Because selenium was not detected above BVs and the residential SSL was approximately 246 times the maximum DL, further sampling for extent of selenium is not warranted.

Uranium was detected above the soil, sediment, and Qbt 2,3,4 BVs in five soil samples, four sediment samples, and two tuff samples with a maximum concentration of 615 mg/kg. Concentrations increased with depth at locations 15-610829 and 15-610835 and decreased with depth at locations 15-610830, 15-610831, 15-610832, 15-610833, and 15-610834. Concentrations increased downgradient. The residential SSL was approximately 89 times and 50 times the maximum concentrations at locations 15-610829 and 15-610835, respectively. The industrial SSL was approximately 6.3 times the maximum concentration. Further sampling for vertical extent of uranium is not warranted, and lateral extent at location 15-610831 is not defined.

Zinc was detected above the soil BV in four samples with a maximum concentration of 114 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of zinc are defined.

Organic Chemicals

Organic COPCs at SWMU 15-009(b) include acetone; Aroclor-1242; Aroclor-1254; Aroclor-1260; 2-butanone; 4-isopropyltoluene; methylene chloride; toluene; 1,2,4-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene.

Acetone was detected in seven samples with a maximum concentration of 0.131 mg/kg. Concentrations decreased with depth at locations 15-610829, 15-610830, and 15-610831 and did not change substantially with depth (0.018 mg/kg and 0.014 mg/kg) at locations 15-610834 and 15-610835. Concentrations increased downgradient. The residential SSL was approximately 4,700,000 times the downgradient concentration at location 15-610831 and approximately 500,000 times the maximum concentration. Further sampling for extent of acetone is not warranted.

Aroclor-1242, Aroclor-1254, and Aroclor-1260 were each detected in one sample at concentrations of 0.0272 mg/kg, 0.0312 mg/kg, and 0.0131 mg/kg, respectively. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of Aroclor-1242, Aroclor-1254, and Aroclor-1260 are defined.

Butanone[2-] was detected in one sample at a concentration of 0.0024 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of 2-butanone are defined.

Isopropyltoluene[4-] was detected in nine samples with a maximum concentration of 0.0167 mg/kg. Concentrations decreased with depth at locations 15-610829, 15-610831, 15-610834, and 15-610836 and did not change substantially with depth (0.0028 mg/kg and 0.0045 mg/kg) at locations 15-610830 and 15-610835. Concentrations did not change substantially downgradient (0.00815 mg/kg). The residential SSL was approximately 141,000 times the maximum concentration. Further sampling for extent of 4-isopropyltoluene is not warranted.

Methylene chloride was detected in one sample at a concentration of 0.0024 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of methylene chloride are defined.

Toluene was detected in eight samples with a maximum concentration of 0.0102 mg/kg. Concentrations increased with depth at location 15-610836, decreased with depth at location 15-610831, and did not change substantially with depth (0.000383 mg/kg to 0.00169 mg/kg) at locations 15-610830, 15-610834, and 15-610835. Concentrations increased downgradient. The residential SSL was approximately 513,000 times the maximum concentration. Further sampling for extent of toluene is not warranted.

Trimethylbenzene[1,2,4-]; 1,2-xylene; and 1,3-xylene+1,4-xylene were each detected in two samples with maximum concentrations of 0.000651 mg/kg, 0.000574 mg/kg, and 0.000702 mg/kg, respectively. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of 1,2,4-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene are defined.

Radionuclides

Radionuclide COPCs at SWMU 15-009(b) include cesium-137, plutonium-239/240, tritium, uranium-234, uranium-235/236, and uranium-238.

Cesium-137 was detected above the sediment FV in one sample and was detected below 1 ft bgs in three soil samples with a maximum activity of 2.54 pCi/g. Activities decreased with depth at all locations but increased downgradient. The residential and industrial SALs were approximately 4.7 times and 16 times the maximum activity, respectively. The vertical extent of cesium-137 is defined, and further sampling for lateral extent is not warranted.

Plutonium-239/240 was detected above the sediment FV in one sample at an activity of 0.134 pCi/g. Activities decreased with depth but increased downgradient. The residential SAL was approximately 592 times the maximum activity. The vertical extent of plutonium-239/240 is defined, and further sampling for lateral extent is not warranted.

Tritium was detected above the sediment FV in one sample and was detected in eight soil samples and seven tuff samples with a maximum activity of 0.263 pCi/g. Activities increased with depth at locations 15-610829 and 15-610833, did not change substantially with depth (0.006 pCi/g to 0.076 pCi/g) at all other locations, and decreased downgradient. The residential SAL was approximately 6500 times the maximum activity. The lateral extent of tritium is defined, and further sampling for vertical extent is not warranted.

Uranium-234 was detected above the soil and sediment BVs in one soil sample and four sediment samples with a maximum activity of 303 pCi/g. Activities decreased with depth at all locations and increased downgradient. The industrial SAL was approximately 10 times the maximum activity. The vertical extent of uranium-234 is defined, and lateral extent is not defined.

Uranium-235/236 was detected above the sediment BV in four samples with a maximum activity of 20.3 pCi/g. Activities decreased with depth at all locations and increased downgradient. The industrial SAL was approximately 7.9 times the maximum activity. The vertical extent of uranium-235/236 is defined, and lateral extent is not defined.

Uranium-238 was detected above the soil and sediment BVs in one soil sample and four sediment samples with a maximum activity of 311 pCi/g. Activities decreased with depth at all locations and increased downgradient. The industrial SAL was approximately 2.3 times the maximum activity. The vertical extent of uranium-238 is defined, and lateral extent is not defined.

8.7.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 3×10^{-7} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.2, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 18 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 2, which is above the NMED target HI of 1 (NMED 2015, 600915). The elevated HI is primarily from uranium. The total dose is 46 mrem/yr, which is above the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The dose is primarily from isotopic uranium.

Based on the risk-screening assessment results, there are no potential unacceptable risks or doses for the industrial scenario at SWMU 15-009(b). There is also no potential unacceptable cancer risk, but there are potential unacceptable noncancer risks and doses for the residential scenario at SWMU 15-009(b).

8.7.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at SWMU 15-009(b).

8.8 SWMU 15-009(c)—Septic System

8.8.1 Site Description and Operational History

SWMU 15-009(c) is a septic system located at Firing Site R-44 at TA-15. The septic system consists of a former septic tank (structure 15-62), associated drainlines, and a former outfall (Plate 17). The septic tank was constructed in 1951 of reinforced concrete with a 540-gal. capacity. The septic system served restroom facilities in the firing site control building 15-44. The drainlines were constructed of cast iron and discharged to an outfall into the south fork of Threemile Canyon. The outfall, located approximately 25 ft downgradient of the tank, has been plugged (LANL 2003, 102119).

The septic tank (structure 15-62) was removed during the 2009–2010 investigation but the drainlines remain in place.

8.8.2 Relationship to Other SWMUs and AOCs

SWMU 15-009(c) is located approximately 150 ft south of Firing Site R-44 [SWMU 15-006(c)] and SWMU 15-008(b), though on the other side of a berm from those sites (Plate 17).

8.8.3 Summary of Previous Investigations

In 1998, interim action RFI activities were performed at SWMU 15-009(c). Nine samples were collected from four locations and analyzed for inorganic chemicals and radionuclides. Data from these samples meet the current data-validation standards and are decision-level data included in this report.

8.8.4 Site Contamination

8.8.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at SWMU 15-009(c). As a result, the following activities were completed as part of the 2009–2010 investigation.

- A total of 33 samples were collected in 2009–2010 from 17 locations. Eight samples were collected from four locations beneath the inlet drainline, septic tank inlet and outlet, and septic tank. Samples were collected from two depth intervals (2.0–2.5 ft bgs to 10.5–11.0 ft bgs and 7.0–7.5 ft bgs to 15.5–16.0 ft bgs) at each location. Twenty-five samples were collected from 13 locations in the drainage below the septic tank outfall. Samples were collected from two depth intervals (0.0–0.5 ft bgs to 0.0–1.0 ft bgs and 1.0–1.2 ft bgs to 1.0–2.0 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, nitrate, perchlorate, total uranium, explosive compounds, SVOCs, VOCs, americium-241, gamma-emitting radionuclides, tritium, isotopic plutonium, and isotopic uranium. Eight samples were also analyzed for PCBs.

The 2009–2010 sampling locations at SWMU 15-009(c) are shown on Plate 17. Table 8.8-1 presents the samples collected and analyses requested for SWMU 15-009(c). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

8.8.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

8.8.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 15-009(c) consist of 42 samples (18 soil, 12 sediment, and 12 tuff) collected from 21 locations.

Inorganic Chemicals

A total of 42 samples (18 soil, 12 sediment, and 12 tuff) were collected at SWMU 15-009(c) and analyzed for TAL metals. A total of 33 samples (9 soil, 12 sediment, and 12 tuff) were also analyzed for cyanide, nitrate, perchlorate, and total uranium. Table 8.8-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Plate 18 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was detected above the Qbt 2,3,4 BV (0.5 mg/kg) in 1 sample at a concentration of 0.602 mg/kg and had DLs (0.577 mg/kg to 11 mg/kg) above the soil and sediment BVs (0.83 mg/kg and 0.5 mg/kg) and the Qbt 2,3,4 BV in 16 soil samples, 10 sediment samples, and 10 tuff samples. Antimony is retained as a COPC.

Beryllium was detected above the soil BV (1.83 mg/kg) in one sample at a concentration of 2.4 mg/kg. The Gehan and quantile tests indicated site concentrations of beryllium in soil are not statistically different from background (Figure G-126 and Table G-17). Beryllium is not a COPC.

Cadmium was not detected above the soil and sediment BVs (0.4 mg/kg for both) but had DLs (0.5 mg/kg to 0.635 mg/kg) above BVs in 11 soil samples and 6 sediment samples. The DLs were 0.1 mg/kg to 0.235 mg/kg above the BVs, and the soil DLs were below or similar to the three highest background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg). Cadmium was not detected or detected below BVs in the other 25 samples (detected below BVs in 16 samples). Cadmium is not a COPC.

Calcium was detected above the soil BV (6120 mg/kg) in one sample at a concentration of 6730 mg/kg. The Gehan and quantile tests indicated site concentrations of calcium in soil are not statistically different from background (Figure G-127 and Table G-17). Calcium is not a COPC.

Chromium was detected above the sediment and Qbt 2,3,4 BVs (10.5 mg/kg and 7.14 mg/kg) in 45 sediment samples and 409 tuff samples with a maximum concentration of 23.6 mg/kg. The quantile and slippage tests indicated site concentrations of chromium in sediment are statistically different from background (Figure G-128 and Table G-18). The Gehan and quantile tests indicated site concentrations of chromium in tuff are statistically different from background (Figure G-129 and Table G-19). Chromium is retained as a COPC.

Cyanide was detected above the soil BV (0.5 mg/kg) in one sample at a concentration of 1.69 mg/kg. Cyanide is retained as a COPC.

Lead was detected above the soil BV (22.3 mg/kg) in one sample at a concentration of 130 mg/kg. The Gehan and quantile tests indicated site concentrations of lead in soil are not statistically different from background (Figure G-130 and Table G-17). Lead is not a COPC.

Mercury was not detected above the soil BV (0.1 mg/kg) but had DLs (0.11 mg/kg) above the BV in four samples. The DLs were only 0.01 mg/kg above the BV. Mercury was not detected or detected above BV in the other 38 samples (detected below BV in 21 samples). Mercury is not a COPC.

Nitrate was detected in seven samples with a maximum concentration of 2.24 mg/kg. Although Nitrate is naturally occurring, the SWMU is a septic system that managed sanitary wastewater. As a result, and the concentrations detected may be site related rather than reflecting only naturally occurring levels of nitrate. Nitrate is not retained as a COPC.

Perchlorate was detected in seven samples with a maximum concentration of 0.00135 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the sediment and Qbt 2,3,4 BVs (0.3 mg/kg for both) but had DLs (0.97 mg/kg to 1.3 mg/kg) above the BVs in 12 sediment samples and 12 tuff samples. Selenium is retained as a COPC.

Silver was not detected above the soil BV (1 mg/kg) but had DLs (2.0 mg/kg to 2.2 mg/kg) above the BV in nine samples. Silver is retained as a COPC.

Uranium was detected above the soil, sediment, and Qbt 2,3,4 BVs (1.82 mg/kg, 2.22 mg/kg, and 2.4 mg/kg) in four soil samples, nine sediment samples, and four tuff samples with a maximum concentration of 8.8 mg/kg. The Gehan and quantile tests indicated site concentrations of uranium in soil, sediment, and tuff are statistically different from background (Figure G-131 and Table G-17, Figure G-132 and Table G-18, and Figure G-133 and Table G-19, respectively). Uranium is retained as a COPC.

Zinc was detected above the soil BV (48.8 mg/kg) in three samples with a maximum concentration of 56.3 mg/kg. The Gehan test indicated site concentrations of zinc in soil are statistically different from background (Table G-17). However, the quantile and slippage tests indicated site concentrations of zinc in soil are not statistically different from background (Figure G-134 and Table G-17). Zinc is not a COPC.

Organic Chemicals

A total of 42 samples (18 soil, 12 sediment, and 12 tuff) were collected at SWMU 15-009(c) and analyzed for explosive compounds, SVOCs, and VOCs. Eight samples (two soil, two sediment, and four tuff) were also analyzed for PCBs, and eight soil samples were analyzed for pesticides. Table 8.8-3 summarizes the analytical results for detected organic chemicals. Plate 19 shows the spatial distribution of detected organic chemicals.

Organic chemicals detected at SWMU 15-009(c) include acetone; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; bis(2-ethylhexyl)phthalate; chrysene; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; 4-isopropyltoluene; phenanthrene; pyrene; toluene; 1,2,4-trimethylbenzene; and 1,3-xylene+1,4-xylene. The detected organic chemicals are retained as COPCs.

Radionuclides

A total of 42 samples (18 soil, 12 sediment, and 12 tuff) were collected at SWMU 15-009(c) and analyzed for gamma-emitting radionuclides, isotopic uranium, and tritium. A total of 33 samples (9 soil, 12 sediment, and 12 tuff) were also analyzed for americium-241 and isotopic plutonium. Table 8.8-4 presents the radionuclides detected or detected above BVs/FVs. Plate 20 shows the spatial distribution of detected radionuclides.

Tritium was detected above the sediment FV (0.093 pCi/g) in one sample and was detected in eight soil samples and nine tuff samples with a maximum activity of 0.173 pCi/g. Tritium is retained as a COPC.

Uranium-234 was detected above the sediment and Qbt 2,3,4 BVs (2.59 pCi/g and 1.98 pCi/g) in two sediment samples and one tuff sample with a maximum activity of 13.9 pCi/g. Uranium-234 is retained as a COPC.

Uranium-235/236 was detected above the sediment and Qbt 2,3,4 BVs (0.2 pCi/g and 0.09 pCi/g) in one sediment sample and one tuff sample with a maximum activity of 0.78 pCi/g. Uranium-235/236 is retained as a COPC.

Uranium-238 was detected above the soil, sediment, and Qbt 2,3,4 BVs (2.29 pCi/g, 2.29 pCi/g, and 1.93 pCi/g) in one soil sample, seven sediment samples, and two tuff samples with a maximum activity of 15.1 pCi/g. Uranium-238 is retained as a COPC.

8.8.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMU 15-009(c) are discussed below.

Inorganic Chemicals

Inorganic COPCs at SWMU 15-009(c) include antimony, chromium, cyanide, nitrate, perchlorate, selenium, silver, and uranium.

Antimony was detected above the Qbt 2,3,4 BV in 1 sample at a concentration of 0.602 mg/kg and had DLs (0.577 mg/kg to 11 mg/kg) above the soil, sediment, and Qbt 2,3,4 BVs in 16 soil samples, 10 sediment samples, and 10 tuff samples. Concentrations increased with depth at location 15-610844 and decreased downgradient. The residential SSL was approximately 52 times the maximum concentration, and the residential and industrial SSLs were approximately 2.8 times and 47 times the maximum DL, respectively. Further sampling for extent of antimony is not warranted.

Chromium was detected above the sediment and Qbt 2,3,4 BVs in 45 sediment samples and 409 tuff samples with a maximum concentration of 23.6 mg/kg. Concentrations increased with depth at locations 15-610838, 15-610848, and 15-610852, and only one depth was sampled at location 15-610854 (concentration was the same as the maximum Qbt 2,3,4 background concentration). Concentrations did not change substantially with depth (1.0 mg/kg) at location 15-610845 and decreased with depth at locations 15-610839, 15-610840, 15-610846, and 15-610850 and decreased downgradient. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 4960 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Cyanide was detected above the soil BV in one sample at a concentration of 1.69 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of cyanide are defined.

Nitrate was detected in seven samples with a maximum concentration of 2.24 mg/kg. Concentrations increased with depth at locations 15-610838 and 15-610841, did not change substantially with depth (0.1 mg/kg and 0.11 mg/kg) at locations 15-610842 and 15-610844, decreased with depth at location 15-610843, and decreased downgradient. The residential SSL was approximately 56,000 times the maximum concentration. Lateral extent of nitrate is defined, and further sampling for vertical extent is not warranted.

Perchlorate was detected in seven samples with a maximum concentration of 0.00135 mg/kg. Concentrations increased with depth at location 15-610841, did not change substantially with depth (0.00026 mg/kg and 0.000037 mg/kg) at locations 15-610842 and 15-610844, decreased with depth at locations 15-610843 and 15-610848, and decreased downgradient. The detected concentrations were below EDLs. The residential SSL was approximately 40,600 times the maximum concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Selenium was not detected above the sediment and Qbt 2,3,4 BVs but had DLs (0.97 mg/kg to 1.3 mg/kg) above the BVs in 12 sediment samples and 12 tuff samples. Because selenium was not detected above BVs and the residential SSL was approximately 300 times the maximum DL, further sampling for extent of selenium is not warranted.

Silver was not detected above the soil BV but had DLs (2.0 mg/kg to 2.2 mg/kg) above the BV in nine samples. Because silver was not detected above BVs and the residential SSL was approximately 178 times the maximum DL, further sampling for extent of silver is not warranted.

Uranium was detected above the soil, sediment, and Qbt 2,3,4 BVs in four soil samples, nine sediment samples, and four tuff samples with a maximum concentration of 8.8 mg/kg. Concentrations increased with depth at locations 15-610838, 15-610845, and 15-610846 and did not change substantially with depth (0.09 mg/kg to 1.28 mg/kg) at locations 15-610849, 15-610850, 15-610852, and 15-610853. Only one depth was sampled at location 15-610854. Concentrations decreased with depth at locations 15-610839, 15-610842, 15-610843, 15-610847, and 15-610848. Concentrations did not change substantially downgradient (0.61 mg/kg). The residential SSL was approximately 26 times the maximum concentration. Further sampling for extent of uranium is not warranted.

Organic Chemicals

Organic COPCs at SWMU 15-009(c) include acetone; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; bis(2-ethylhexyl)phthalate; chrysene; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; 4-isopropyltoluene, phenanthrene; pyrene; toluene; 1,2,4-trimethylbenzene; and 1,3-xylene+1,4-xylene.

Acetone was detected in five samples with a maximum concentration of 0.0527 mg/kg. Concentrations increased with depth at locations 15-610839, 15-610840, 15-610852, and 15-610853 and decreased with depth at location 15-610851. Concentrations did not change substantially downgradient (0.051 mg/kg). The residential SSL was approximately 1,260,000 times the maximum concentration. Further sampling for extent of acetone is not warranted.

Anthracene, benzo(g,h,i)perylene, and indeno(1,2,3-cd)pyrene were each detected in two samples with maximum concentrations of 0.031 mg/kg, 0.0346 mg/kg, and 0.0324 mg/kg, respectively. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of anthracene, benzo(g,h,i)perylene, and indeno(1,2,3-cd)pyrene are defined.

Benzo(a)anthracene and phenanthrene were each detected in four samples with maximum concentrations of 0.101 mg/kg and 0.189 mg/kg, respectively. Concentrations decreased with depth at locations 15-610842 and 15-610843, did not change substantially with depth (0.044 mg/kg) at location 15-610841, and decreased downgradient. The lateral and vertical extent of benzo(a)anthracene and phenanthrene are defined.

Benzo(a)pyrene was detected in four samples with a maximum concentration of 0.0596 mg/kg. Concentrations were below the EQL but increased with depth at location 15-610844; decreased with depth at locations 15-610841, 15-610842, and 15-610843; and decreased downgradient. The residential SSL was approximately 13 times the maximum concentration at location 15-610844. The lateral extent of benzo(a)pyrene is defined, and further sampling for vertical extent is not warranted.

Benzo(b)fluoranthene, fluoranthene, and pyrene were each detected in five samples with maximum concentrations of 0.111 mg/kg, 0.226 mg/kg, and 0.152 mg/kg, respectively. Concentrations were below the EQLs but increased with depth at location 15-610844; decreased with depth at locations 15-610841, 15-610842, and 15-610843; and decreased downgradient. The residential SSLs for benzo(b)fluoranthene, fluoranthene, and pyrene were approximately 69 times, 100,000 times, and 87,000 times the concentrations at location 15-610844, respectively. The lateral extent of benzo(b)fluoranthene, fluoranthene, and pyrene are defined, and further sampling for vertical extent is not warranted.

Bis(2-ethylhexyl)phthalate was detected in one sample at a concentration of 0.105 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of bis(2-ethylhexyl)phthalate are defined.

Chrysene was detected in three samples with a maximum concentration of 0.0814 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of chrysene are defined.

Fluorene was detected in one sample at a concentration of 0.0154 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of fluorene are defined.

Isopropyltoluene[4-] was detected in five samples with a maximum concentration of 0.00428 mg/kg. Concentrations did not change substantially with depth (0.000076 mg/kg and 0.003 mg/kg) at locations 15-610839 and 15-610851. Concentrations decreased with depth at location 15-610848 and decreased downgradient. The residential SSL was approximately 551,000 times the maximum concentration. The lateral extent of 4-isopropyltoluene is defined, and further sampling for vertical extent is not warranted.

Toluene was detected in seven samples with a maximum concentration of 0.0122 mg/kg. Concentrations were below EQLs but increased with depth at locations 15-610839, 15-610849, and 15-610850. Concentrations decreased with depth at locations 15-610848 and 15-610852 and did not change substantially with depth (0.01 mg/kg) at location 15-610851. Concentrations decreased downgradient. The residential SSL was approximately 429,000 times the maximum concentration. The lateral extent of toluene is defined, and further sampling for vertical extent is not warranted.

Trimethylbenzene[1,2,4-] was detected in one sample at a concentration of 0.00049 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of 1,2,4-trimethylbenzene are defined.

Xylene[1,3-]+1,4-xylene was detected in two samples with a maximum concentration of 0.000572 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of 1,3-xylene+1,4-xylene are defined.

Radionuclides

Radionuclide COPCs at SWMU 15-009(c) include tritium, uranium-234, uranium-235/236, and uranium-238.

Tritium was detected above the sediment FV in one sample and was detected in eight soil and nine tuff samples with a maximum activity of 0.173 pCi/g. Activities increased with depth at locations 15-610838, 15-610839, 15-610840, 15-610847, and 15-610849, and only one depth was sampled at location 15-610854. Activities decreased with depth at location 15-610845 and did not change substantially with depth (0.0059 pCi/g to 0.0198 pCi/g) at locations 15-610841, 15-610842, 15-610843, 15-610844, and 15-610848. Activities did not change substantially downgradient (0.066 pCi/g). The residential SAL was approximately 9900 times the maximum activity. Further sampling for extent of tritium is not warranted.

Uranium-234 was detected above the sediment and Qbt 2,3,4 BVs in two sediment samples and one tuff sample with a maximum activity of 13.9 pCi/g. Activities increased with depth at locations 15-610846 and 15-610850, decreased with depth at location 15-610853, and decreased downgradient of the maximum activity at location 15-610850. The residential SAL was approximately 21 times the maximum activity. The lateral extent of uranium-234 is defined, and further sampling for vertical extent is not warranted.

Uranium-235/236 was detected above the sediment and Qbt 2,3,4 BVs in one sediment sample and one tuff sample with a maximum activity of 0.78 pCi/g. Activities increased with depth at locations 15-610846 and 15-610850 and decreased downgradient. The residential SAL was approximately 54 times the maximum activity. The lateral extent of uranium-235/236 is defined, and further sampling for vertical extent is not warranted.

Uranium-238 was detected above the soil, sediment, and Qbt 2,3,4 BVs in one soil sample, seven sediment samples, and two tuff samples with a maximum activity of 15.1 pCi/g. Activities increased with depth at locations 15-610839, 15-610846, and 15-610850, and only one depth was sampled at location 15-610854. Activities decreased with depth at locations 15-610847, 15-610848, 15-610849, and 15-610852; did not change substantially with depth (0.5 pCi/g) at location 15-610853; and decreased downgradient. The residential and industrial SALs were approximately 9.7 times and 47 times the maximum activity, respectively. The lateral extent of uranium-238 is defined, and further sampling for vertical extent is not warranted.

8.8.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 2×10^{-7} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.02, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.1 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 5×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.2, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 1 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1. [The residential exposure scenario is also protective of construction workers.](#)

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and residential,~~ [and construction worker](#) scenarios at SWMU 15-009(c).

8.8.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at SWMU 15-009(c).

8.9 SWMU 15-009(h)—Septic System

8.9.1 Site Description and Operational History

SWMU 15-009(h) is a septic system located at the Ector firing site on the eastern side of TA-15. The septic system consists of a 6-ft \times 4-ft \times 5-ft septic tank (structure 15-282), associated drainlines, and a drain field (Figure 8.9-1). The septic tank was constructed in the late 1970s of reinforced concrete with a 905-gal. capacity and flowed to a drain field. The septic system served restroom facilities in the Ector firing site control building 15-280. In the 1990s, the sanitary waste drainlines that served this septic system were rerouted to the Sanitary Wastewater Systems Consolidation (SWSC) plant at TA-46 and are

currently active (LANL 2003, 102117). Although the investigation work plan proposed removing the septic tank, the tank could not be removed because it is next to active utility lines (LANL 2010, 111324.14).

8.9.2 Relationship to Other SWMUs and AOCs

SWMU 15-009(h) is located approximately 225 ft east of the Ector firing site [SWMU 15-006(b)] and the associated drainline and outfall [SWMU 15-014(m)] though on the other side of the control building (Figure 8.9-1).

8.9.3 Summary of Previous Investigations

No sampling was conducted at this SWMU before 2009.

8.9.4 Site Contamination

8.9.4.1 Soil, Rock, and Sediment Sampling

Because no previous investigations had been conducted, characterization was required to assess potential contamination at SWMU 15-009(h). As a result, the following activities were completed as part of the 2009–2010 investigation.

- Fourteen samples were collected in 2009–2010 from seven locations beneath the inlet drainline, septic tank inlet and outlet, septic tank, and drain field. Samples were collected from two depth intervals (4.8–6.1 ft bgs to 6.5–8.0 ft bgs and 6.0–7.1 ft bgs to 11.5–13.0 ft bgs) at each location. All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, nitrate, perchlorate, total uranium, explosive compounds, SVOCs, VOCs, americium-241, gamma-emitting radionuclides, tritium, isotopic plutonium, and isotopic uranium. In addition, four samples were analyzed for PCBs.

The 2009–2010 sampling locations at SWMU 15-009(h) are shown on Figure 8.9-1. Table 8.9-1 presents the samples collected and analyses requested for SWMU 15-009(h). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

8.9.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

8.9.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 15-009(h) consist of 14 samples (11 soil and 3 tuff) collected from 7 locations.

Inorganic Chemicals

A total of 14 samples (11 soil and 3 tuff) were collected at SWMU 15-009(h) and analyzed for TAL metals, cyanide, nitrate, perchlorate, and total uranium. Table 8.9-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Figure 8.9-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was not detected above the soil and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) but had DLs (0.992 mg/kg to 1.12 mg/kg) in 11 soil samples and 3 tuff samples. Antimony is retained as a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in two samples with a maximum concentration of 70.9 mg/kg. Barium is retained as a COPC.

Cadmium was not detected above the soil BV (0.4 mg/kg) but had DLs (0.497 mg/kg to 0.551 mg/kg) above BV in eight samples. The DLs were only 0.097 mg/kg to 0.151 mg/kg above the BV, below the highest background DL (2 mg/kg), and below the three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg and 2.6 mg/kg). Cadmium was not detected or was detected below BVs in the other six samples (detected below BV in three samples). Cadmium is not a COPC.

Calcium was detected above the soil BV (6120 mg/kg) in one sample at a concentration of 45,400 mg/kg. The Gehan and quantile tests indicated site concentrations of calcium in soil are not statistically different from background (Figure G-135 and Table G-20). Calcium is not a COPC.

Chromium was detected above the soil and Qbt 2,3,4 BVs (19.3 mg/kg and 7.14 mg/kg) in two soil samples and three tuff samples with a maximum concentration of 36.1 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in soil are statistically different from background (Figure G-136 and Table G-20). Chromium is retained as a COPC.

Mercury was detected above the soil BV (0.1 mg/kg) in one sample at a concentration of 0.118 mg/kg. The concentration was only 0.018 mg/kg above the BV, and mercury was not detected or detected below BVs in the other 13 samples (detected below BVs in 12 samples). Mercury is not a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in one sample at a concentration of 7.31 mg/kg. Nickel is retained as a COPC.

Nitrate was detected in eight samples with a maximum concentration of 9.71 mg/kg. Although Nitrate is naturally occurring, the SWMU is a septic system that managed sanitary wastewater. As a result, and the concentrations detected may be site related rather than reflecting only naturally occurring levels of nitrate. Nitrate is not retained as a COPC.

Perchlorate was detected in six samples with a maximum concentration of 0.0015 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the Qbt 2,3,4 BV (0.3 mg/kg) but had DLs (0.919 mg/kg to 1.23 mg/kg) above the BV in three samples. Selenium is retained as a COPC.

Uranium was detected above the soil BV (1.82 mg/kg) in eight samples with a maximum concentration of 6.41 mg/kg. The Gehan and quantile tests indicated site concentrations of uranium in soil are statistically different from background (Figure G-137 and Table G-20). Uranium is retained as a COPC.

Zinc was detected above the soil BV (48.8 mg/kg) in one sample at a concentration of 86.5 mg/kg. The Gehan and quantile tests indicated site concentrations of zinc in soil are not statistically different from background (Figure G-138 and Table G-20). Zinc is not a COPC.

Organic Chemicals

A total of 14 samples (11 soil and 3 tuff) were collected at SWMU 15-009(h) and analyzed for explosive compounds, SVOCs, and VOCs. Four samples (three soil and one tuff) were also analyzed for PCBs. Table 8.9-3 summarizes the analytical results for detected organic chemicals. Figure 8.9-3 shows the spatial distribution of detected organic chemicals.

Organic chemicals detected at SWMU 15-009(h) include acetone, ethylbenzene, and 2-hexanone. The detected organic chemicals are retained as COPCs.

Radionuclides

A total of 14 samples (11 soil and 3 tuff) were collected at SWMU 15-009(h) and analyzed for gamma-emitting radionuclides, tritium, isotopic plutonium, and isotopic uranium. Table 8.9-4 presents the radionuclides detected or detected above BVs/FVs. Figure 8.9-4 shows the spatial distribution of detected radionuclides.

Plutonium-239/240 was detected below 1 ft bgs in one soil sample at an activity of 0.0286 pCi/g. Plutonium-239/240 is retained as a COPC.

Tritium was detected in six samples with a maximum activity of 19.6 pCi/g. Tritium is retained as a COPC.

Uranium-234 was detected above the soil BV (2.59 pCi/g) in one sample at an activity of 2.74 pCi/g. Uranium-234 is retained as a COPC.

Uranium-235/236 was detected above the soil BV (0.2 pCi/g) in one sample at an activity of 0.291 pCi/g. Uranium-235/236 is retained as a COPC.

Uranium-238 was detected above the soil BV (2.29 pCi/g) in four samples with a maximum activity of 3.96 pCi/g. Uranium-238 is retained as a COPC.

8.9.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMU 15-009(h) are discussed below.

Inorganic Chemicals

Inorganic COPCs at SWMU 15-009(h) include antimony, barium, chromium, nickel, [nitrate](#), perchlorate, selenium, and uranium.

Antimony was not detected above the soil and Qbt 2,3,4 BVs but had DLs (0.992 mg/kg to 1.12 mg/kg) in 11 soil samples and 3 tuff samples. Because antimony was not detected above BVs and the residential SSL was approximately 28 times the maximum DL, further sampling for extent of antimony is not warranted.

Barium was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 70.9 mg/kg. Concentrations increased with depth at location 15-610855 and decreased with depth at location 15-610858 (the concentration in the shallow sample at location 15-610858 was 108 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations did not change substantially (2.1 mg/kg) downgradient. The residential SSL was approximately 220 times the maximum concentration. Further sampling for extent of barium is not warranted.

Chromium was detected above the soil and Qbt 2,3,4 BVs in two soil samples and three tuff samples with a maximum concentration of 36.1 mg/kg. Concentrations increased with depth at all locations and decreased downgradient. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 3200 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Nickel was detected above the Qbt 2,3,4 BV in one sample at a concentration of 7.31 mg/kg. Concentrations decreased with depth at location 15-610858 (the concentration in the shallow sample was 8.63 mg/kg and below the soil BV [Appendix E, Pivot Tables]) and decreased downgradient. The lateral and vertical extent of nickel are defined.

Nitrate was detected in eight samples with a maximum concentration of 9.71 mg/kg. Concentrations did not change substantially with depth (0.17 mg/kg to 0.49 mg/kg) at locations 15-610855, 15-610856, 15-610857, and 15-610860 and decreased downgradient. The residential SSL was approximately 13,000 times the maximum concentration. Lateral extent of nitrate is defined, and further sampling for vertical extent is not warranted.

Perchlorate was detected in six samples with a maximum concentration of 0.0015 mg/kg. Concentrations did not change substantially with depth (0.00005 mg/kg to 0.000593 mg/kg) at locations 15-610859, 15-610860, and 15-610861. Concentrations increased downgradient. All detected concentrations were below EDLs. The residential SSL was approximately 36,500 times the maximum concentration. Further sampling for extent of perchlorate is not warranted.

Selenium was not detected above the Qbt 2,3,4 BV but had DLs (0.919 mg/kg to 1.23 mg/kg) above the BV in three samples. Because selenium was not detected above BVs and the residential SSL was approximately 318 times the maximum DL, further sampling for extent of selenium is not warranted.

Uranium was detected above the soil BV in eight samples with a maximum concentration of 6.41 mg/kg. Concentrations increased with depth at location 15-610860; decreased with depth at locations 15-610855, 15-610856, 15-610857, and 15-610861; and did not change substantially downgradient (approximately 2.5 mg/kg). The residential SSL was approximately 36 times the maximum concentration. Further sampling for extent of uranium is not warranted.

Organic Chemicals

Organic COPCs at SWMU 15-009(h) include acetone, ethylbenzene, and 2-hexanone.

Acetone was detected in two samples with a maximum concentration of 0.00919 mg/kg. Concentrations were below EQLs, decreased with depth, and decreased downgradient. The residential SSL was approximately 7,340,000 times the maximum concentration. The vertical extent of acetone is defined, and further sampling for lateral extent is not warranted.

Ethylbenzene was detected in one sample at a concentration of 0.00117 mg/kg. Concentrations increased with depth and decreased downgradient. The residential SSL was approximately 59,700 times the maximum concentration. Further sampling for extent of ethylbenzene is not warranted.

Hexanone[2-] was detected in one sample at a concentration of 0.00201 mg/kg. Concentrations were below the EQL, decreased with depth, and decreased downgradient. The residential SSL was approximately 104,000 times the maximum concentration. The vertical extent of 2-hexanone is defined, and further sampling for lateral extent is not warranted.

Radionuclides

Radionuclide COPCs at SWMU 15-009(h) include plutonium-239/240, tritium, uranium-234, uranium-235/236, and uranium-238.

Plutonium-239/240 was detected below 1 ft bgs in one soil sample at an activity of 0.0286 pCi/g. Activities did not change substantially with depth (0.0005 pCi/g) at location 15-610861 (the activity in the shallow sample was 0.0281 pCi/g and below the soil FV [Appendix E, Pivot Tables]) and decreased downgradient. The residential SAL is approximately 1150 times the maximum activity. The vertical extent of plutonium-239/240 is defined, and further sampling for lateral extent is not warranted.

Tritium was detected in six samples at a maximum activity of 19.6 pCi/g. Activities increased with depth at location 15-610861, decreased with depth at locations 15-610855 and 15-610860, did not change substantially with depth (0.0206 pCi/g) at location 15-610859, and decreased downgradient. The residential SAL was approximately 38 times the maximum activity. The lateral extent of tritium is defined, and further sampling for vertical extent is not warranted.

Uranium-234 was detected above the soil BV in one sample at an activity of 2.74 pCi/g. Activities decreased with depth and decreased downgradient. The lateral and vertical extent of uranium-234 are defined.

Uranium-235/236 was detected above the soil BV in one sample at an activity of 0.291 pCi/g. Activities decreased with depth and decreased downgradient. The lateral and vertical extent of uranium-235/236 are defined.

Uranium-238 was detected above the soil BV in four samples with a maximum activity of 3.96 pCi/g. Activities increased with depth at location 15-610860, decreased with depth at location 15-610856, did not change substantially with depth (0.85 pCi/g) at location 15-610857, and decreased downgradient. The residential SAL was approximately 22 times the maximum activity. The lateral extent of uranium-238 is defined, and further sampling for vertical extent is not warranted.

8.9.5 Summary of Human Health Risk Screening

Industrial Scenario

No samples were collected from the 0.0–1.0 ft depth interval, and the industrial scenario was not evaluated for SWMU 15-009(h).

Residential Scenario

The total excess cancer risk for the residential scenario is 2×10^{-10} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.07, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.7 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the residential and construction worker scenarios at SWMU 15-009(h).

8.9.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at SWMU 15-009(h).

8.10 SWMU 15-010(b)—Settling Tank

8.10.1 Site Description and Operational History

SWMU 15-010(b) is a settling tank (structure 15-147) located in the northwest corner of TA-15 near former shop building 15-8 (Figure 8.10-1). The tank, constructed in 1947 of concrete, measures 5 ft × 5 ft × 5.5 ft with an approximate capacity of 900 gal. The tank was originally designed to be a septic tank; however, subsequent engineering records confirm the tank was used as an HE settling tank. The settling tank served former building 15-8, which housed HE-machining operations during the 1950s and discharged to an outfall at the edge of Threemile Canyon (LANL 1993, 020946, p. 10-25). The tank is no longer in operation; however, the date it ceased to be used is not known.

The investigation work plan proposed removing the tank. However, facility restrictions on the handling of HE prevented removing the tank, which was found to contain liquid, until the contents were characterized. The liquid contents were sampled for waste characterization purposes and found to be nonhazardous and nonradioactive and were removed (Appendix F).

8.10.2 Relationship to Other SWMUs and AOCs

SWMU 15-010(b) is located approximately 1000 ft west of AOC 15-014(h) (Plate 1).

8.10.3 Summary of Previous Investigations

In 1995, RFI activities were performed at SWMU 15-010(b) (LANL 1996, 054977). Four samples were collected from three locations and analyzed for HE.

Data from four samples collected in the 1995 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

8.10.4 Site Contamination

8.10.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at SWMU 15-010(b). As a result, the following activities were completed as part of the 2009–2010 investigation.

- Seventeen samples were collected in 2009–2010 from nine locations in the drainage below the site. At all but one location, samples were collected from two depth intervals (0.0–0.5 ft bgs to 0.0–0.7 ft bgs and 1.0–1.6 ft bgs to 1.0–2.0 ft bgs). At one location, only a surface sample (0.0–0.8 ft bgs) was collected. All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, nitrate, perchlorate, total uranium, explosive compounds, SVOCs, VOCs, americium-241, gamma-emitting radionuclides, tritium, isotopic plutonium, and isotopic uranium. Four samples were also analyzed for PCBs.

The 2009–2010 sampling locations at SWMU 15-010(b) are shown on Figure 8.10-1. Table 8.10-1 presents the samples collected and analyses requested for SWMU 15-010(b). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

The approved investigation work plan (LANL 2010, 111324.14; NMED 2010, 111458) specified collection of confirmation samples below the tank, tank inlet, and tank outlet following removal of the tank. As described above, the tank was not removed and confirmation samples were not collected. Therefore, additional sampling at these locations will be performed during the Phase II investigation.

8.10.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

8.10.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 15-010(b) consist of 17 samples (15 sediment and 2 tuff) collected from 9 locations.

Inorganic Chemicals

A total of 17 samples (15 sediment and 2 tuff) were collected at SWMU 15-010(b) and analyzed for TAL metals, cyanide, nitrate, perchlorate, and total uranium. Table 8.10-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Figure 8.10-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was not detected above the sediment and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) but had DLs (1.01 mg/kg to 1.35 mg/kg) above the BVs in 15 sediment samples and 2 tuff samples. Antimony is retained as a COPC.

Barium was detected above the sediment BV (127 mg/kg) in one sample at a concentration of 143 mg/kg. The Gehan and quantile tests indicated site concentrations of barium in sediment are not statistically different from background (Figure G-139 and Table G-21). Barium is not a COPC.

Cadmium was not detected above the sediment BV (0.4 mg/kg) but had DLs (0.528 mg/kg to 0.673 mg/kg) above the BV in 15 samples. Cadmium is retained as a COPC.

Calcium was detected above the sediment BV (4420 mg/kg) in one sample at a concentration of 4480 mg/kg. The Gehan and quantile tests indicated site concentrations of calcium in sediment are not statistically different from background (Figure G-140 and Table G-21). Calcium is not a COPC.

Chromium was detected above the sediment and Qbt 2,3,4 BVs (10.5 mg/kg and 7.14 mg/kg) in three sediment samples and one tuff sample with a maximum concentration of 18.2 mg/kg. The Gehan and slippage tests indicated site concentrations of chromium in sediment are statistically different from background (Figure G-141 and Table G-21). Chromium is retained as a COPC.

Copper was detected above the sediment BV (11.2 mg/kg) in two samples with a maximum concentration of 16.9 mg/kg. The Gehan and slippage tests indicated site concentrations of copper in sediment are not statistically different from background (Figure G-142 and Table G-21). Copper is not a COPC.

Iron was detected above the sediment BV (13,800 mg/kg) in three samples with a maximum concentration of 19,100 mg/kg. The Gehan and quantile tests indicated site concentrations of iron in sediment are statistically different from background (Figure G-143 and Table G-21). Iron is retained as a COPC.

Manganese was detected above the sediment BV (543 mg/kg) in one sample at a concentration of 574 mg/kg. The Gehan and quantile tests indicated site concentrations of manganese in sediment are not statistically different from background (Figure G-144 and Table G-21). Manganese is not a COPC.

Mercury was detected above the sediment BV (0.1 mg/kg) in five samples with a maximum concentration of 0.688 mg/kg. Mercury is retained as a COPC.

Nitrate was detected in three samples at a maximum concentration of 1.65 mg/kg. ~~Although Nitrate is naturally occurring, the SWMU is a former HE settling tank and HE could be a source of nitrate. and As a result, the concentrations detected may be site related rather than reflecting only naturally occurring levels of nitrate. Nitrate is not retained as a COPC.~~

Perchlorate was detected in two samples with a maximum concentration of 0.000762 mg/kg. Perchlorate is retained as a COPC.

Selenium was ~~not~~ detected above the sediment and Qbt 2,3,4 BVs (0.3 mg/kg for both) in 1 sediment sample and 1 tuff sample with a maximum concentration of 0.72 mg/kg and but had DLs (~~0.579~~ 0.971 mg/kg to 1.33 mg/kg) above the BVs in 145 sediment samples and 12 tuff samples. Selenium is retained as a COPC.

Uranium was detected above the sediment BV (2.22 mg/kg) in five samples with a maximum concentration of 13.3 mg/kg. The Gehan and quantile tests indicated site concentrations of uranium in sediment are statistically different from background (Figure G-145 and Table G-21). Uranium is retained as a COPC.

Vanadium was detected above the sediment BV (19.7 mg/kg) in two samples with a maximum concentration of 23.7 mg/kg. The Gehan and slippage tests indicated site concentrations of vanadium in sediment are statistically different from background (Figure G-146 and Table G-21). Vanadium is retained as a COPC.

Zinc was detected above the sediment BV (60.2 mg/kg) in two samples with a maximum concentration of 72.9 mg/kg. The Gehan test indicated site concentrations of zinc in sediment are statistically different from background (Table G-21). However, the quantile and slippage tests indicated site concentrations of zinc in sediment are not statistically different from background (Figure G-147 and Table G-21). Zinc is not a COPC.

Organic Chemicals

A total of 17 samples (15 sediment and 2 tuff) were collected at SWMU 15-010(b) and analyzed for explosive compounds, SVOCs, and VOCs. Four sediment samples were also analyzed for PCBs. Table 8.10-3 summarizes the analytical results for detected organic chemicals. Figure 8.10-3 shows the spatial distribution of detected organic chemicals.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons are a class of SVOCs frequently detected as a result of environmental sampling but generally were not released from the SWMUs or AOCs being investigated. PAHs unrelated to site activities are thus often detected in samples analyzed for the presence of site-related SVOCs.

PAHs are known to be widely distributed in the environment from a number of sources, both natural, such as forest fires, and anthropogenic, such as combustion of fossil fuels, oil drips off motor vehicles, vehicle tires, coal tar pitch, and weathering or eroding of asphalt pavement (Kose et al. 2008, 219977; Teaf 2008, 219976). PAHs from these sources generally occur as complex mixtures, not as single compounds. Individual PAH compounds can be manufactured for research purposes, and some PAHs (e.g., anthracene, fluorene, naphthalene, and pyrene) are used in dye production, the manufacture of synthetic fibers, and in plastics and pesticides.

The principal sources of PAHs in soil along parking lots, roads, and highways are vehicular exhaust and emissions, the wearing of tires, and asphalt. PAH-containing materials, such as asphalt and rubber particles, do not easily dissolve in water, preventing migration, except as suspended particles in storm water. PAH concentrations in excess of soil cleanup levels may result from common anthropogenic sources, such as runoff from asphalt parking lots.

Site Activities

SWMU 15-010(b) was identified as an SWMU because of possible soil contamination resulting from releases associated with HE machining performed in former building 15-8. PAHs were not known to have been used at this site.

SWMU 15-010(b) is located on a slope near the top of the canyon wall. Storm-water best management practices (BMPs) have been installed at the site to direct run-on around the site. Before installation of BMPs, however, the site received runoff from a weathered asphalt roadway (Appendix I, Figures I-8 and I-9). In addition, the site is in an area of the Laboratory that burned during the Cerro Grande fire, and trees in the area where samples were collected have been burned (Appendix I, Figures I-10 and I-11). Based on the fact that PAHs were not present in the HE materials machined at this site, the fact that the sampled area formerly received runoff from weathered asphalt, and the fact that the area was burned during the Cerro Grande fire, the low concentrations of PAHs detected in samples used to characterize this site [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene] are associated with the weathered asphalt and fire residue, are not related to historic Laboratory site operations, and are not COPCs.

Organic COPCs

Other organic chemicals detected at SWMU 15-010(b) include acetone; Aroclor-1254; Aroclor-1260; bis(2-ethylhexyl)phthalate; 1,1-dichloroethene; di-n-butylphthalate; methylene chloride; styrene; tetrachloroethene; toluene; and 1,3-xylene+1,4-xylene. The detected organic chemicals listed are retained as COPCs.

Radionuclides

A total of 17 samples (15 sediment and 2 tuff) were collected at SWMU 15-010(b) and analyzed for americium-241, gamma-emitting radionuclides, tritium, isotopic plutonium, and isotopic uranium. Table 8.10-4 presents the radionuclides detected or detected above BVs/FVs. Figure 8.10-4 shows the spatial distribution of detected radionuclides.

Cesium-137 was detected above the sediment FV (0.9 pCi/g) in two samples with a maximum activity of 2.34 pCi/g. Because the only detections or detections above FV were in sediment, statistics were evaluated. The quantile and slippage tests indicated site activities of cesium-137 in sediment are not statistically different from background (Figure G-148 and Table G-21). Cesium-137 is not a COPC.

Plutonium-239/240 was detected above the sediment FV (0.068 pCi/g) in one sample at an activity of 0.121 pCi/g. Because the only detections or detections above FV were in sediment, statistics were evaluated. The quantile and slippage tests indicated site activities of plutonium-239/240 in sediment are not statistically different from background (Figure G-149 and Table G-21). Plutonium-239/240 is not a COPC.

Uranium-234 was detected above the sediment BV (2.59 pCi/g) in one sample at an activity of 4.93 pCi/g. Because the only detections or detections above BV were in sediment, statistics were evaluated. The Gehan and quantile tests indicated site activities of uranium-234 in sediment are not statistically different from background (Figure G-150 and Table G-21). Uranium-234 is not a COPC.

Uranium-235/236 was detected above the sediment BV (0.2 pCi/g) in one sample at an activity of 0.386 pCi/g. Because the only detections or detections above BV were in sediment, statistics were evaluated. The quantile and slippage tests indicated site activities of uranium-235/236 in sediment are not statistically different from background (Figure G-151 and Table G-21). Uranium-235/236 is not a COPC.

Uranium-238 was detected above the sediment BV (2.29 pCi/g) in three samples with a maximum activity of 6.93 pCi/g. Because the only detections or detections above BV were in sediment, statistics were evaluated. The quantile and slippage tests indicated site activities of uranium-238 in sediment are statistically different from background (Figure G-152 and Table G-21). Uranium-238 is retained as a COPC.

8.10.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMU 15-010(b) are discussed below. As described in section 8.10.4.1, samples were collected in the drainage downgradient of the tank, but not beneath the tank, tank inlet, and tank outlet. Therefore, nature and extent is evaluated only for the drainage downgradient of the tank.

Inorganic Chemicals

Inorganic COPCs at SWMU 15-010(b) include antimony, cadmium, chromium, iron, mercury, nitrate, perchlorate, selenium, uranium, and vanadium.

Antimony was not detected above the sediment and Qbt 2,3,4 BVs but had DLs (1.01 mg/kg to 1.35 mg/kg) above the BVs in 15 sediment samples and 2 tuff samples. Because antimony was not detected above BVs and the residential SSL was approximately 23 times the maximum DL, further sampling for extent of antimony is not warranted.

Cadmium was not detected above the sediment BV but had DLs (0.528 mg/kg to 0.673 mg/kg) above BV in 15 samples. Because cadmium was not detected above BV and the residential SSL was approximately 105 times the maximum DL, further sampling for extent of cadmium is not warranted.

Chromium was detected above the sediment and Qbt 2,3,4 BVs in three sediment samples and one tuff sample with a maximum concentration of 18.2 mg/kg. Concentrations increased with depth at locations 15-610863 and 15-610872, decreased with depth at locations 15-610868 and 15-610870, and decreased downgradient. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The

residential SSL was approximately 6400 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Iron was detected above the sediment BV in three samples with a maximum concentration of 19,100 mg/kg. Concentrations increased with depth at locations 15-610866 and 15-610868, and only one depth was sampled at location 15-610867. Concentrations increased downgradient. The residential SSL was approximately 2.9 times the maximum concentration (the maximum concentration was 35,700 mg/kg below the SSL), and the industrial SSL was 48 times the maximum concentration. Further sampling for extent of iron is not warranted.

Mercury was detected above the sediment BV in five samples with a maximum concentration of 0.688 mg/kg. Concentrations decreased with depth at location 15-610868, did not change substantially with depth (0.059 mg/kg and 0.436 mg/kg) at locations 15-610864 and 15-610869, and decreased downgradient. The residential SSL was approximately 34 times the maximum concentration. The lateral extent of mercury is defined, and further sampling for vertical extent is not warranted.

Nitrate was detected in three samples at a maximum concentration of 1.65 mg/kg. Concentrations increased with depth at location 15-610868 and decreased with depth at location 15-610871. Only a surface sample was collected at location 15-610867. Concentrations decreased downgradient. The residential SSL was approximately 76,000 times the maximum concentration. Lateral extent of nitrate is defined, and further sampling for vertical extent is not warranted.

Perchlorate was detected in two samples with a maximum concentration of 0.000762 mg/kg. Concentrations increased with depth at location 15-610869, decreased with depth at location 15-610872, and decreased downgradient. The residential SSL was approximately 72,000 times the maximum concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Selenium was ~~not~~ detected above the sediment and Qbt 2,3,4 BVs in 1 sediment sample and 1 tuff sample with a maximum concentration of 0.72 mg/kg and but had DLs (0.579-0.971 mg/kg to 1.33 mg/kg) above the BVs in 145 sediment samples and 21 tuff samples. Concentrations did not change substantially with depth (0.141 mg/kg) at location 15610871 and decreased downgradient. Because selenium was not detected above BVs and tThe residential SSL was approximately 543 times the maximum concentration and 294 times the maximum DL. ~~f~~EFurther sampling for extent of selenium is not warranted.

Uranium was detected above the sediment BV in five samples with a maximum concentration of 13.3 mg/kg. Concentrations increased with depth at location 15-610864; decreased with depth at locations 15-610863, 15-610869, and 15-610872; and decreased downgradient. The lateral extent of uranium is defined, and further sampling for vertical extent is not warranted.

Vanadium was detected above the sediment BV in two samples with a maximum concentration of 23.7 mg/kg. Concentrations increased with depth at locations 15-610866 and 15-610868 and increased downgradient. The residential SSL was approximately 17 times and the industrial SSL was approximately 276 times the maximum concentration. Further sampling for extent of vanadium is not warranted.

Organic Chemicals

Organic COPCs at SWMU 15-010(b) include acetone; Aroclor-1254; Aroclor-1260; bis(2-ethylhexyl)phthalate; 1,1-dichloroethene; di-n-butylphthalate; methylene chloride; styrene; tetrachloroethene; toluene; and 1,3-xylene+1,4-xylene.

Acetone was detected in seven samples with a maximum concentration of 0.689 mg/kg. Concentrations increased with depth at locations 15-610863 and 15-610871, decreased with depth at location 15-610869, did not change substantially with depth (0.052 mg/kg and 0.011 mg/kg) at locations 15-610864 and 15-610872, and decreased downgradient. The residential SSL was approximately 96,000 times the maximum concentration. The lateral extent of acetone is defined, and further sampling for vertical extent is not warranted.

Aroclor-1254 was detected in two samples with a maximum concentration of 0.0065 mg/kg. Concentrations did not change substantially with depth (0.0019 mg/kg) and decreased downgradient. The residential SSL was approximately 175 times the maximum concentration. The lateral extent of Aroclor-1254 is defined, and further sampling for vertical extent is not warranted.

Aroclor-1260 was detected in one sample at a concentration of 0.0025 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of Aroclor-1260 are defined.

Bis(2-ethylhexyl)phthalate was detected in two samples with a maximum concentration of 0.17 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of bis(2-ethylhexyl)phthalate are defined.

Dichloroethene[1,1-] was detected in one sample at a concentration of 0.00037 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of 1,1-dichloroethene are defined.

Di-n-butylphthalate was detected in ~~three~~five samples with a maximum concentration of 3.64 mg/kg. Concentrations did not change substantially with depth (0.038 mg/kg) at location 15-610869, decreased with depth at locations 15-610864 and 15-610872, and decreased downgradient. The lateral and vertical extent of di-n-butylphthalate are defined.

Methylene chloride was detected in five samples with a maximum concentration of 0.00434 mg/kg. Concentrations increased with depth at location 15-610864, decreased with depth at locations 15-610869 and 15-610872, did not change substantially with depth (0.0014 mg/kg) at location 15-610863, and decreased downgradient. All detected concentrations were below the EQLs. The residential SSL was approximately 94,000 times the maximum concentration. The lateral extent of methylene chloride is defined, and further sampling for vertical extent is not warranted.

Styrene was detected in one sample at a concentration of 0.000555 mg/kg. The concentration was below the EQL, increased with depth, and decreased downgradient. The residential SSL was approximately 13,100,000 times the concentration. The lateral extent of styrene is defined, and further sampling for vertical extent is not warranted.

Tetrachloroethene was detected in one sample at a concentration of 0.000584 mg/kg. The concentration was below the EQL, decreased with depth, and decreased downgradient. The lateral and vertical extent of tetrachloroethene are defined.

Toluene was detected in six samples with a maximum concentration of 0.0185 mg/kg. Concentrations increased with depth at locations 15-610863, 15-610864, and 15-610871; decreased with depth at locations 15-610868, 15-610869, and 15-610872; and decreased downgradient. The residential SSL was approximately 283,000 times the maximum concentration. The lateral extent of toluene is defined, and further sampling for vertical extent is not warranted.

Xylene[1,3-]+1,4-xylene was detected in two samples with a maximum concentration of 0.000732 mg/kg. Concentrations increased with depth at location 15-610863, decreased with depth at location 15-610864, and decreased downgradient. The residential SSL was approximately 1,190,000 times the maximum concentration. The lateral extent of 1,3-xylene+1,4-xylene is defined, and further sampling for vertical extent is not warranted.

Radionuclides

Radionuclide COPCs at SWMU 15-010(b) include uranium-238.

Uranium-238 was detected above the sediment BV in three samples with a maximum activity of 6.93 pCi/g. Activities increased with depth at location 15-610864, decreased with depth at locations 15-610863 and 15-610872, and decreased downgradient. The residential SAL was approximately 21 times the maximum activity. The lateral extent of uranium-238 is defined, and further sampling for vertical extent is not warranted.

8.10.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 2×10^{-7} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.02, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.8 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.4, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 2 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and~~ residential, and construction worker scenarios at SWMU 15-010(b).

8.10.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at SWMU 15-010(b).

8.11 AOC 15-014(h)—Outfalls from Building 15-40

8.11.1 Site Description and Operational History

AOC 15-014(h) consists of three outfalls located in the northwest corner of TA-15 (Plate 21). The outfalls served a former laboratory and office (former building 15-40). All three outfalls daylight north of former building 15-40 and discharge to Threemile Canyon (LANL 1990, 007512; LANL 1993, 020946, p. 10-22).

The westernmost outfall is a former National Pollutant Discharge Elimination System– (NPDES-) permitted outfall that received industrial effluent, including wastewater from a photographic laboratory from former building 15-40. This outfall consists of an 8-in.-diameter vitrified-clay pipe (VCP) that daylights approximately 75 ft north of the northwest corner of former building 15-40 (LANL 1990, 007512; LANL 1993, 020946, p. 10-22). The outfall was removed from the NPDES permit in 1994 (Dale 1998, 057524).

The middle outfall is a former NPDES-permitted outfall that received noncontact cooling water, roof runoff, and floor-drain effluent from former building 15-40. The floor drains received water from drain valves in a potable water system. This outfall consists of an 8-in.-diameter VCP that daylights approximately 100 ft north of the northeast corner of former building 15-40 (LANL 1990, 007512; LANL 1993, 020946, p. 10-22). The outfall was removed from the NPDES permit in 1990 (EPA 1990, 012454).

The easternmost outfall receives storm water from yard drains and is located north and east of former building 15-40. This outfall consists of a 12-in.-diameter corrugated metal pipe that daylights approximately 75 ft northeast of the northeast corner of former building 15-40 (LANL 1990, 007512; LANL 1993, 020946, p. 10-22). From the outfall, an approximately 60-ft-long ditch connects to a 30-ft-long, 12-in.-diameter corrugated metal pipe that accommodates drainage beneath a security fence.

8.11.2 Relationship to Other SWMUs and AOCs

AOC 15-014(h) is located approximately 1000 ft east of SWMU 15-010(b), which is the nearest other SWMU or AOC (Plate 1).

8.11.3 Summary of Previous Investigations

In 1995, RFI activities were performed at AOC 15-014(h) (LANL 1996, 054977). Four samples were collected from two locations and analyzed for inorganic chemicals, SVOCs, and VOCs.

Data from four samples collected during the 1995 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

8.11.4 Site Contamination

8.11.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was required to assess potential contamination at AOC 15-014(h). As a result, the following activities were completed as part of the 2009–2010 investigation.

- A total of 52 samples were collected in 2009–2010 from 3 locations beneath drainlines and 23 locations in the 3 drainages below each of the outfalls. At each location, samples were collected from two depth intervals (0.0–0.5 ft bgs to 2.0–3.9 ft bgs and 1.0–1.4 ft bgs to 7.0–8.8 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, perchlorate, total uranium, explosive compounds, SVOCs, VOCs, americium-241, gamma-emitting radionuclides, tritium, isotopic plutonium, and isotopic uranium. Sixteen samples were also analyzed for PCBs.

The 2009–2010 sampling locations at AOC 15-014(h) are shown on Plate 21. Table 8.11-1 presents the samples collected and analyses requested for AOC 15-014(h). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

8.11.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

8.11.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at AOC 15-014(h) consist of 52 samples (20 soil, 26 sediment, and 6 tuff) collected from 26 locations.

Inorganic Chemicals

A total of 52 samples (20 soil, 26 sediment, and 6 tuff) were collected at AOC 15-014(h) and analyzed for TAL metals, cyanide, perchlorate, and total uranium. Table 8.11-2 presents the inorganic chemicals above BVs and detected inorganic chemicals with no BVs. Plate 22 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 BV (7340 mg/kg) in three samples with a maximum concentration of 10,700 mg/kg. Aluminum is retained as a COPC.

Antimony was not detected above the soil, sediment, and Qbt 2,3,4 BVs (0.83 mg/kg, 0.83 mg/kg, and 0.5 mg/kg) but had DLs (0.817 mg/kg to 1.57 mg/kg) above BVs in 17 soil samples, 22 sediment samples, and 5 tuff samples. Antimony is retained as a COPC.

Arsenic was detected above the sediment BV (3.98 mg/kg) in one sample at a concentration of 4.45 mg/kg. The Gehan and quantile tests indicated site concentrations of arsenic in sediment are not statistically different from background (Figure G-153 and Table G-22). Arsenic is not a COPC.

Barium was detected above the sediment and Qbt 2,3,4 BVs (127 mg/kg and 46 mg/kg) in 17 sediment samples and 6 tuff samples with a maximum concentration of 195 mg/kg. The Gehan and quantile tests indicated site concentrations of barium in sediment are statistically different from background (Figure G-154 and Table G-22). Barium is retained as a COPC.

Beryllium was detected above the sediment BV (1.31 mg/kg) in one sample at a concentration of 1.33 mg/kg. The Gehan test indicated site concentrations of beryllium in sediment are statistically different from background (Table G-22). However, the quantile and slippage tests indicated site concentrations of beryllium in sediment are not statistically different from background (Figure G-155 and Table G-22). Beryllium is not a COPC.

Cadmium was detected above the soil and sediment BVs (0.4 mg/kg for both) in 1 soil sample and 2 sediment samples with a maximum concentration of 1.54 mg/kg and had DLs (0.519 mg/kg to 0.716 mg/kg) above BVs in 17 soil samples and 21 sediment samples. The slippage test indicated site concentrations of cadmium in sediment are statistically different from background (Figure G-156 and Table G-22). Cadmium is retained as a COPC.

Calcium was detected above the soil and Qbt 2,3,4 BVs (6120 mg/kg and 2200 mg/kg) in one soil sample and one tuff sample with a maximum concentration of 8490 mg/kg. The Gehan and quantile tests indicated site concentrations of calcium in soil are not statistically different from background (Figure G-157 and Table G-23). There were too few tuff samples to perform statistical comparisons. The concentration above BV in tuff was only 40 mg/kg above BV and 10 mg/kg above the maximum Qbt 2,3,4 background concentration. Calcium was detected below BVs in the other 50 samples and was not statistically different from soil background. Calcium is not a COPC.

Chromium was detected above the soil, sediment, and Qbt 2,3,4 BVs (19.3 mg/kg, 10.5 mg/kg, and 7.14 mg/kg) in 4 soil samples, 16 sediment samples, and 6 tuff samples with a maximum concentration of 48.9 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in soil and sediment are statistically different from background (Figure G-158 and Table G-23, and Figure G-159 and Table G-22, respectively). Chromium is retained as a COPC.

Cobalt was detected above the soil, sediment, and Qbt 2,3,4 BVs (8.64 mg/kg, 4.73 mg/kg, and 3.14 mg/kg) in 1 soil sample, 14 sediment samples, and 3 tuff samples with a maximum concentration of 9.41 mg/kg. The Gehan and quantile tests indicated site concentrations of cobalt in soil are not statistically different from background (Figure G-160 and Table G-23). The Gehan and quantile tests indicated site concentrations of cobalt in sediment are statistically different from background (Figure G-161 and Table G-22). Cobalt is retained as a COPC.

Copper was detected above the soil, sediment, and Qbt 2,3,4 BVs (14.7 mg/kg, 11.2 mg/kg, and 4.66 mg/kg) in one soil sample, six sediment samples, and four tuff samples with a maximum concentration of 53.6 mg/kg. The Gehan test indicated site concentrations of copper in soil are statistically different from background (Table G-23). However, the quantile and slippage tests indicated site concentrations of copper in soil are not statistically different from background (Figure G-162 and Table G-23). The Gehan and quantile tests indicated site concentrations of copper in sediment are statistically different from background (Figure G-163 and Table G-22). Copper is retained as a COPC.

Cyanide was detected above the soil and sediment BVs (0.5 mg/kg and 0.82 mg/kg) in one soil sample and one sediment sample with a maximum concentration of 3.25 mg/kg. The quantile and slippage tests indicated site concentrations of cyanide in sediment are not statistically different from background (Figure G-164 and Table G-22). There is no background data set for cyanide in soil. Cyanide was not detected or was detected below BVs in the other 50 samples (detected below BVs in 19 samples). Cyanide is not a COPC.

Iron was detected above the sediment BV (13,800 mg/kg) in four samples with a maximum concentration of 16,900 mg/kg. The Gehan and quantile tests indicated site concentrations of iron in sediment are statistically different from background (Figure G-165 and Table G-22). Iron is retained as a COPC.

Lead was detected above the soil, sediment, and Qbt 2,3,4 BVs (22.3 mg/kg, 19.7 mg/kg, and 11.2 mg/kg) in two soil samples, eight sediment samples, and three tuff samples with a maximum concentration of 80.2 mg/kg. The Gehan and quantile tests indicated site concentrations of lead in soil are not statistically different from background (Figure G-166 and Table G-23). The Gehan and quantile tests indicated site concentrations of lead in sediment are statistically different from background (Figure G-167 and Table G-22). Lead is retained as a COPC.

Magnesium was detected above the Qbt 2,3,4 BV (1690 mg/kg) in three samples with a maximum concentration of 1830 mg/kg. The maximum concentration was only 140 mg/kg above BV and was below the two highest Qbt 2,3,4 background concentrations (2720 mg/kg and 2820 mg/kg). Magnesium was detected below BVs in the other 49 samples. Magnesium is not a COPC.

Manganese was detected above the sediment and Qbt 2,3,4 BVs (543 mg/kg and 482 mg/kg) in one sediment sample and one tuff sample with a maximum concentration of 610 mg/kg. The Gehan and quantile tests indicated site concentrations of manganese in sediment are not statistically different from background (Figure G-168 and Table G-22). The maximum concentration in tuff was 92 mg/kg above BV and 178 mg/kg below the maximum Qbt 2,3,4 background concentration (752 mg/kg). Manganese was detected below BV in the other 50 samples. Manganese is not a COPC.

Mercury was detected above the soil, sediment, and Qbt 2,3,4 BVs (0.1 mg/kg for all) in two soil samples, seven sediment samples, and one tuff sample with a maximum concentration of 1.54 mg/kg. Mercury is retained as a COPC.

Nickel was detected above the sediment and Qbt 2,3,4 BVs (9.38 mg/kg and 6.58 mg/kg) in six sediment samples and four tuff samples with a maximum concentration of 12.1 mg/kg. The Gehan and quantile tests indicated site concentrations of nickel in sediment are statistically different from background (Figure G-169 and Table G-22). Nickel is retained as a COPC.

Perchlorate was detected in 18 samples with a maximum concentration of 0.00284 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the sediment and Qbt 2,3,4 BVs (0.3 mg/kg for both) but had DLs (1.05 mg/kg to 1.5 mg/kg) above the BVs in 26 sediment samples and 6 tuff samples. Selenium is retained as a COPC.

Silver was detected above the soil, sediment, and Qbt 2,3,4 BVs (1 mg/kg for all) in five soil samples, seven sediment samples, and one tuff sample with a maximum concentration of 21 mg/kg. Silver is retained as a COPC.

Uranium was detected above the soil and sediment BVs (1.82 mg/kg and 2.22 mg/kg) in 6 soil samples and 16 sediment samples with a maximum concentration of 13.9 mg/kg. The Gehan and quantile tests indicated site concentrations of uranium in soil and sediment are statistically different from background (Figure G-170 and Table G-23, and Figure G-171 and Table G-22). Uranium is retained as a COPC.

Vanadium was detected above the sediment and Qbt 2,3,4 BVs (19.7 mg/kg and 17 mg/kg) in 19 sediment samples and 3 tuff samples with a maximum concentration of 30.8 mg/kg. The Gehan and quantile tests indicated site concentrations of vanadium in sediment are statistically different from background (Figure G-172 and Table G-22). Vanadium is retained as a COPC.

Zinc was detected above the soil and sediment BVs (48.8 mg/kg and 60.2 mg/kg) in one soil sample and three sediment samples with a maximum concentration of 126 mg/kg. The Gehan and quantile tests indicated site concentrations of zinc in soil and sediment are not statistically different from background (Figure G-173 and Table G-23, and Figure G-174 and Table G-22). Zinc is not a COPC.

Organic Chemicals

A total of 52 samples (20 soil, 26 sediment, and 6 tuff) were collected at AOC 15-014(h) and analyzed for explosive compounds, SVOCs, and VOCs. Sixteen samples (six soil, seven sediment, and three tuff) were also analyzed for PCBs. Table 8.11-3 summarizes the analytical results for detected organic chemicals. Plate 23 shows the spatial distribution of detected organic chemicals.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons are a class of SVOCs frequently detected as a result of environmental sampling but generally were not released from the SWMUs or AOCs being investigated. PAHs unrelated to site activities are thus often detected in samples analyzed for the presence of site-related SVOCs.

PAHs are known to be widely distributed in the environment from a number of sources, both natural, such as forest fires, and anthropogenic, such as combustion of fossil fuels, oil drips off motor vehicles, vehicle tires, coal tar pitch, and weathering or eroding of asphalt pavement (Kose et al. 2008, 219977; Teaf 2008, 219976). PAHs from these sources generally occur as complex mixtures, not as single compounds. Individual PAH compounds can be manufactured for research purposes, and some PAHs (e.g., anthracene, fluorene, naphthalene, and pyrene) are used in dye production, the manufacture of synthetic fibers, and in plastics and pesticides.

The principal sources of PAHs in soil along parking lots, roads, and highways are vehicular exhaust and emissions, the wearing of tires, and asphalt. PAH-containing materials, such as asphalt and rubber particles, do not easily dissolve in water, preventing migration, except as suspended particles in storm water. PAH concentrations in excess of soil cleanup levels may result from common anthropogenic sources, such as runoff from asphalt parking lots.

Site Activities

AOC 15-014(h) was identified as an AOC because of possible soil contamination resulting from releases from the three outfalls. Discharges from these outfalls were associated with a photographic laboratory, noncontact cooling water, roof drains, floor drains receiving potable water, and yard drainage. PAHs were not known to have been associated with any materials used at this site, which could have been discharged to the outfalls.

The three drainages below the outfalls sampled during the 2009–2010 investigation all receive runoff from the paved area surrounding the former structures and roof drains. This area contains weathered asphalt (Appendix I, Figures I-12 to I-16), and the building roof also has tar. Based on the fact that PAHs were not used in the facilities that discharged to the outfalls, and the fact that the sampled area receives runoff from weathered asphalt and a tarred roof, the low concentrations of PAHs detected in samples used to characterize this site [acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene] are not related to historic Laboratory site operations and are not COPCs.

Organic COPCs

Other organic chemicals detected at AOC 15-014(h) include acetone; Aroclor-1254; Aroclor-1260; benzoic acid; bis(2-ethylhexyl)phthalate; chloroform; 1,1-dichloroethene; di-n-butylphthalate; di-n-octylphthalate; ethylbenzene; 4-isopropyltoluene; methylene chloride; tetrachloroethene; toluene; 1,2,4-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene. The detected organic chemicals listed are retained as COPCs.

Radionuclides

A total of 52 samples (20 soil, 26 sediment, and 6 tuff) were collected at AOC 15-014(h) and analyzed for americium-241, gamma-emitting radionuclides, tritium, isotopic plutonium, and isotopic uranium. Table 8.11-4 presents the radionuclides detected or detected above BVs/FVs. Plate 24 shows the spatial distribution of detected radionuclides.

Cesium-137 was detected above the sediment FV (0.9 pCi/g) in one sample and was detected below 1 ft bgs in six soil samples with a maximum activity of 1.53 pCi/g. Cesium-137 is retained as a COPC.

Plutonium-238 was detected above the sediment FV (0.006 pCi/g) in one sample at an activity of 0.0599 pCi/g. Plutonium-238 is retained as a COPC.

Plutonium-239/240 was detected above the soil FV (0.054 pCi/g) in one sample and detected below 1 ft bgs in two soil samples with a maximum activity of 0.0622 pCi/g. Plutonium-239/240 is retained as a COPC.

Tritium was detected in eight samples with a maximum activity of 0.883 pCi/g. Tritium is retained as a COPC.

Uranium-234 was detected above the soil and sediment BVs (2.59 pCi/g for both) in one soil sample and four-three sediment samples with a maximum activity of 4.17 pCi/g. ~~Because the only detections or detections above BV were in sediment, statistics were evaluated.~~ The quantile and slippage tests indicated site activities of uranium-234 in sediment are statistically different from background (Figure G-175 and Table G-22). Uranium-234 is retained as a COPC.

Uranium-235/236 was detected above the soil and sediment BVs (0.2 pCi/g for both) in one soil sample and one sediment sample with a maximum activity of 0.23 pCi/g. The maximum activities in soil and sediment were only 0.019 pCi/g and 0.03 pCi/g above the BVs, respectively, and uranium-235/236 was not detected or not detected above BVs in the other 50 samples (detected below BVs in 32 samples). Uranium-235/236 is not a COPC.

Uranium-238 was detected above the soil and sediment BVs (2.29 pCi/g for both) in four soil samples and nine sediment samples with a maximum activity of 5.21 pCi/g. Uranium-238 is retained as a COPC.

8.11.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at AOC 15-014(h) are discussed below.

Inorganic Chemicals

Inorganic COPCs at AOC 15-014(h) include aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, mercury, nickel, perchlorate, selenium, silver, uranium, and vanadium.

Aluminum was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 10,700 mg/kg. Concentrations did not change with depth at location 15-610505 and decreased with depth at locations 15-610508 and 15-610524 (the concentrations in shallow samples at locations 15-610505, 15-610508, and 15-610524 were 10,700 mg/kg, 10,800 mg/kg, and 11,800 mg/kg, respectively, and below the soil and sediment BVs [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The lateral and vertical extent of aluminum are defined.

Antimony was not detected above the soil, sediment, and Qbt 2,3,4 BVs but had DLs (0.817 mg/kg to 1.57 mg/kg) above the BVs in 17 soil samples, 22 sediment samples, and 5 tuff samples. Because antimony was not detected above BVs and the residential SSL was approximately 20 times the maximum DL, further sampling for extent of antimony is not warranted.

Barium was detected above the sediment and Qbt 2,3,4 BVs in 17 sediment samples and 6 tuff samples with a maximum concentration of 195 mg/kg. Concentrations increased with depth at location 15-610525, did not change substantially with depth (2 mg/kg) at location 15-610505, and decreased with depth at all other locations (the concentrations in the shallow samples at locations 15-610508 and 15-610526 were 167 mg/kg and 111 mg/kg, respectively, and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential SSL was approximately 80 times the maximum concentration. The lateral extent of barium is defined, and further sampling for vertical extent is not warranted.

Cadmium was detected above the soil and sediment BVs in 1 soil sample and 2 sediment samples with a maximum concentration of 1.54 mg/kg and had DLs (0.519 mg/kg to 0.716 mg/kg) above BVs in 17 soil samples and 21 sediment samples. Concentrations did not change substantially with depth (0.612 mg/kg) at location 15-610523, decreased with depth at location 15-610502 and decreased downgradient. The residential SSL was approximately 46 times the maximum concentration and 98 times the maximum DL. Further sampling for extent of cadmium is not warranted.

Chromium was detected above the soil, sediment, and Qbt 2,3,4 BVs in 4 soil samples, 16 sediment samples, and 6 tuff samples with a maximum concentration of 48.9 mg/kg. Concentrations increased with depth at locations 15-610501, 15-610502, 15-610508, 15-610510, 15-610511, 15-610512, 15-610517, 15-610519, 15-610520, 15-610523, and 15-610525. Concentrations did not change substantially with depth (0.43 mg/kg) at location 15-610524 and decreased with depth at locations 15-610504, 15-610505, 15-610513, 15-610515, 15-610516, 15-610521, and 15-610526 (concentrations in the shallow samples at locations 15-610524 and 15-610526 were 9.87 mg/kg and 14.7 mg/kg, respectively, and below the soil and sediment BVs [Appendix E, Pivot Tables]). Concentrations decreased downgradient. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 2400 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Cobalt was detected above the soil, sediment, and Qbt 2,3,4 BVs in 1 soil sample, 14 sediment samples, and 3 tuff samples with a maximum concentration of 9.41 mg/kg. Concentrations increased with depth at locations 15-610504, 15-610505, 15-610508, and 15-610525. The concentrations at location 15-610506 and 15-610515 did not change substantially with depth (1.5 mg/kg and 0.08 mg/kg) with the medium for the surface samples being sediment and the medium for the deep samples being soil (the concentrations in the deep samples were 6.39 mg/kg and 5.29 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations did not change substantially with depth (0.04 mg/kg, 0.15 mg/kg, 0.7 mg/kg, and 0.11 mg/kg) at locations 15-610501, 15-610510, 15-610512, and 15-610513 and decreased with depth at locations 15-610502, 15-610516, 15-610519, 15-610521, 15-610523, and 15-610526. Concentrations decreased downgradient. The residential and industrial SSLs were approximately 2.4 times and 37 times the maximum concentration, respectively. The lateral extent of cobalt is defined, and further sampling for vertical extent is not warranted.

Copper was detected above the soil, sediment, and Qbt 2,3,4 BVs in one soil sample, six sediment samples, and four tuff samples with a maximum concentration of 53.6 mg/kg. Concentrations increased with depth at location 15-610523 and decreased with depth at all other locations (the concentrations in the shallow samples at locations 15-610505, 15-610508, and 15-610524 were 8.28 mg/kg, 10.4 mg/kg, and 7.39 mg/kg, respectively, and below the soil and sediment BVs [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential SSL was approximately 58 times the maximum concentration. The lateral extent of copper is defined, and further sampling for vertical extent is not warranted.

Iron was detected above the sediment BV in four samples with a maximum concentration of 16,900 mg/kg. Concentrations increased with depth at locations 15-610504 and 15-610525, decreased with depth at locations 15-610502 and 15-610515, and decreased downgradient. The residential SSL was approximately 3.2 times the maximum concentration (the maximum concentration was 37,900 mg/kg below the SSL), and the industrial SSL was 54 times the maximum concentration. The lateral extent of iron is defined, and further sampling for vertical extent is not warranted.

Lead was detected above the soil, sediment, and Qbt 2,3,4 BVs in two soil samples, eight sediment samples, and three tuff samples with a maximum concentration of 80.2 mg/kg. Concentrations increased with depth at location 15-610523, did not change substantially with depth (0.1 mg/kg) at location 15-610510, and decreased with depth at all other locations (concentrations in the shallow samples at locations 15-610505 and 15-610508 were 15.9 mg/kg and 19.4 mg/kg, respectively, and below the sediment or soil BVs [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential and industrial SSLs were approximately 5 times and 10 times the maximum concentration, respectively. The lateral extent of lead is defined, and further sampling for vertical extent is not warranted.

Mercury was detected above the soil, sediment, and Qbt 2,3,4 BVs in two soil samples, seven sediment samples, and one tuff sample with a maximum concentration of 1.54 mg/kg. Concentrations increased with depth at location 15-610523; decreased with depth at locations 15-610501, 15-610502, 15-610513, and 15-610515; did not change substantially with depth (0.052 mg/kg) at location 15-610510; and decreased downgradient. The residential SSL was approximately 15 times and the industrial SSL was approximately 253 times the maximum concentration. The lateral extent of mercury is defined, and further sampling for vertical extent is not warranted.

Nickel was detected above the sediment and Qbt 2,3,4 BVs in six sediment samples and four tuff samples with a maximum concentration of 12.1 mg/kg. Concentrations increased with depth at location 15-610525; did not change substantially with depth (0.56 mg/kg, 0.11 mg/kg, and 0.27 mg/kg) at locations 15-610501, 15-610502, and 15-610508; and decreased with depth at locations 15-610505, 15-610515, and 15-610524 (concentration in the shallow sample at location 15-610505 was 7.46 mg/kg and below the sediment BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential SSL was approximately 129 times the maximum concentration. The lateral extent of nickel is defined, and further sampling for vertical extent is not warranted.

Perchlorate was detected in 18 samples with a maximum concentration of 0.00284 mg/kg. Concentrations increased with depth at locations 15-610520 and 15-610521; did not change substantially with depth (0.00003 mg/kg to 0.00164 mg/kg) at locations 15-610507, 15-610508, 15-610509, 15-610510, and 15-610515; decreased with depth at locations 15-610501, 15-610504, 15-610505, 15-610506, 15-610513, and 15-610525; and decreased downgradient. All but one of the concentrations were below the EDLs. The residential SSL was approximately 19,300 times the maximum concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Selenium was not detected above the sediment and Qbt 2,3,4 BVs but had DLs (1.05 mg/kg to 1.5 mg/kg) above the BVs in 26 sediment samples and 6 tuff samples. Because selenium was not detected above BVs and the residential SSL was approximately 260 times the maximum DL, further sampling for extent of selenium is not warranted.

Silver was detected above the soil, sediment, and Qbt 2,3,4 BVs in five soil samples, seven sediment samples, and one tuff sample with a maximum concentration of 21 mg/kg. Concentrations increased with depth at location 15-610523; did not change substantially with depth (0.15 mg/kg to 0.44 mg/kg) at locations 15-610514, 15-610517, 15-610520, and 15-610525; decreased with depth at locations 15-610501, 15-610502, and 15-610503; and decreased downgradient. The residential SSL was approximately 19 times and the industrial SSL was approximately 309 times the maximum concentration. The lateral extent of silver is defined, and further sampling for vertical extent is not warranted.

Uranium was detected above the soil and sediment BVs in 6 soil samples and 16 sediment samples with a maximum concentration of 13.9 mg/kg. Concentrations increased with depth at locations 15-610614 and 15-610523, decreased with depth at all other locations, and decreased downgradient. The residential SSL was approximately 17 times and the industrial SSL was approximately 279 times the maximum concentration. The lateral extent of uranium is defined, and further sampling for vertical extent is not warranted.

Vanadium was detected above the sediment and Qbt 2,3,4 BVs in 19 sediment samples and 3 tuff samples with a maximum concentration of 30.8 mg/kg. Concentrations increased with depth at locations 15-610504, 15-610505, 15-610517, and 15-610525; did not change substantially with depth (0.2 mg/kg) at location 15-610501; and decreased with depth at all other locations (the concentration in the shallow sample at location 15-610508 was 23.8 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations decreased downgradient. The residential SSL was approximately 13 times and the industrial SSL was approximately 212 times the maximum concentration. The lateral extent of vanadium is defined, and further sampling for vertical extent is not warranted.

Organic Chemicals

Organic COPCs at AOC 15-014(h) include acetone; Aroclor-1254; Aroclor-1260; benzoic acid; bis(2-ethylhexyl)phthalate; chloroform; 1,1-dichloroethene; di-n-butylphthalate; di-n-octylphthalate; ethylbenzene; 4-isopropyltoluene; methylene chloride; tetrachloroethene; toluene; 1,2,4-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene.

Acetone was detected in six samples with a maximum concentration of 0.0295 mg/kg. Concentrations were below the EQLs; increased with depth at locations 15-610507 and 15-610508; decreased with depth at locations 15-610504, 15-610516, 15-610523, and 15-610526; and decreased downgradient. The residential SSL was approximately 2,250,000 times the maximum concentration. The lateral extent of acetone is defined, and further sampling for vertical extent is not warranted.

Aroclor-1254 was detected in four samples with a maximum concentration of 0.704 mg/kg. Concentrations decreased with depth at both locations and decreased downgradient. The lateral and vertical extent of Aroclor-1254 are defined.

Aroclor-1260 was detected in four samples with a maximum concentration of 0.258 mg/kg. Concentrations decreased with depth at both locations and decreased downgradient. The lateral and vertical extent of Aroclor-1260 are defined.

Benzoic acid was detected in three samples with a maximum concentration of 1.01 mg/kg. Concentrations decreased with depth at all locations and decreased downgradient. The lateral and vertical extent of benzoic acid are defined.

Bis(2-ethylhexyl)phthalate was detected in three samples with a maximum concentration of 0.343 mg/kg. Concentrations increased with depth at location 15-610523, decreased with depth at locations 15-610508 and 15-610515, and decreased downgradient. The residential SSL was approximately 1100 times the maximum concentration. The lateral extent of bis(2-ethylhexyl)phthalate is defined, and further sampling for vertical extent is not warranted.

Chloroform was detected in one sample at a concentration of 0.000687 mg/kg. The concentration was below the EQL, increased with depth, and decreased downgradient. The residential SSL was approximately 8600 times the concentration. The lateral extent of chloroform is defined, and further sampling for vertical extent is not warranted.

Dichloroethene[1,1-] was detected in one sample at a concentration of 0.000772 mg/kg. The concentration was below the EQL, decreased with depth, and decreased downgradient. The lateral and vertical extent of 1,1-dichloroethene are defined.

Di-n-butylphthalate was detected in two samples with a maximum concentration of 0.129 mg/kg. Concentrations were below the EQL, did not change substantially (0.036 mg/kg) with depth, and decreased downgradient. The lateral and vertical extent of di-n-butylphthalate are defined.

Di-n-octylphthalate was detected in one sample at a concentration of 1.43 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of di-n-octylphthalate are defined.

Ethylbenzene was detected in two samples with a maximum concentration of 0.00076 mg/kg. Concentrations were below the EQL, increased with depth at location 15-610517, decreased with depth at location 15-610515, and decreased downgradient. The residential SSL was approximately 99,000 times the maximum concentration. The lateral extent of ethylbenzene is defined, and further sampling for vertical extent is not warranted.

Isopropyltoluene[4-] was detected in six samples with a maximum concentration of 0.0425 mg/kg. Concentrations increased with depth at location 15-610523, decreased with depth at the other locations, and decreased downgradient. The residential SSL was approximately 56,000 times the maximum concentration. The lateral extent of 4-isopropyltoluene is defined, and further sampling for vertical extent is not warranted.

Methylene chloride was detected in seven samples with a maximum concentration of 0.00941 mg/kg. Concentrations increased with depth at location 15-610510 and decreased with depth at the other locations and downgradient. The residential SSL was approximately 43,000 times the maximum concentration. The lateral extent of methylene chloride is defined, and further sampling for vertical extent is not warranted.

Tetrachloroethene was detected in 14 samples with a maximum concentration of 0.00155 mg/kg. Concentrations increased with depth at locations 15-610514, 15-610517, and 15-610519; decreased with depth at the other locations; did not change substantially with depth (0.000155 mg/kg to 0.00109 mg/kg) at locations 15-610513, 15-610515, and 15-610516; and decreased downgradient. The residential SSL was approximately 72,000 times the maximum concentration. The lateral extent of tetrachloroethene is defined, and further sampling for vertical extent is not warranted.

Toluene was detected in 15 samples with a maximum concentration of 0.00244 mg/kg. Concentrations increased with depth at locations 15-610510, 15-610515, and 15-610517; did not change substantially with depth (0.00013 mg/kg to 0.0018 mg/kg) at locations 15-610519, 15-610520, and 15-610523; decreased with depth at the other locations; and decreased or did not change substantially

(0.000152 mg/kg and 0.000654 mg/kg) downgradient. The residential SSL was approximately 2,140,000 times the maximum concentration. Further sampling for extent of toluene is not warranted.

Trimethylbenzene[1,2,4-] was detected in one sample at a concentration of 0.000383 mg/kg. The concentration was below the EQL, increased with depth, and decreased downgradient. The residential SSL was approximately 151,000 times the maximum concentration. The lateral extent of 1,2,4-trimethylbenzene is defined, and further sampling for vertical extent is not warranted.

Xylene[1,2-] was detected in two samples with a maximum concentration of 0.000371 mg/kg. Concentrations were below the EQLs, increased with depth at location 15-610520, decreased with depth at location 15-610526, and decreased downgradient. The residential SSL was approximately 2,170,000 times the maximum concentration. The lateral extent of 1,2-xylene is defined, and further sampling for vertical extent is not warranted.

Xylene[1,3-]+1,4-xylene was detected in 19 samples with a maximum concentration of 0.00114 mg/kg. Concentrations were below the EQLs; increased with depth at locations 15-610502, 15-610505, 15-610506, 15-610507, 15-610517, 15-610518, 15-610520, and 15-610523; did not change substantially with depth (0.000201 mg/kg to 0.00071 mg/kg) at locations 15-610515, 15-610516, and 15-610519; decreased with depth at the other locations; and decreased or did not change substantially (0.000368 mg/kg and 0.000664 mg/kg) downgradient. The residential SSL was approximately 764,000 times the maximum concentration. Further sampling for extent of 1,3-xylene+1,4-xylene is not warranted.

Radionuclides

Radionuclide COPCs at AOC 15-014(h) include cesium-137, plutonium-238, plutonium-239/240, tritium, uranium-234, and uranium-238.

Cesium-137 was detected above the sediment FV in one sample and was detected below 1 ft bgs in six soil samples with a maximum activity of 1.53 pCi/g. Activities did not change substantially with depth (0.041 pCi/g, 0.182 pCi/g, and 0.148 pCi/g) at locations 15-610513, 15-610514, and 15-610523; decreased with depth at locations 15-610509, 15-610510, 15-610515, and 15-610520; and increased, did not change substantially (0.18 pCi/g), or decreased downgradient. The residential and industrial SALs were approximately 7.8 times and 27 times the maximum activity, respectively. Further sampling for extent of cesium-137 is not warranted.

Plutonium-238 was detected above the sediment FV in one sample at an activity of 0.0599 pCi/g. Activities decreased with depth and decreased downgradient. The lateral and vertical extent of plutonium-238 are defined.

Plutonium-239/240 was detected above the soil FV in one sample and detected below 1 ft bgs in two soil samples with a maximum activity of 0.0622 pCi/g. Activities did not change substantially with depth (0.0017 pCi/g and 0.0075 pCi/g) at locations 15-610509 and 15-610523, decreased with depth at location 15-610507, and decreased downgradient. The residential SAL was approximately 1280 times the maximum activity. The lateral extent of plutonium-239/240 is defined, and further sampling for vertical extent is not warranted.

Tritium was detected in eight samples with a maximum activity of 0.883 pCi/g. Activities increased with depth at locations 15-610520, 15-610523, and 15-610526; did not change substantially with depth (0.0047 pCi/g and 0.062 pCi/g) at locations 15-610502 and 15-610524; decreased with depth at locations 15-610509 and 15-610521; and decreased or did not change substantially (0.016 pCi/g) downgradient. The residential SAL was approximately 1950 times the maximum activity. Further sampling for extent of tritium is not warranted.

Uranium-234 was detected above the soil and sediment BVs in one soil sample and three sediment ~~four~~ samples with a maximum activity of 4.17 pCi/g. Activities did not change substantially with depth (0.62 pCi/g) at location 15-610523; decreased with depth at locations 15-610505, 15-610506, and 15-610520; and increased or decreased downgradient. The residential SAL was approximately 700 times the maximum activity. Further sampling for extent of uranium-234 is not warranted.

Uranium-238 was detected above the soil and sediment BVs in four soil samples and nine sediment samples with a maximum activity of 5.21 pCi/g. Activities did not change substantially with depth (0.13 pCi/g and 0.63 pCi/g) at locations 15-610510 and 15-610523; decreased with depth at the other locations; and increased, decreased, or did not change substantially (0.17 pCi/g) downgradient. The residential SAL was approximately 28 times the maximum activity. Further sampling for extent of uranium-238 is not warranted.

8.11.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 1×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.07, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.5 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 3×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is approximately 1, which is equivalent to the NMED target HI of 1 (NMED 2015, 600915). The total dose is 1 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and residential,~~ and construction worker scenarios at AOC 15-014(h).

8.11.6 Summary of Ecological Risk Screening

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at AOC 15-014(h).

9.0 TA-36 BACKGROUND AND FIELD INVESTIGATION RESULTS

9.1 Background of TA-36

9.1.1 Operational History

TA-36 is located east of TA-15 and south of Pajarito Road (Plate 1). TA-36 contains four active firing sites (Eenie, Meenie, Minie, and Lower Slobovia) that support explosives testing. The firing sites and associated buildings are used for a wide variety of nonnuclear ordnance tests for the U.S. Department of Defense. Activities include shipping, receiving, transporting, and testing HE; developing diagnostic techniques; testing armor/anti-armor systems; and testing weapons components and guns (LANL 1993, 015313, p. 2-5). TA-36 operations associated with the Threemile Canyon Aggregate Area include a laboratory and an experiment facility located on a mesa top south of Threemile Canyon and west of TA-18.

The following four SWMUs within the Threemile Canyon Aggregate Area and located in TA-36 are addressed in this supplemental investigation report:

- SWMU 36-002 is a former sump (former structure 36-49) located approximately 40 ft northwest of controlled environmental building 36-48.
- SWMU 36-003(a) is a septic system located east of building 36-1.
- SWMU 36-008 is a surface disposal area located on the south rim of Threemile Canyon.
- SWMU C-36-003 is a former NPDES-permitted outfall located on the south rim of Threemile Canyon.

Figure 9.1-1 shows the site features of the SWMUs at TA-36.

9.1.2 Summary of Releases

Potential contaminants at TA-36 may have been released into the environment through operational releases at the firing sites, a former laboratory and experimental area, and associated facilities.

9.1.3 Current Site Usage and Status

TA-36 is actively used to support a variety of programs related to HE testing and other activities and is expected to remain active for the foreseeable future. TA-36 operations associated with the Threemile Canyon Aggregate Area include an active laboratory and experiment facility.

9.2 SWMU 36-002—Former Sump

9.2.1 Site Description and Operational History

SWMU 36-002 is a former sump (structure 36-49) that was located at TA-36, near the edge of Threemile Canyon and approximately 40 ft northwest of building 36-48 (Figure 9.2-1). The 4-ft-diameter × 8-ft-deep sump was constructed in 1965 by excavating directly into native tuff. A 4-ft-diameter corrugated metal pipe was placed vertically into the excavation. The interior of the pipe was filled with 3-in.-diameter gravel to a depth of 2 ft bgs. The sump had a metal cover. From 1965 to 1993, the sump received effluent from two sinks in building 36-48 via a 4-in.-diameter VCP that connected to the sump at 2 ft bgs. Building 36-48 was used for shot assembly and controlled-temperature experiments as well as cutting, lapping, and polishing DU. One of the sinks connected to the sump had a chemical-resistant coating. The sinks were disconnected from the sump in 1993, and the sump was removed during the 1994 RFI (LANL 1995, 062839).

9.2.2 Relationship to Other SWMUs and AOCs

No SWMUs and AOCs are being investigated in the vicinity of SWMU 36-002 (Plate 1). The nearest site is SWMU 36-008, which is approximately 650 ft to the east of SWMU 36-002 and on the opposite side of Potrillo Road.

9.2.3 Summary of Previous Investigations

In 1994, Phase I RFI activities were performed at SWMU 36-002. The soil and rock in and around the sump was excavated and stockpiled on the site on a lined, bermed pad. Five samples were collected from five depths within the excavation and analyzed for inorganic chemicals, SVOCs, and VOCs (LANL 1995, 062839, p. 1-6).

Based on the Phase I RFI results, the stockpiled material excavated during sampling was returned to the original sump excavation. The sump and part of the inlet pipe were removed and disposed of as construction debris (LANL 1995, 062839, p. 1-6).

Data from five samples collected during the 1994 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

9.2.4 Site Contamination

9.2.4.1 Soil, Rock, and Sediment Sampling

Based on previous investigation results, further characterization was needed to assess potential contamination at SWMU 36-002. As a result, the following activities were completed as part of the 2009–2010 investigation:

- Six samples were collected from three locations to define the nature and extent of contamination. Sampling locations were within the footprint of the former sump, at the drainline elbow, and downgradient of the former sump. Samples were collected from two depth intervals (4.0–5.0 ft bgs to 9.0–10.0 ft bgs and 9.0–10.0 ft bgs to 15.0–16.0 ft bgs) at each location. All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, nitrate, perchlorate, explosive compounds, SVOCs, VOCs, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, and tritium. Four samples were also analyzed for PCBs.
- All investigation samples were field screened for gross-alpha and –beta radioactivity, and surface samples were screened for HE using a spot test. Field-screening results were recorded on borehole logs and/or corresponding SCLs. Borehole logs are presented in Appendix C, and SCLs/COC forms are included in Appendix E.

The 2009–2010 sampling locations at SWMU 36-002 are shown on Figure 9.2-1. Table 9.2-1 presents the samples collected and analyses requested at SWMU 36-002. The geodetic coordinates of sampling locations are presented in Table 3.2-1.

9.2.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

9.2.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 36-002 consist of results from six tuff samples collected from three locations.

Inorganic Chemicals

Six tuff samples were collected and analyzed for TAL metals, cyanide, nitrate, and perchlorate. Table 9.2-2 presents the inorganic chemicals above BVs and the detected inorganic chemicals with no BVs. Figure 9.2-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 BV (7340 mg/kg) in one sample at a concentration of 13,800 mg/kg. Aluminum is retained as a COPC.

Antimony was not detected above the Qbt 2,3,4 BV (0.5 mg/kg) but had DLs (0.857 mg/kg to 1.07 mg/kg) above the BV in six samples. Antimony is retained as a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in three samples with a maximum concentration of 84.6 mg/kg. Barium is retained as a COPC.

Beryllium was detected above the Qbt 2,3,4 BV (1.21 mg/kg) in one sample at a concentration of 2.69 mg/kg. Beryllium is retained as a COPC.

Calcium was detected above the Qbt 2,3,4 BV (2200 mg/kg) in one sample at a concentration of 4700 mg/kg. Calcium is retained as a COPC.

Chromium was detected above the Qbt 2,3,4 BV (7.14 mg/kg) in two samples with a maximum concentration of 9.64 mg/kg. The concentrations were 2.5 mg/kg and 1.24 mg/kg above the BV and below the maximum Qbt 2,3,4 background concentration (13 mg/kg). Chromium was detected below the BV in the other four samples. Chromium is not a COPC.

Cobalt was detected above the Qbt 2,3,4 BV (3.14 mg/kg) in one sample at a concentration of 4.2 mg/kg. Cobalt is retained as a COPC.

Copper was detected above the Qbt 2,3,4 BV (4.66 mg/kg) in two samples with a maximum concentration of 9.92 mg/kg. Copper is retained as a COPC.

Lead was detected above the Qbt 2,3,4 BV (11.2 mg/kg) in one sample at a concentration of 13 mg/kg. The concentration was 1.8 mg/kg above the BV and below the two highest Qbt 2,3,4 background concentrations (14.5 mg/kg and 15.5 mg/kg). Lead was detected below the BV in the other five samples. Lead is not a COPC.

Magnesium was detected above the Qbt 2,3,4 BV (1690 mg/kg) in two samples with a maximum concentration of 3080 mg/kg. Magnesium is retained as a COPC.

Manganese was detected above the Qbt 2,3,4 BV (482 mg/kg) in one sample at a concentration of 497 mg/kg. The concentration was 15 mg/kg above the BV and below the three highest Qbt 2,3,4 background concentrations (1700 mg/kg, 2720 mg/kg, and 2820 mg/kg). Manganese was detected below the BV in the other five samples. Manganese is not a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in two samples with a maximum concentration of 10.6 mg/kg. Nickel is retained as a COPC.

Perchlorate was detected in three samples with a maximum concentration of 0.00377 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the Qbt 2,3,4 BV (0.3 mg/kg) but had DLs (0.884 mg/kg to 1.02 mg/kg) above the BV in six samples. Selenium is retained as a COPC.

Organic Chemicals

Six tuff samples were collected and analyzed for explosive compounds, SVOCs, and VOCs. Four tuff samples were also analyzed for PCBs. Table 9.2-3 lists the organic chemicals detected. Figure 9.2-3 shows the spatial distribution of detected organic chemicals.

Ethylbenzene was the only organic chemical detected and is retained as a COPC.

Radionuclides

Six tuff samples were collected and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, and tritium. Table 9.2-4 presents the radionuclides detected or detected above BVs/FVs. Figure 9.2-4 shows the spatial distribution of detected radionuclides.

Plutonium-238 was detected in one sample below 1 ft bgs at an activity of 0.033 pCi/g. Plutonium-238 is retained as a COPC.

Tritium was detected in one sample at an activity of 0.01 pCi/g. Tritium is retained as a COPC.

9.2.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMU 36-002 are discussed below.

Inorganic Chemicals

Inorganic COPCs at SWMU 36-002 include aluminum, antimony, barium, beryllium, calcium, cobalt, copper, magnesium, nickel, perchlorate, and selenium.

Aluminum was detected above the Qbt 2,3,4 BV in one sample at a concentration of 13,800 mg/kg. Concentrations decreased with depth and decreased laterally. The lateral and vertical extent of aluminum are defined.

Antimony was not detected above the Qbt 2,3,4 BV but had DLs (0.857 mg/kg to 1.07 mg/kg) above the BV in six samples. Because antimony was not detected above BV and the residential SSL was approximately 29 times the maximum DL, further sampling for extent of antimony is not warranted.

Barium was detected above the Qbt 2,3,4 BV in three samples with a maximum concentration of 84.6 mg/kg. Concentrations decreased with depth at locations 36-610877 and 36-610878. Concentrations did not change substantially (2.4 mg/kg) laterally from location 36-610877 to location 36-610878 in shallow samples but increased laterally in deep samples. The residential SSL was approximately 184 times the maximum concentration. The vertical extent of barium is defined, and further sampling for lateral extent is not warranted.

Beryllium was detected above the Qbt 2,3,4 BV in one sample at a concentration of 2.69 mg/kg. Beryllium concentrations decreased with depth and decreased laterally. The lateral and vertical extent of beryllium are defined.

Calcium was detected above the Qbt 2,3,4 BV in one sample at a concentration of 4700 mg/kg. Concentrations decreased with depth and decreased laterally. The lateral and vertical extent of calcium are defined.

Cobalt was detected above the Qbt 2,3,4 BV in one sample at a concentration of 4.2 mg/kg. Concentrations decreased with depth and increased laterally from location 36-610877 to location 36-610878. The residential and industrial SSLs were approximately 5.5 times and 83 times the maximum concentration, respectively. The vertical extent of cobalt is defined, and further sampling for lateral extent is not warranted.

Copper was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 9.92 mg/kg. Concentrations decreased with depth at both locations and decreased laterally from location 36-610877 to location 36-610878. The lateral and vertical extent of copper are defined.

Magnesium was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 3080 mg/kg. Concentrations decreased with depth at both locations and decreased laterally from location 36-610877 to location 36-610878. The lateral and vertical extent of magnesium are defined.

Nickel was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 10.6 mg/kg. Concentrations decreased with depth at both locations and decreased laterally from location 36-610877 to location 36-610878. The lateral and vertical extent of nickel are defined.

Perchlorate was detected in three samples with a maximum concentration of 0.00377 mg/kg. Concentrations did not change substantially with depth (0.00145 mg/kg) at location 36-610878, decreased with depth at location 36-610877, and did not change substantially laterally (0.00105 mg/kg) from location 36-610877 to location 36-610878. The residential SSL was approximately 14,500 times the maximum concentration. Further sampling for extent of perchlorate is not warranted.

Selenium was not detected above the Qbt 2,3,4 BV but had DLs (0.884 mg/kg and 1.02 mg/kg) above the BV in six samples. Because selenium was not detected above the BV and the residential SSL was approximately 380 times the maximum DL, further sampling for extent of selenium is not warranted.

Organic Chemicals

Organic COPC at SWMU 36-002 includes ethylbenzene.

Ethylbenzene was detected in one sample at a concentration of 0.000482 mg/kg. The concentration was below the EQL, decreased with depth, and decreased laterally from location 36-610877 to location 36-610878. The lateral and vertical extent of ethylbenzene are defined.

Radionuclides

Radionuclide COPCs at SWMU 36-002 include plutonium-238 and tritium.

Plutonium-238 was detected in one sample at an activity of 0.033 pCi/g. Activities decreased with depth and increased laterally from location 36-610877 to location 36-610878. The residential SAL was approximately 2500 times the maximum activity. The vertical extent of plutonium-238 is defined, and further sampling for lateral extent is not warranted.

Tritium was detected in one sample at an activity of 0.01 pCi/g. Activities increased with depth and increased laterally from location 36-610877 to location 36-610878. The residential SAL was approximately 172,000 times the maximum activity. Further sampling for extent of tritium is not warranted.

9.2.5 Summary of Human Health Risk-Screening Assessments

Industrial Scenario

Samples were not collected from the 0.0–1.0 ft depth interval, and the industrial scenario was not evaluated at SWMU 36-002.

Residential Scenario

The total excess cancer risk for the residential scenario is 6×10^{-11} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.4, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.01 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the residential and construction worker scenarios at SWMU 36-002.

9.2.6 Summary of Ecological Risk-Screening Assessment

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at SWMU 36-002.

9.3 SWMU 36-003(a)—Septic System

9.3.1 Site Description and Operational History

SWMU 36-003(a) is a septic system located at TA-36 approximately 115 ft east of building 36-1 (Figure 9.3-1). The septic system consists of a septic tank (structure 36-17), associated drainlines, a manhole (structure 36-38), a distribution box / drain field, and a seepage pit (LASL 1965, 102122; LANL 2004, 102121). The septic tank is a single-chamber tank constructed of reinforced concrete with an 1160-gal. capacity. The drain field consists of four 200-ft-long perforated tile pipes spaced 10 ft apart. The drain field was replaced with the seepage pit in late 1973 or early 1974.

This septic system was constructed in 1949 and received effluent from the restroom facilities in an office and laboratory in building 36-1. In addition to sanitary wastes, spent photo-processing chemicals from x-ray developing may have been discharged to the septic system (LANL 1993, 015313, pp. 5-24, 5-27). The main guard station at TA-36 (building 36-22) was later added to the septic system. In 1988, the guard station was disconnected from the septic tank and rerouted to an adjacent septic system. In 1992, the sanitary waste drainlines that previously served SWMU 36-003(a) were rerouted to the SWSC plant and are currently active (LANL 1993, 015313, pp. 5-22–5-23). In 1995, the septic tank was decontaminated by steam cleaning and the tank was filled with concrete.

9.3.2 Relationship to Other SWMUs and AOCs

SWMU 36-003(a) is located approximately 50 ft south and 150 ft east of SWMU 36-008 (Figure 9.3-1).

9.3.3 Summary of Previous Investigations

In 1994, RFI activities were performed at SWMU 36-003(a). Four sludge samples were collected from four locations in the septic tank. Twelve subsurface samples were collected from borings at six locations. A sample was collected from each boring at the soil-tuff interface and in the tuff 2 ft below the interface. The samples were analyzed for inorganic chemicals, SVOCs, and VOCs (LANL 1995, 053985, p. 1-15).

In 1995, an EC was performed at SWMU 36-003(a). The cleanup involved excavating soil to expose the top of the tank, opening the tank and removing the contents, decontaminating the tank by steam cleaning, filling the tank with concrete, and placing backfill above the tank. The tank contents were disposed of as hazardous waste. Five confirmation subsurface samples were collected from four locations outside the tank walls, beneath the tank inlet, beneath the tank outlet, and below the bottom of the tank and were submitted for analyses of inorganic chemicals and VOCs (LANL 1996, 054484, pp. 1–5).

Data from all samples collected during the 1994 RFI and the 1995 EC do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

9.3.4 Site Contamination

9.3.4.1 Soil and Rock Sampling

Based on previous investigation results, further characterization was needed to assess potential contamination at SWMU 36-003(a). As a result, the following activities were completed as part of the 2009–2010 investigation:

- Twenty samples were collected in 2009–2010 from 10 locations. Six samples were collected from four locations beneath the inlet drainline, septic tank inlet, and septic tank. Samples were collected from one or two depth intervals (3.0–4.0 ft bgs, 1.5–2.5 ft bgs, 5.0–5.6 ft bgs and 5.6–6.1 ft bgs, and 2.0–3.0 ft bgs and 3.0–4.2 ft bgs) at each location. Four samples were collected from a borehole adjacent to the seepage pit. Samples were collected at intervals of 49.0–50.0 ft bgs, 59.0–60.0 ft bgs, 69.0–70.0 ft bgs, and 77.5–80.0 ft bgs. Ten samples were collected from five locations within and adjacent to the drain field. Samples were collected from two depth intervals (0.5–1.0 ft bgs to 2.0–3.5 ft bgs and 1.0–2.5 ft bgs to 7.0–8.0 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, nitrate, perchlorate, explosive compounds, SVOCs, VOCs, americium-241, gamma-emitting radionuclides, tritium, isotopic plutonium, and isotopic uranium. Six samples were also analyzed for PCBs.

The 2009–2010 sampling locations at SWMU 36-003(a) are shown on Figure 9.3-1. Table 9.3-1 presents the samples collected and analyses requested at SWMU 36-003(a). The geodetic coordinates of sampling locations are presented in Table 3.2-1.

9.3.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

9.3.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 36-003(a) consist of results from 20 samples (7 soil and 13 tuff) collected from 10 locations.

Inorganic Chemicals

A total of 20 samples (7 soil and 13 tuff) were collected at SWMU 36-003(a) and analyzed for TAL metals, cyanide, nitrate, and perchlorate. Table 9.3-2 presents the inorganic chemicals above BVs and the detected inorganic chemicals with no BVs. Figure 9.3-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was not detected above the soil and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) but had DLs (0.944 mg/kg to 1.29 mg/kg) above the BVs in 20 samples. Antimony is retained as a COPC.

Beryllium was detected above the soil BV (1.83 mg/kg) in one sample at a concentration of 5.57 mg/kg. Beryllium is retained as a COPC.

Cadmium was not detected above the soil BV (0.4 mg/kg) but had DLs (0.492 mg/kg to 0.644 mg/kg) above the BV in seven samples. The DLs were 0.092 mg/kg to 0.244 mg/kg above the BV, below the highest background DL (2 mg/kg), and below or similar to the three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg). Cadmium was not detected in the other 13 samples. Cadmium is not a COPC.

Chromium was detected above the soil and Qbt 2,3,4 BVs (19.3 mg/kg and 7.14 mg/kg) in two soil samples and eight tuff samples with a maximum concentration of 59.1 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in tuff are statistically different from background (Figure G-176 and Table G-24). Chromium is retained as a COPC.

Cobalt was detected above the Qbt 2,3,4 BV (3.14 mg/kg) in three samples with a maximum concentration of 6.75 mg/kg. The Gehan and quantile tests indicated site concentrations of cobalt in tuff are not statistically different from background (Figure G-177 and Table G-24). Cobalt is not a COPC.

Copper was detected above the Qbt 2,3,4 BV (4.66 mg/kg) in one sample at a concentration of 5.36 mg/kg. The Gehan and quantile tests indicated site concentrations of copper in tuff are statistically different from background (Figure G-178 and Table G-24). Copper is retained as a COPC.

Nickel was detected above the soil BV (15.4 mg/kg) in one sample at a concentration of 39.9 mg/kg. Nickel is retained as a COPC.

Nitrate was detected in 14 samples with a maximum concentration of 2.87 mg/kg. Although Nitrate is naturally occurring, the SWMU is a septic system that managed sanitary wastewater. As a result, and the concentrations detected may be site related rather than reflecting only naturally occurring levels of nitrate. Nitrate is not retained as a COPC.

Perchlorate was detected in five samples with a maximum concentration of 0.00229 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the Qbt 2,3,4 BV (0.3 mg/kg) but had DLs (0.93 mg/kg to 1.1 mg/kg) above the BV in 13 samples. Selenium is retained as a COPC.

Sodium was detected above the soil BV (915 mg/kg) in three samples with a maximum concentration of 1720 mg/kg. The concentrations were below or similar to the three highest soil background concentrations (1600 mg/kg, 1700 mg/kg, and 1800 mg/kg). Sodium was detected below BVs in the other 17 samples. Sodium is not a COPC.

Zinc was detected above the soil BV (48.8 mg/kg) in one sample at a concentration of 50.5 mg/kg. The concentration was 1.7 mg/kg above the BV and below the five highest soil background concentrations (53 mg/kg, 55 mg/kg, 57 mg/kg, 60 mg/kg, and 75.5 mg/kg). Zinc was detected below BVs in the other 19 samples. Zinc is not a COPC.

Organic Chemicals

A total of 20 samples (7 soil and 13 tuff) were collected at SWMU 36-003(a) and analyzed for SVOCs, VOCs, and explosive compounds. Six tuff samples were also analyzed for PCBs. Table 9.3-3 summarizes the analytical results for detected organic chemicals. Figure 9.3-3 shows the spatial distribution of detected organic chemicals.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons are a class of SVOCs frequently detected as a result of environmental sampling but generally were not released from the SWMUs or AOCs being investigated. PAHs unrelated to site activities are thus often detected in samples analyzed for the presence of site-related SVOCs.

PAHs are known to be widely distributed in the environment from a number of sources, both natural, such as forest fires, and anthropogenic, such as combustion of fossil fuels, oil drips off motor vehicles, vehicle tires, coal tar pitch, and weathering or eroding of asphalt pavement (Kose et al. 2008, 219977; Teaf 2008, 219976). PAHs from these sources generally occur as complex mixtures, not as single compounds. Individual PAH compounds can be manufactured for research purposes, and some PAHs (e.g., anthracene, fluorene, naphthalene, and pyrene) are used in dye production, the manufacture of synthetic fibers, and in plastics and pesticides.

The principal sources of PAHs in soil along parking lots, roads, and highways are vehicular exhaust and emissions, the wearing of tires, and asphalt. PAH-containing materials, such as asphalt and rubber particles, do not easily dissolve in water, preventing migration, except as suspended particles in storm water. PAH concentrations in excess of soil cleanup levels may result from common anthropogenic sources, such as runoff from asphalt parking lots.

Site Activities

SWMU 36-003(a) was identified as a SWMU because of possible contamination resulting from potential releases of hazardous materials from the septic system that served building 36-1. This septic system was constructed in 1949 and received effluent from the restroom facilities in an office and laboratory in building 36-1. In addition, spent photo-processing chemicals from x-ray developing may have been discharged to the septic system. PAHs were not used in building 36-1.

SWMU 36-003(a) is located directly adjacent to and downgradient of a paved parking area around building 36-1 and a paved roadway (Potrillo Drive), consisting of old and weathered asphalt (Appendix I, Figures I-17 to I-19). The area where samples were collected receives runoff from the asphalt. Based on the fact that PAHs were not used in building 36-1, and the long-term presence of an old and weathered asphalt-paved road and parking area directly adjacent to SWMU 36-003(a), the PAHs detected in samples used to characterize this site [acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene,

benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene] are from the adjacent weathered roadway, parking area, and storm drainage; are not related to historic Laboratory site operations; and are not COPCs.

Organic COPCs

Other organic chemicals detected at SWMU 36-003(a) include 4-isopropyltoluene, RDX, and 1,2,4-trimethylbenzene. The detected organic chemicals listed are retained as COPCs.

Radionuclides

A total of 20 samples (7 soil and 13 tuff) were collected at SWMU 36-003(a) and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, and tritium. Table 9.3-4 summarizes radionuclides detected or detected above BVs/FVs. Figure 9.3-4 shows the spatial distribution of detected radionuclides.

Uranium-235/236 was detected above the Qbt 2,3,4 BV (0.09 pCi/g) in one sample at an activity of 0.0957 pCi/g. The activity was only 0.057 pCi/g above the BV, and uranium-235/236 was not detected or detected below the BVs in the other 19 samples (detected below BVs in 4 samples). Uranium-235/236 is not a COPC.

9.3.3.4 Nature and Extent of Contamination

The nature and extent of inorganic and organic COPCs at SWMU 36-003(a) are discussed below.

Inorganic Chemicals

Inorganic COPCs at SWMU 36-003(a) include antimony, beryllium, chromium, copper, nickel, nitrate, perchlorate, and selenium.

Antimony was not detected above the soil and Qbt 2,3,4 BVs but had DLs (0.944 mg/kg to 1.29 mg/kg) above the BVs in 20 samples. Because antimony was not detected above BVs and the residential SSL was approximately 24 times the maximum DL, further sampling for extent of antimony is not warranted.

Beryllium was detected above the soil BV in one sample at a concentration of 5.57 mg/kg. Beryllium concentrations increased with depth and decreased downgradient. The residential SSL was approximately 28 times the concentration. The lateral extent of beryllium is defined, and further sampling for vertical extent is not warranted.

Chromium was detected above the soil and Qbt 2,3,4 BVs in two soil samples and eight tuff samples with a maximum concentration of 59.1 mg/kg. Concentrations increased with depth at locations 36-610882, 36-610884, 36-610885, 36-610887, 36-610888, and 36-610889, and only one depth was sampled at location 36-610880. Concentrations decreased with depth at location 36-610879. Concentrations decreased downgradient. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 1980 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Copper was detected above the Qbt 2,3,4 BV in one sample at a concentration 5.36 mg/kg. Only one depth was sampled at location 36-610880. The concentration was below the maximum Qbt 2,3,4 background concentration (6.2 mg/kg), and the residential SSL was approximately 584 times the concentration. Concentrations decreased downgradient. The lateral extent of copper is defined, and further sampling for vertical extent is not warranted.

Nickel was detected above the soil BV in one sample at a concentration of 39.9 mg/kg. Concentrations increased with depth and decreased downgradient. The residential SSL was approximately 390 times the maximum concentration. The lateral extent of nickel is defined, and further sampling for vertical extent is not warranted.

Nitrate was detected in 14 samples with a maximum concentration of 2.87 mg/kg. Concentrations did not change substantially with depth (0.09 mg/kg to 0.32 mg/kg) at locations 36-610879, 36-610882, 36-610884, 36-610886, and 36-610889 and decreased with depth at location 36-610888. Only one depth was sampled at location 36-610880. Concentrations did not change substantially (0.63 mg/kg) downgradient. Further sampling for extent of nitrate is not warranted.

Perchlorate was detected in five samples with a maximum concentration of 0.00229 mg/kg. Concentrations increased with depth at locations 36-610884, 36-610886, and 36-610887; did not change substantially with depth (0.0015 mg/kg) at location 36-610889; and decreased downgradient. The residential SSL was approximately 24,000 times the maximum concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Selenium was not detected above the Qbt 2,3,4 BV but had DLs (0.93 mg/kg to 1.1 mg/kg) above the BV in 13 samples. Because selenium was not detected above the BV and the residential SSL was approximately 355 times the maximum DL, further sampling for extent of selenium is not warranted.

Organic Chemicals

Organic COPCs at SWMU 36-003(a) include 4-isopropyltoluene, RDX and 1,2,4-trimethylbenzene.

Isopropyltoluene[4-] was detected in two samples with a maximum concentration of 0.00811 mg/kg. Concentrations increased with depth at locations 36-610882 and 36-610884 and decreased downgradient. The residential SSL was approximately 295,000 times the maximum concentration. The lateral extent of 4-isopropyltoluene is defined, and further sampling for vertical extent is not warranted.

RDX was detected in one sample at a concentration of 0.184 mg/kg. The concentration was below the EQL, decreased with depth, and increased downgradient. The residential SSL was approximately 330 times the maximum concentration. The vertical extent of RDX is defined, and further sampling for lateral extent is not warranted.

Trimethylbenzene[1,2,4-] was detected in one sample at a concentration of 0.000343 mg/kg. Only one depth was sampled at location 36-610880. The concentration was below the EQL, and the residential SSL was approximately 170,000 times the concentration. Concentrations decreased downgradient. The lateral extent of 1,2,4-trimethylbenzene is defined, and further sampling for vertical extent is not warranted.

Radionuclides

No radionuclide COPCs were identified at SWMU 36-003(a).

9.3.5 Summary of Human Health Risk-Screening Assessments

Industrial Scenario

No carcinogenic COPCs were identified in 0.0–1.0 ft bgs depth interval. The HI is 0.002, which is below the NMED target HI of 0.006 (NMED 2015, 600915). No radionuclide COPCs were identified for the industrial scenario.

Residential Scenario

The total excess cancer risk for the residential scenario is 3×10^{-8} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.2, which is below the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified for the residential scenario. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and residential,~~ and construction worker scenarios at SWMU 36-003(a).

9.3.6 Summary of Ecological Risk-Screening Assessment

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at SWMU 36-003(a).

9.4 SWMU 36-008—Surface Disposal Area Located Near Building 36-1

9.4.1 Site Description and Operational History

SWMU 36-008 is a surface disposal area located at TA-36 north of building 36-1, an office and laboratory (Plate 25). The disposal area is on the south rim of Threemile Canyon and extends down the steeply sloping edge of the mesa. The approximately 1-acre disposal area was discovered in June 2000 after the Cerro Grande fire burned through the area. The dates the site was used for disposal are not known. The materials strewn over the site seemed to be associated with building activities, and it is possible the disposal area may have been used as early as 1949, when building 36-1 was constructed. Surface debris included laboratory glassware, metal cans, metal pipe, and miscellaneous metal fragments. As part of Cerro Grande fire response efforts, visible debris was removed from the surface disposal area. Approximately 5 yd³ of debris was collected from the site, segregated, and staged for disposal; in addition, storm-water BMPs were implemented to prevent erosion (LANL 2000, 068656).

9.4.2 Relationship to Other SWMUs and AOCs

SWMU 36-008 is located approximately 100 ft northwest and downgradient of SWMU 36-003(a). The SWMU C-36-003 outfall is located approximately 20 ft inside the southern boundary of SWMU 36-008 (Plate 25).

9.4.3 Summary of Previous Investigations

No sampling was conducted at SWMU 36-008 before 2009.

9.4.4 Site Contamination

9.4.4.1 Soil, Sediment, and Rock Sampling

Because no previous investigations had been conducted, characterization was required to assess potential contamination at SWMU 36-008. The following activities were completed as part of the 2009–2010 investigation.

- A total of 91 samples were collected in 2009–2010 from 48 locations to define the nature and extent of contamination. Sampling locations were located throughout the SWMU and adjacent to and downgradient of the SWMU. At each location a sample was collected from the surface (0.0–0.5 ft bgs to 0.0–1.0 ft bgs), and at 43 locations a sample was also collected from the subsurface (0.5–2.0 ft bgs to 2.0–3.0 ft bgs). All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, nitrate, perchlorate, explosive compounds, SVOCs, VOCs, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, and tritium. In addition, 15 samples were analyzed for PCBs.

The 2009–2010 sampling locations at SWMU 36-008 are shown on Plate 25. Table 9.4-1 presents the samples collected and analyses requested at SWMU 36-008. The geodetic coordinates of sampling locations are presented in Table 3.2-1.

9.4.4.2 Soil, Rock, and Sediment Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

9.4.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data collected at SWMU 36-008 consist of results from 91 samples (78 soil, 7 sediment, and 6 tuff) collected from 48 locations. In addition, there are decision-level data for 16 samples (9 soil, 6 sediment, and 1 tuff) collected at SWMU C-36-003 (see section 9.5.4). Because SWMU C-36-003 is located within the footprint of SWMU 36-008, the following COPC identification and nature and extent evaluations for SWMU 36-008 include the combined data sets for SWMUs 36-008 and C-36-003. ~~are evaluated below for COPC identification and nature and extent.~~

Inorganic Chemicals

A total of 107 samples (87 soil, 13 sediment, and 7 tuff) were collected and analyzed for TAL metals, cyanide, nitrate, and perchlorate. Table 9.4-2 presents the inorganic chemicals above BVs and the detected inorganic chemicals with no BVs. Plate 26 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 BV (7340 mg/kg) in one sample at a concentration of 11,000 mg/kg. The concentration was 3660 mg/kg above the BV, and aluminum was detected below BVs in the other 106 samples. Aluminum is not a COPC.

Antimony was not detected above the soil, sediment, and Qbt 2,3,4 BVs (0.83 mg/kg, 0.83 mg/kg, and 0.5 mg/kg) but had DLs (0.919 mg/kg to 5.62 mg/kg) above the BVs in 83 soil samples, 13 sediment samples, and 7 tuff samples. Antimony is retained as a COPC.

Arsenic was detected above the Qbt 2,3,4 BV (2.79 mg/kg) in one sample at a concentration of 3.2 mg/kg. The concentration was 0.41 mg/kg above the BV and below the two highest Qbt 2,3,4 background concentrations (4 mg/kg and 5 mg/kg). Arsenic was not detected or detected below BVs in the other 106 samples (detected below BVs in 105 samples). Arsenic is not a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in two samples with a maximum concentration of 153 mg/kg. Barium is retained as a COPC.

Beryllium was detected above the Qbt 2,3,4 BV (1.21 mg/kg) in one sample at a concentration of 2.44 mg/kg. The maximum concentration was 1.23 mg/kg above the BV and 0.64 mg/kg above the maximum Qbt 2,3,4 background concentration (1.8 mg/kg). Beryllium was not detected or not detected above BVs in the other 106 samples (detected below BVs in 105 samples). Beryllium is not a COPC.

Cadmium was detected above the soil and sediment BVs (0.4 mg/kg for both) in 9 soil samples and 3 sediment samples with a maximum concentration of 3.35 mg/kg and had DLs (0.478 mg/kg to 0.882 mg/kg) above the BVs in 59 soil samples and 8 sediment samples. The quantile and slippage tests indicated site concentrations of cadmium in sediment are statistically different from background (Figure G-179 and Table G-25). Cadmium is retained as a COPC.

Calcium was detected above the soil, sediment, and Qbt 2,3,4 BVs (6120 mg/kg, 4420 mg/kg, and 2200 mg/kg) in two soil samples, three sediment samples, and one tuff sample with a maximum concentration of 11,700 mg/kg. The Gehan test indicated site concentrations of calcium in soil are statistically different from background (Table G-26). However, the quantile and slippage tests indicated site concentrations of calcium in soil are not statistically different from background (Figure G-180 and Table G-26). The Gehan and quantile tests indicated site concentrations of calcium in sediment are statistically different from background (Figure G-181 and Table G-25). Calcium is retained as a COPC.

Chromium was detected above the soil, sediment, and Qbt 2,3,4 BVs (19.3 mg/kg, 10.5 mg/kg, and 7.14 mg/kg) in 19 soil samples, 5 sediment samples, and 7 tuff samples with a maximum concentration of 192 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in soil and sediment are statistically different from background (Figure G-182 and Table G-26, and Figure G-183 and Table G-25, respectively). Chromium is retained as a COPC.

Cobalt was detected above the soil and Qbt 2,3,4 BVs (8.64 mg/kg and 3.14 mg/kg) in one soil sample and one tuff sample with maximum concentration of 11.3 mg/kg. The Gehan and quantile tests indicated site concentrations of cobalt in soil are not statistically different from background (Figure G-184 and Table G-26). The concentration above the Qbt 2,3,4 BV (5.34 mg/kg) was 2.2 mg/kg above the BV and maximum Qbt 2,3,4 background concentration (3.14 mg/kg). Cobalt was detected below BVs in the other 105 samples (including the other 6 tuff samples). Cobalt is not a COPC.

Copper was detected above the soil, sediment, and Qbt 2,3,4 BVs (14.7 mg/kg, 11.2 mg/kg, and 4.66 mg/kg) in ~~five~~ 14 soil samples, ~~five~~ 5 sediment samples, and ~~three~~ 3 tuff samples with a maximum concentration of 4870 mg/kg. The Gehan and quantile tests indicated site concentrations of copper in soil and sediment are statistically different from background (Figure G-185 and Table G-26, and Figure G-186 and Table G-25, respectively). Copper is retained as a COPC.

Cyanide was detected above the soil and sediment BVs (0.5 mg/kg and 0.82 mg/kg) in 31 soil samples and 1 sediment sample with a maximum concentration of 4.24 mg/kg. The Gehan and quantile tests indicated site concentrations of cyanide in sediment are not statistically different from background (Figure G-187 and Table G-25). Cyanide was detected substantially above the soil BV. Cyanide is retained as a COPC.

Lead was detected above the soil, sediment, and Qbt 2,3,4 BVs (22.3 mg/kg, 19.7 mg/kg, and 11.2 mg/kg) in 10 soil samples, 4 sediment samples, and 2 tuff samples with a maximum concentration of 202 mg/kg. The Gehan and quantile tests indicated site concentrations of lead in soil are not statistically different from background (Figure G-188 and Table G-26). The Gehan and quantile tests indicated site concentrations of lead in sediment are statistically different from background (Figure G-189 and Table G-25). Lead is retained as a COPC.

Magnesium was detected above the Qbt 2,3,4 BV (1690 mg/kg) in one sample at a concentration of 2590 mg/kg. The concentration was 900 mg/kg above the BV and below the two highest Qbt 2,3,4 background concentrations (2820 mg/kg and 2720 mg/kg). Magnesium was detected below BVs in the other 106 samples. Magnesium is not a COPC.

Manganese was detected above the soil and sediment BVs (671 mg/kg and 543 mg/kg) in three soil samples and three sediment samples with a maximum concentration of 893 mg/kg. The Gehan and quantile tests indicated site concentrations of manganese in soil are not statistically different from background (Figure G-190 and Table G-26). The Gehan and quantile tests indicated site concentrations of manganese in sediment are statistically different from background (Figure G-191 and Table G-25). Manganese is retained as a COPC.

Mercury was detected above the soil, sediment, and Qbt 2,3,4 BVs (0.1 mg/kg for all) in 22 soil samples, 8 sediment samples, and 1 tuff sample with a maximum concentration of 25 mg/kg. Mercury is retained as a COPC.

Nickel was detected above the soil, sediment, and Qbt 2,3,4 BVs (15.4 mg/kg, 9.38 mg/kg, and 6.58 mg/kg) in one soil sample, one sediment sample, and one tuff sample with a maximum concentration of 53 mg/kg. The Gehan and quantile tests indicated site concentrations of nickel in soil are not statistically different from background (Figure G-192 and Table G-26). The Gehan test indicated site concentrations of nickel in sediment are statistically different from background (Table G-25). However, the quantile and slippage tests indicated site concentrations of nickel in sediment are not statistically different from background (Figure G-193 and Table G-25). The concentration in tuff (9.22 mg/kg) was above the maximum Qbt 2,3,4 background concentration (7 mg/kg). Nickel is retained as a COPC.

Nitrate was detected in 101 samples with a maximum concentration of 540 mg/kg. Nitrate is retained as a COPC.

Perchlorate was detected in 71 samples with a maximum concentration of 0.688 mg/kg. Perchlorate is retained as a COPC.

Selenium was detected above the Qbt 2,3,4 BV (0.3 mg/kg) in 1 sample at a concentration of 0.635 mg/kg and had DLs (1.01 mg/kg to 2.03 mg/kg) above the soil and sediment BVs (1.52 mg/kg and 0.3 mg/kg) and the Qbt 2,3,4 BV in 4 soil samples, 13 sediment samples, and 6 tuff samples. Selenium is retained as a COPC.

Silver was detected above the soil, sediment, and Qbt 2,3,4 BVs (1 mg/kg for all) in 10 soil samples, 3 sediment samples, and 1 tuff sample with a maximum concentration of 348 mg/kg. Silver is retained as a COPC.

Sodium was detected above the soil BV (915 mg/kg) in one sample at a concentration of 1000 mg/kg. The quantile and slippage tests indicated site concentrations of sodium in soil are not statistically different from background (Figure G-194 and Table G-26). Sodium is not a COPC.

Uranium was detected above the soil and sediment BVs (1.82 mg/kg and 2.22 mg/kg) in 24 soil samples and 2 sediment samples with a maximum concentration of 10.4 mg/kg. The Gehan and quantile tests indicated site concentrations of uranium in soil and sediment are statistically different from background (Figure G-195 and Table G-26, and Figure G-196 and Table G-25, respectively). Uranium is retained as a COPC.

Vanadium was detected above the Qbt 2,3,4 BV (17 mg/kg) in one sample at a concentration of 26.2 mg/kg. The concentration was 9.2 mg/kg above the BV and only 5.2 mg/kg above the maximum Qbt 2,3,4 background concentration (21 mg/kg). Vanadium was detected below BVs in the other 106 samples. Vanadium is not a COPC.

Zinc was detected above the soil, sediment, and Qbt 2,3,4 BVs (48.8 mg/kg, 60.2 mg/kg, and 63.5 mg/kg) in 26 soil samples, 2 sediment samples, and 1 tuff sample with a maximum concentration of 1320 mg/kg. The Gehan and quantile tests indicated site concentrations of zinc in soil and sediment are statistically different from background (Figure G-197 and Table G-26, and Figure G-198 and Table G-25, respectively). Zinc is retained as a COPC.

Organic Chemicals

A total of 107 samples (87 soil, 13 sediment, and 7 tuff) were collected and analyzed for SVOCs, VOCs, and explosive compounds. A total of 31 samples (23 soil, 1 sediment, and 7 tuff) were also analyzed for PCBs. Table 9.4-3 summarizes the analytical results for detected organic chemicals. Plate 27 shows the spatial distribution of detected organic chemicals.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons are a class of SVOCs frequently detected as a result of environmental sampling but generally were not released from the SWMUs or AOCs being investigated. PAHs unrelated to site activities are thus often detected in samples analyzed for the presence of site-related SVOCs.

PAHs are known to be widely distributed in the environment from a number of sources, both natural, such as forest fires, and anthropogenic, such as combustion of fossil fuels, oil drips off motor vehicles, vehicle tires, coal tar pitch, and weathering or eroding of asphalt pavement (Kose et al. 2008, 219977; Teaf 2008, 219976). PAHs from these sources generally occur as complex mixtures, not as single compounds. Individual PAH compounds can be manufactured for research purposes, and some PAHs (e.g., anthracene, fluorene, naphthalene, and pyrene) are used in dye production, the manufacture of synthetic fibers, and in plastics and pesticides.

The principal sources of PAHs in soil along parking lots, roads, and highways are vehicular exhaust and emissions, the wearing of tires, and asphalt. PAH-containing materials, such as asphalt and rubber particles, do not easily dissolve in water, preventing migration, except as suspended particles in storm water. PAH concentrations in excess of soil cleanup levels may result from common anthropogenic sources, such as runoff from asphalt parking lots.

Site Activities

SWMU 36-008 was identified as a SWMU because of possible contamination resulting from potential releases of hazardous materials from the disposal area located on the steeply sloping edge of the mesa below building 36-1. The site appears to be associated with building 36-1 (an office and laboratory), which was constructed in 1949. PAHs were not used in building 36-1. This disposal area was revealed in June 2000 after the Cerro Grande fire burned the vegetation surrounding the site.

~~SWMU C-36-003 was identified as a SWMU because of possible contamination resulting from potential releases of hazardous materials from the outfall that received effluent from a floor drain and spent photo-processing chemicals from a sink in building 36-1. PAHs were not used in building 36-1. The outfall is located within the southern boundary of SWMU 36-008. Vegetation around the site was burned during the 2000 Cerro Grande fire.~~

Currently, SWMUs 36-008 ~~and C-36-003~~ are is located directly adjacent to and downgradient of a paved parking area around building 36-1, consisting of old and weathered asphalt (Appendix I, Figure I-20). Currently, storm-water BMPs consisting of a rock berm are present along the edge of the paved area (Appendix I, Figure I-21), but storm-water runoff previously went directly onto SWMUs 36-008 and C-36-003. This area was also impacted by the Cerro Grande fire, and evidence of burned trees is present in the area (Appendix I, Figures I-22 to I-24). Based on the fact that PAHs were not used in building 36-1, and on the long-term presence of an old and weathered asphalt-paved road and parking area directly adjacent to SWMUs 36-008 ~~and C-36-003~~ and the presence of burned trees within the SWMUs, the PAHs detected in samples used to characterize these sites [acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene] are not related to historic Laboratory site operations and are not COPCs.

Organic COPCs

Other organic chemicals detected at SWMUs 36-008 ~~and C-36-003~~ include acetone; Aroclor-1254; Aroclor-1260; benzoic acid; bis(2-ethylhexyl)phthalate; bromodichloromethane; butylbenzylphthalate; chlorodibromomethane; chloroform; chloromethane; 2-chloronaphthalene; 4-chlorotoluene; dibenzofuran; 1,1-dichloroethene; di-n-butylphthalate; 4-isopropyltoluene; methylene chloride; RDX; styrene; TATB; toluene; trichloroethene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene. The detected organic chemicals listed are retained as COPCs.

Radionuclides

A total of 107 samples (87 soil, 13 sediment, and 7 tuff) were collected ~~at SWMUs 36-008 and C-36-003~~ and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, and tritium. Table 9.4-4 summarizes radionuclides detected or detected above BVs/FVs. Plate 28 shows the spatial distribution of detected radionuclides.

Americium-241 was detected above the soil and sediment FVs (0.013 pCi/g and 0.04 pCi/g) in five soil samples and one sediment sample with a maximum activity of 0.0465 pCi/g. Americium-241 is retained as a COPC.

Cesium-137 was detected above the soil and sediment FVs (1.65 pCi/g and 0.9 pCi/g) in 1 soil sample and 3 sediment samples, was detected below 1 ft bgs in 30 soil samples, and was detected in 1 tuff sample with a maximum activity of 3.31 pCi/g. Cesium-137 is retained as a COPC.

Plutonium-238 was detected above the sediment FV (0.006 pCi/g) in one sample at an activity of 0.026 pCi/g. The activity was only 0.02 pCi/g above the FV. Plutonium-238 was not detected in the other 106 samples. Plutonium-238 is not a COPC.

Plutonium-239/240 was detected above the soil and sediment FVs (0.054 pCi/g and 0.068 pCi/g) in five soil samples and one sediment sample and was detected below 1 ft bgs in four soil samples with a maximum activity of 0.0953 pCi/g. Plutonium-239/240 is retained as a COPC.

Tritium was detected in nine samples with a maximum activity of 0.98 pCi/g. Tritium is retained as a COPC.

Uranium-234 was detected above the soil BV (2.59 pCi/g) in seven samples with a maximum activity of 6.1 pCi/g. Uranium-234 is retained as a COPC.

Uranium-235/236 was detected above the soil and Qbt 2,3,4 BVs (0.2 pCi/g and 0.09 pCi/g) in one soil sample and one tuff sample with a maximum activity of 0.278 pCi/g. Uranium-235/236 is retained as a COPC.

Uranium-238 was detected above the soil BV (2.29 pCi/g) in 10 samples with a maximum activity of 5.17 pCi/g. Uranium-238 is retained as a COPC.

9.4.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMUs 36-008 and ~~C-36-003~~ are discussed below.

Inorganic Chemicals

Inorganic COPCs at SWMUs 36-008 and ~~C-36-003~~ include antimony, barium, cadmium, calcium, chromium, copper, cyanide, lead, manganese, mercury, nickel, nitrate, perchlorate, selenium, silver, uranium, and zinc.

Antimony was not detected above the soil, sediment, and Qbt 2,3,4 BVs but had DLs (0.919 mg/kg to 5.62 mg/kg) above the BVs in 83 soil samples, 13 sediment samples, and 7 tuff samples. Because antimony was not detected above BVs and the residential and industrial SSLs were approximately 5.6 times and 92 times the maximum DL, respectively, further sampling for extent of antimony is not warranted.

Barium was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 153 mg/kg. Concentrations increased with depth at location 36-610584 and decreased with depth at location 36-610600 (the concentration in the shallow sample at location 36-610600 was 137 mg/kg and below the soil BV [Appendix E, Pivot Tables]). Concentrations increased downgradient at location 36-610584. The residential and industrial SSLs were approximately 10 times and 1670 times the maximum concentration, respectively. Further sampling for extent of barium is not warranted.

Cadmium was detected above the soil and sediment BVs in 9 soil samples and 3 sediment samples with a maximum concentration of 3.35 mg/kg and had DLs (0.478 mg/kg to 0.882 mg/kg) above the BVs in 59 soil samples and 8 sediment samples. Concentrations increased with depth at locations 36-610824 and 36-610827, decreased with depth at all other locations, and decreased downgradient. The residential SSL was approximately 21 times the maximum concentration and 80 times the maximum DL. The lateral extent of cadmium is defined, and further sampling for vertical extent is not warranted.

Calcium was detected above the soil, sediment, and Qbt 2,3,4 BVs in two soil samples, three sediment samples, and one tuff sample with a maximum concentration of 11,700 mg/kg. Concentrations increased with depth at location 36-610584, only one depth was sampled at location 36-610609, and concentrations decreased with depth at all other locations. Concentrations decreased downgradient. The NMED residential essential nutrient SSL was approximately 1100 times the maximum concentration. The lateral extent of calcium is defined, and further sampling for vertical extent is not warranted.

Chromium was detected above the soil, sediment and Qbt 2,3,4 BVs in 19 soil samples, 5 sediment samples, and 7 tuff samples with a maximum concentration of 192 mg/kg. Concentrations increased with

depth at locations 36-610584, 36-610591, 36-610594, 36-610599, 36-610600, 36-610602, 36-610613, 36-610615, and 36-610825; did not change substantially with depth (1.7 mg/kg and 1.2 mg/kg) at locations 36-610598 and 36-610822; and only one depth was sampled at location 36-610609. Concentrations decreased with depth at all other locations and decreased downgradient. As discussed in section 4.2, because there was no known use of hexavalent chromium at these sites, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 609 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Copper was detected above the soil, sediment, and Qbt 2,3,4 BVs in ~~five~~ 14 soil samples, ~~five~~ 5 sediment samples, and ~~three~~ 3 tuff samples with a maximum concentration of 4870 mg/kg. Concentrations increased with depth at locations 36-610603, 36-610605, 36-610824, and 36-610827; did not change substantially with depth (0.47 mg/kg) at location 36-610584; and only one depth was sampled at location 36-610609. Concentrations decreased with depth at all other locations and decreased downgradient. The residential and industrial SSLs were approximately 7.5 times and 123 times the maximum concentrations of the locations where concentrations were increasing with depth (420 mg/kg at location 36-610603). The lateral extent of copper is defined, and further sampling for vertical extent is not warranted.

Cyanide was detected above the soil and sediment BVs in 31 soil samples and 1 sediment sample with a maximum concentration of 4.24 mg/kg. Concentrations increased with depth at location 36-610598; did not change substantially with depth (0.043 mg/kg, 0.89 mg/kg, 0.28 mg/kg, and 0.18 mg/kg) at locations 36-610589, 36-610596, 36-610824, and 36-610827; and only one depth was sampled at locations 36-610576 and 36-610595. Concentrations decreased with depth at all other locations. Concentration increased downgradient at location 36-610598 where the maximum concentration was detected. The residential and industrial SSLs were approximately 2.6 times and 15 times the maximum concentration, respectively. Further sampling for extent of cyanide is not warranted.

Lead was detected above the soil, sediment, and Qbt 3 BVs in 10 soil samples, 4 sediment samples, and 2 tuff samples with a maximum concentration of 202 mg/kg. Concentrations increased with depth at location 36-610603 and decreased with depth at all other locations. Concentrations decreased downgradient. The residential SSL was approximately 11 times and the industrial SSL was approximately 22 times the maximum concentration at location 36-610603. The lateral extent of lead is defined, and further sampling for vertical extent is not warranted.

Manganese was detected above the soil and sediment BVs in three soil samples and three sediment samples with a maximum concentration of 893 mg/kg. Only one depth was sampled at location 36-610595, and concentrations decreased with depth at locations 36-610590, 36-610602, 36-610619, 36-610821, and 36-610828. Concentrations decreased downgradient. The residential SSL was approximately 15 times and the industrial SSL was approximately 231 times the maximum concentration at location 36-610595. The lateral extent of manganese is defined, and further sampling for vertical extent is not warranted.

Mercury was detected above the soil, sediment, and Qbt 2,3,4 BVs in 22 soil samples, 8 sediment samples, and 1 tuff sample with a maximum concentration of 25 mg/kg. Concentrations increased with depth at location 36-610605; did not change substantially with depth (0.051 mg/kg to 0.72 mg/kg) at locations 36-610574, 36-610606, 36-610608, 36-610610, 36-610824, 36-610825, 36-610826, and 36-610827; and decreased with depth at the other seven locations. Only one depth was sampled at locations 36-610576, 36-610595, and 36-610609. Concentrations decreased downgradient. The residential SSL was approximately 50 times the maximum concentration at location 36-610605. The lateral extent of mercury is defined, and further sampling for vertical extent is not warranted.

Nickel was detected above the soil, sediment, and Qbt 2,3,4 BVs in one soil sample, one sediment sample, and one tuff sample with a maximum concentration of 53 mg/kg. Concentrations increased with depth at location 36-610584 and decreased with depth at locations 36-610607 and 36-610825. Concentrations decreased downgradient. The residential SSL was approximately 29 times the maximum concentration. The lateral extent of nickel is defined, and further sampling for vertical extent is not warranted.

Nitrate was detected in 101 samples with a maximum concentration of 540 mg/kg. Concentrations were consistent with naturally occurring levels of nitrate at most locations. Nitrate was elevated at six locations: 36-610574, 36-610585, 36-610607, 36-610824, 36-610825, and 36-610826. Concentrations decreased or did not change substantially (1.9 mg/kg at location 36-610574) with depth at these locations. Concentrations decreased downgradient. The residential SSL was approximately 230 times the maximum concentration. The lateral extent of nitrate is defined, and further sampling for vertical extent is not warranted.

Perchlorate was detected in 71 samples with a maximum concentration of 0.688 mg/kg. Concentrations increased with depth at locations 36-610590, 36-610594, 36-610616, and 36-610822. Only one depth was sampled at locations 36-610576, 36-610595, 36-610609, and 36-610623. Concentrations did not change substantially with depth (less than 0.48 mg/kg) and decreased at the other locations. Concentrations decreased downgradient. The residential SSL was approximately 80 times the maximum concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Selenium was detected above the Qbt 2,3,4 BV in 1 sample at a concentration of 0.635 mg/kg and had DLs (1.01 mg/kg to 2.03 mg/kg) above the soil, sediment, and Qbt 2,3,4 BVs in 4 soil samples, 13 sediment samples, and 6 tuff samples. Concentrations decreased with depth (the concentration in the shallow sample at location 36-610825 was 1.35 mg/kg and below the soil BV [Appendix E, Pivot Tables]) and decreased downgradient. The residential SSL was approximately 192 times the maximum DL. Further sampling for extent of selenium is not warranted.

Silver was detected above the soil, sediment, and Qbt 2,3,4 BVs in 10 soil samples, 3 sediment samples, and 1 tuff sample with a maximum concentration of 348 mg/kg. Concentrations increased with depth at locations 36-610825 and 36-610827 and decreased with depth at the other locations. Concentrations decreased downgradient. The industrial SSL was approximately 21 times the maximum concentration at locations 36-610825 and 36-610827. The lateral extent of silver is defined, and further sampling for vertical extent is not warranted.

Uranium was detected above the soil and sediment BVs in 24 soil samples and 2 sediment samples with a maximum concentration of 10.4 mg/kg. Concentrations increased with depth at location 36-610824, did not change substantially with depth (0.69 mg/kg) at location 36-610615, and decreased with depth at the other locations. Concentrations decreased downgradient. The residential SSL was approximately 22 times the maximum concentration. The lateral extent of uranium is defined, and further sampling for vertical extent is not warranted.

Zinc was detected above the soil, sediment, and Qbt 2,3,4 BVs in 26 soil samples, 2 sediment samples, and 1 tuff sample with a maximum concentration of 1320 mg/kg. Concentrations increased with depth at locations 36-610603 and 36-610619, and only one depth was sampled at locations 36-610576 and 36-610595. The concentrations at locations 36-610576, 36-610595, and 36-610619 were below the maximum soil background concentration (75.5 mg/kg). Concentrations decreased with depth at the other locations and decreased downgradient. The residential SSL was approximately 187 times and the industrial SSL was approximately 295 times the maximum concentration. The lateral extent of zinc is defined, and further sampling for vertical extent is not warranted.

Organic Chemicals

Organic COPCs at SWMUs 36-008 and ~~C-36-003~~ include acetone; Aroclor-1254; Aroclor-1260; benzoic acid; bis(2-ethylhexyl)phthalate; bromodichloromethane; butylbenzylphthalate; chlorodibromomethane; chloroform; chloromethane; 2-chloronaphthalene; 4-chlorotoluene; dibenzofuran; 1,1-dichloroethene; di-n-butylphthalate; 4-isopropyltoluene; methylene chloride; RDX; styrene; TATB; toluene; trichloroethene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene.

Acetone was detected in 14 samples with a maximum concentration of 0.0394 mg/kg. Concentrations decreased with depth or did not change substantially with depth (0.00097 mg/kg to 0.00328 mg/kg) except at locations 36-610595 and 36-610623, where only one depth was sampled, and at location 36-610591, where concentrations increased with depth. Concentrations at locations 36-610591 and 36-610594 were below the EQLs. Concentrations did not change substantially (0.037 mg/kg) downgradient. The residential SSL was approximately 1,680,000 times the maximum concentration. Further sampling for extent of acetone is not warranted.

Aroclor-1254 was detected in 18 samples with a maximum concentration of 1.03 mg/kg. Concentrations did not change substantially with depth (0.0001 mg/kg to 0.17 mg/kg) at locations 36-610574, 36-610579, 36-610583, 36-610824, 36-610826, and 36-610827 and decreased with depth at the other locations. Concentrations decreased downgradient. The residential and industrial SSLs were approximately 6 times and 60 times the maximum concentration at the locations listed above. The lateral extent of Aroclor-1254 is defined, and further sampling for vertical extent is not warranted.

Aroclor-1260 was detected in 15 samples with a maximum concentration of 0.617 mg/kg. Concentrations did not change substantially with depth (0.0014 mg/kg and 0.1 mg/kg) at locations 36-610574, 36-610579, 36-610583, 36-610824, 36-610826, and 36-610827 and decreased with depth at the other locations. Concentrations decreased downgradient. The residential and industrial SSLs were approximately ~~210~~ times and 100 times the maximum concentration at the locations listed above. The lateral extent of Aroclor-1260 is defined, and further sampling for vertical extent is not warranted.

Benzoic acid was detected in 13 samples with a maximum concentration of 1.65 mg/kg. Concentrations increased with depth at location 36-610582, and only one depth was sampled at locations 36-610576 and 36-610595. Concentrations did not change substantially with depth (0.016 mg/kg to 0.09 mg/kg) or decreased with depth at the other locations. Concentrations decreased downgradient. All concentrations were below the EQLs. The residential SSL was approximately 152,000 times the maximum concentration. The lateral extent of benzoic acid is defined, and further sampling for vertical extent is not warranted.

Bis(2-ethylhexyl)phthalate was detected in five samples with a maximum concentration of 0.604 mg/kg. Concentrations increased with depth at locations 36-610579 and 36-610620, decreased with depth at locations 36-610588 and 36-610605, and decreased downgradient. All but the maximum detected concentrations were below the EQLs. The residential SSL was approximately 630 times the maximum concentration. The lateral extent of bis(2-ethylhexyl)phthalate is defined, and further sampling for vertical extent is not warranted.

Bromodichloromethane was detected in one sample at a concentration of 0.000117 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of bromodichloromethane are defined.

Butylbenzylphthalate was detected in one sample at a concentration of 0.214 mg/kg. The concentration was below the EQL, increased with depth, and decreased downgradient. The residential SSL was approximately 13,600 times the concentration. The lateral extent of butylbenzylphthalate is defined, and further sampling for vertical extent is not warranted.

Chlorodibromomethane was detected in one sample at a concentration of 0.000635 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of chlorodibromomethane are defined.

Chloroform was detected in two samples with a maximum concentration of 0.00982 mg/kg. Concentrations did not change substantially with depth (0.0093 mg/kg) and decreased downgradient. The residential SSL was approximately 6000 times the maximum concentration. The lateral extent of chloroform is defined, and further sampling for vertical extent is not warranted.

Chloromethane was detected in one sample at a concentration of 0.000633 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of chloromethane are defined.

Chloronaphthalene[2-] was detected in one sample at a concentration of 0.0215 mg/kg. The concentration was below the EQL, increased with depth, and increased downgradient. The residential SSL was approximately 291,000 times the concentration. Further sampling for extent of 2-chloronaphthalene is not warranted.

Chlorotoluene[4-] was detected in one sample at a concentration of 0.000496 mg/kg. The concentration was below the EQL, increased with depth, and decreased downgradient. The residential SSL was approximately 3,220,000 times the concentration. The lateral extent of 4-chlorotoluene is defined, and further sampling for vertical extent is not warranted.

Dibenzofuran was detected in six samples with a maximum concentration of 2.94 mg/kg. Concentrations decreased with depth at all locations and decreased downgradient. The lateral and vertical extent of dibenzofuran are defined.

Dichloroethene[1,1-] was detected in four samples with a maximum concentration of 0.00246 mg/kg. Concentrations decreased with depth and increased downgradient. The residential SSL was approximately 179,000 times the maximum concentration. The vertical extent of 1,1-dichloroethene is defined, and further sampling for lateral extent is not warranted.

Di-n-butylphthalate was detected in 13 samples with a maximum concentration of 8.07 mg/kg. Concentrations did not change substantially with depth (0.18 mg/kg and 0.19 mg/kg) at locations 36-610588 and 36-610826, decreased with depth at the other locations, and decreased downgradient. The residential SSL was approximately 760 times the maximum concentration. The lateral extent of di-n-butylphthalate is defined, and further sampling for vertical extent is not warranted.

Isopropyltoluene[4-] was detected in 40 samples with a maximum concentration of 0.0893 mg/kg. Concentrations increased with depth at eight locations and did not change substantially with depth (0.000435 mg/kg to 0.0859 mg/kg) at eight locations. Concentrations decreased with depth at the other locations and did not change substantially downgradient (0.04 mg/kg or less). The residential SSL was approximately 26,400 times the maximum concentration. Further sampling for extent of 4-isopropyltoluene is not warranted.

Methylene chloride was detected in eight samples with a maximum concentration of 0.00573 mg/kg. Concentrations were below the EQLs. Concentrations increased with depth at location 36-610615, and only one depth was sampled at location 36-610609. Concentrations decreased with depth at the other locations and decreased downgradient. The residential SSL was approximately 71,400 times the maximum concentration. The lateral extent of methylene chloride is defined, and further sampling for vertical extent is not warranted.

RDX was detected in one sample at a concentration of 0.106 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of RDX are defined.

Styrene was detected in one sample at a concentration of 0.00197 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of styrene are defined.

TATB was detected in two samples with a maximum concentration of 0.331 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of TATB are defined.

Toluene was detected in 42 samples with a maximum concentration of 0.015 mg/kg. Concentrations increased with depth at 9 locations and did not change substantially with depth (0.00006 mg/kg to 0.012 mg/kg) at 10 locations. Only one depth was sampled at location 36-610623. Concentrations decreased with depth at the other locations and did not change substantially (0.015 mg/kg) downgradient. The residential SSL was approximately 349,000 times the maximum concentration. Further sampling for extent of toluene is not warranted.

Trichloroethene was detected in seven samples with a maximum concentration of 0.000905 mg/kg. Concentrations were below the EQLs. Concentrations increased with depth at locations 36-610612 and 36-610622, and only one depth was sampled at locations 36-610576 and 36-610595. Concentrations decreased with depth at the other locations and did not change substantially (0.0004 mg/kg) downgradient. The residential SSL was approximately 7480 times the maximum concentration. Further sampling for extent of trichloroethene is not warranted.

Trimethylbenzene[1,2,4-] was detected in seven samples with a maximum concentration of 0.00499 mg/kg. Concentrations were below the EQLs. Concentrations increased with depth at locations 36-610600, 36-610618, and 36-610619; and only one depth was sampled at location 36-610576. Concentrations decreased with depth at the other locations and did not change substantially (0.0046 mg/kg) downgradient. The residential SSL was approximately 11,600 times the maximum concentration. Further sampling for extent of 1,2,4-trimethylbenzene is not warranted.

Trimethylbenzene[1,3,5-] was detected in two samples with a maximum concentration of 0.00569 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of 1,3,5-trimethylbenzene are defined.

Xylene[1,2-] was detected in four samples with a maximum concentration of 0.000616 mg/kg. Concentrations were below the EQLs. Concentrations increased with depth at locations 36-610611 and 36-610618, decreased with depth at locations 36-610590 and 36-610614, and did not change substantially (0.00025 mg/kg) downgradient. The residential SSL was approximately 1,310,000 times the maximum concentration. Further sampling for extent of 1,2-xylene is not warranted.

Xylene[1,3-]+1,4-xylene was detected in 14 samples with a maximum concentration of 0.00096 mg/kg. Concentrations were below the EQLs. Concentrations increased with depth at seven locations, and only one depth was sampled at locations 36-610576 and 36-610595. Concentrations decreased with depth at the other locations. Concentrations did not change substantially (0.00042 mg/kg) downgradient. The residential SSL was approximately 907,000 times the maximum concentration. Further sampling for extent of 1,3-xylene+1,4-xylene is not warranted.

Radionuclides

Radionuclide COPCs at SWMUs 36-008 and ~~C-36-003~~ include americium-241, cesium-137, plutonium-239/240, tritium, uranium-234, uranium-235/236, and uranium-238.

Americium-241 was detected above the soil and sediment FVs in five soil samples and one sediment sample with a maximum activity of 0.0465 pCi/g. Activities decreased with depth at all locations and increased downgradient at locations 36-610580 and 36-610584. The residential SAL was approximately 1780 times the maximum activity. The vertical extent of americium-241 is defined, and further sampling for lateral extent is not warranted.

Cesium-137 was detected above the soil and sediment FVs in 1 soil sample and 3 sediment samples, was detected below 1 ft bgs in 30 soil samples, and was detected in 1 tuff sample with a maximum activity of 3.31 pCi/g. Activities increased with depth at location 36-610603 and decreased with depth at the other locations (activities in the shallow samples at locations 36-610574, 36-610580, 36-610581, 36-610582, 36-610585, 36-610588, 36-610589, 36-610592, 36-610593, 36-610594, 36-610596, 36-610598, 36-610601, 36-610602, 36-610605, 36-610611, 36-610612, 36-610613, 36-610614, 36-610615, 36-610617, 36-610618, 36-610629, 36-610622, 36-610824, 36-610826, 36-610827, and 36-610828 were 0.883 pCi/g, 1.08 pCi/g, 0.645 pCi/g, 0.61 pCi/g, 0.357 pCi/g, 0.412 pCi/g, 1.07 pCi/g, 0.726 pCi/g, 1.15 pCi/g, 0.691 pCi/g, 0.765 pCi/g, 0.691 pCi/g, 0.485 pCi/g, 0.615 pCi/g, 0.256 pCi/g, 0.176 pCi/g, 0.616 pCi/g, 0.978 pCi/g, 1.03 pCi/g, 0.794 pCi/g, 0.335 pCi/g, 1.48 pCi/g, 1.31 pCi/g, 0.91 pCi/g, 0.625 pCi/g, 0.335 pCi/g, 0.669 pCi/g, and 0.58 pCi/g, respectively, and below the soil FV [Appendix E, Pivot Tables]). Activities increased downgradient at location 36-610584, where the maximum activity was detected. The residential and industrial SALs were approximately 3.6 times and 12 times the maximum activity, respectively. Further sampling for extent of cesium-137 is not warranted.

Plutonium-239/240 was detected above the soil and sediment FVs in five soil samples and one sediment sample and was detected below 1 ft bgs in four soil samples, with a maximum activity of 0.0953 pCi/g. Activities increased with depth at location 36-610598, did not change substantially with depth (0.003 pCi/g) at location 36-610615, and decreased with depth at all other locations (activities in the shallow samples at locations 36-610615, 36-610620, and 36-610622 were 0.0259 pCi/g, 0.0409 pCi/g, and 0.0414 pCi/g, respectively, and below the soil FV [Appendix E, Pivot Tables]). Activities did not change substantially downgradient (0.006 pCi/g to 0.008 pCi/g). The residential SAL was approximately 830 times the maximum activity. Further sampling for extent of plutonium-239/240 is not warranted.

Tritium was detected in nine samples with a maximum activity of 0.98 pCi/g. Activities increased with depth at locations 36-610607 and 36-610825, did not change substantially with depth (0.0037 pCi/g) at location 36-610826, and decreased with depth at the other locations. Activities decreased downgradient. The lateral extent of tritium is defined, and further sampling for vertical extent is not warranted.

Uranium-234 was detected above the soil BV in seven samples with a maximum activity of 6.1 pCi/g. Activities did not change substantially with depth (0.06 pCi/g) at location 36-610824, decreased with depth at the other locations, and decreased downgradient. The lateral and vertical extent of uranium-234 are defined.

Uranium-235/236 was detected above the soil and Qbt 2,3,4 BVs in one soil sample and one tuff sample with a maximum activity of 0.278 pCi/g. Activities decreased with depth at both locations (the activity in the shallow sample at location 36-610825 was 0.134 pCi/g and below the soil BV [Appendix E, Pivot Tables]) and decreased downgradient. The lateral and vertical extent of uranium-235/236 are defined.

Uranium-238 was detected above the soil BV in 10 samples with a maximum activity of 5.17 pCi/g. Activities increased with depth at location 36-610605, did not change substantially with depth (<1 pCi/g) at locations 36-610824 and 36-610826, decreased with depth at the other locations, and did not change substantially downgradient (1.9 pCi/g). The residential SAL was approximately 28 times the maximum activity. Further sampling for extent of uranium-238 is not warranted.

9.4.5 Summary of Human Health Risk-Screening Assessments

Industrial Scenario

The total excess cancer risk for the industrial scenario is 1×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.1, which is below the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.6 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 3×10^{-6} , which is below the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The HI is 0.9, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 2 mrem/yr, which is below the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The residential exposure scenario is also protective of construction workers.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, ~~and residential,~~ and construction worker scenarios at SWMUs 36-008 ~~and C-36-003.~~

9.4.6 Summary of Ecological Risk-Screening Assessment

Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at SWMUs 36-008 ~~and C-36-003.~~

9.5 SWMU C-36-003—Outfall from Building 36-1

9.5.1 Site Description and Operational History

SWMU C-36-003 is a former NPDES-permitted outfall (EPA 06A106) located at TA-36 on the south rim of Threemile Canyon, north of office and laboratory building 36-1 (Plate 25). The outfall became operational in the 1950s and served the sink and floor drains on the first floor of the building and the floor, sink, and equipment drains in the photoprocessing labs on the second floor of the building. In 1993 the floor and sink drains were rerouted to the SWSC plant. The outfall was removed from the NPDES permit in 2001 (EPA 2001, 082282).

9.5.2 Relationship to Other SWMUs and AOCs

The SWMU C-36-003 outfall is located approximately 20 ft inside the southern boundary of SWMU 36-008. Portions of SWMU 36-003(a) are located approximately 50 ft south and upgradient of the SWMU C-36-003 outfall (Plate 25).

9.5.3 Summary of Previous Investigations

In 1994, RFI activities were performed at SWMU C-36-003 (LANL 1995, 053985). One surface and one water sample were collected from one location just below the outfall. Water from a source in building 36-1 was flushed through the drainline and outfall to provide water for sampling. Five surface samples were collected from five locations in the drainage channel below the outfall. The samples were analyzed for inorganic chemicals and SVOCs.

Data from all samples collected during the 1994 RFI do not meet current data-validation standards and are not decision-level data. These data were not used to evaluate the nature and extent of contamination and are not discussed further in this report.

9.5.4 Site Contamination

9.5.4.1 Soil, Sediment, and Rock Sampling

Based on previous investigation results, further characterization was needed to assess potential contamination at SWMU C-36-003. As a result, the following activities were completed as part of the 2009–2010 investigation:

- Sixteen samples were collected in 2009–2010 from eight locations to define the nature and extent of contamination. Sampling locations were below the outfall and in the drainage below the outfall. Samples were collected at two depth intervals (0.0–0.5 ft bgs or 0.0–1.0 ft bgs and 2.0–2.5 ft bgs or 2.0–3.0 ft bgs) at each location. All samples were analyzed at off-site fixed laboratories for TAL metals, cyanide, total uranium, nitrate, perchlorate, explosive compounds, SVOCs, VOCs, PCBs, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, and tritium.

The 2009–2010 sampling locations at SWMU C-36-003 are shown on Plate 25. Table 9.4-1 presents the samples collected and analyses requested at SWMU C-36-003. The geodetic coordinates of sampling locations are presented in Table 3.2-1.

9.5.4.2 Soil, Sediment, and Rock Field-Screening Results

No radiological field-screening results exceeded twice the daily site background levels. No changes were made to sampling or other activities based on field-screening results. Field-screening results are presented in Table 3.2-2.

9.5.4.3 Soil, Sediment, and Rock Sampling Analytical Results

Decision-level data collected at SWMU C-36-003 consist of results from 16 samples (9 soil, 6 sediment, and 1 tuff) collected from 8 locations. ~~As described in section 9.4.4, because SWMU C-36-003 is located within the footprint of SWMU 36-008, these data were combined with the decision-level data for SWMU 36-008, and the combined data sets were evaluated for COPCs. See section 9.4.4.3 for results of the evaluation of COPCs for SWMUs 36-008 and C-36-003.~~

Inorganic Chemicals

A total of 16 samples (9 soil, 6 sediment, and 1 tuff) were collected and analyzed for TAL metals, cyanide, nitrate, and perchlorate. Table 9.4-2 presents the inorganic chemicals above BVs and the detected inorganic chemicals with no BVs. Plate 26 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was not detected above the soil, sediment, and Qbt 2,3,4 BVs (0.83 mg/kg, 0.83 mg/kg, and 0.5 mg/kg) but had DLs (0.955 mg/kg to 1.49 mg/kg) above the BVs in nine soil samples, six sediment samples, and one tuff sample. Antimony is retained as a COPC.

Cadmium was detected above the soil BV (0.4 mg/kg) in five samples with a maximum concentration of 3.35 mg/kg and had DLs (0.478 mg/kg to 0.745 mg/kg) above the soil BV and sediment BVs (0.4 mg/kg) in two soil samples and six sediment samples. Cadmium is retained as a COPC.

Calcium was detected above the soil and sediment BVs (6120 mg/kg and 4420 mg/kg) in one soil sample and one sediment sample with a maximum concentration of 11,700 mg/kg. The Gehan test indicated site concentrations of calcium in soil are statistically different from background (Table G-27). However, the quantile and slippage tests indicated site concentrations of calcium in soil are not statistically different from background (Figure G-199 and Table G-27). There were too few sediment samples for statistical tests. The maximum concentration in sediment (4470 mg/kg) was above the maximum sediment background concentration (4240 mg/kg). Calcium is retained as a COPC.

Chromium was detected above the soil, sediment, and Qbt 2,3,4 BVs (19.3 mg/kg, 10.5 mg/kg, and 7.14 mg/kg) in seven soil samples, four sediment samples, and one tuff sample with a maximum concentration of 192 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in soil are statistically different from background (Figure G-200 and Table G-27). Chromium is retained as a COPC.

Copper was detected above the soil and Qbt 2,3,4 BVs (14.7 mg/kg and 4.66 mg/kg) in five soil samples and one tuff sample with a maximum concentration of 2720 mg/kg. The Gehan and quantile tests indicated site concentrations of copper in soil are statistically different from background (Figure G-201 and Table G-27). Copper is retained as a COPC.

Cyanide was detected above the soil BV (0.5 mg/kg) in seven samples with a maximum concentration of 2.18 mg/kg. Cyanide is retained as a COPC.

Lead was detected above the soil and Qbt 2,3,4 BVs (22.3 mg/kg and 11.2 mg/kg) in one soil sample and one tuff sample with a maximum concentration of 144 mg/kg. The Gehan and quantile tests indicated site concentrations of lead in soil are not statistically different from background (Figure G-202 and Table G-27). The maximum tuff concentration (35.7 mg/kg) is above the maximum Qbt 2,3,4 background concentration (15.5 mg/kg). Lead is retained as a COPC.

Manganese was detected above the sediment BV (543 mg/kg) in two soil samples with a maximum concentration of 860 mg/kg. Manganese is retained as a COPC.

Mercury was detected above the soil, sediment, and Qbt 2,3,4 BVs (0.1 mg/kg for all) in seven soil samples, three sediment samples, and one tuff sample with a maximum concentration of 0.815 mg/kg. Mercury is retained as a COPC.

Nickel was detected above the soil BV (15.4 mg/kg) in one sample with a maximum concentration of 53 mg/kg. The Gehan and quantile tests indicated site concentrations of nickel in soil are not statistically different from background (Figure G-203 and Table G-27); however, the maximum concentration was substantially above the soil BV and maximum soil background concentration (29 mg/kg). Nickel is retained as a COPC.

Nitrate was detected in 14 samples with a maximum concentration of 540 mg/kg. Nitrate is retained as a COPC.

Perchlorate was detected in 13 samples with a maximum concentration of 0.688 mg/kg. Perchlorate is retained as a COPC.

Selenium was detected above the Qbt 2,3,4 BV (0.3 mg/kg) in one sample at a concentration of 0.635 mg/kg and had DLs (1.04 mg/kg to 1.56 mg/kg) above the sediment BV (0.3 mg/kg) in six samples. Selenium is retained as a COPC.

Silver was detected above the soil, sediment, and Qbt 2,3,4 BVs (1 mg/kg for all) in nine soil samples, two sediment samples, and one tuff sample with a maximum concentration of 348 mg/kg. Silver is retained as a COPC.

Sodium was detected above the soil BV (915 mg/kg) in one sample at a concentration of 1000 mg/kg. The Gehan and quantile tests indicated site concentrations of sodium in soil are not statistically different from background (Figure G-204 and Table G-27). Sodium is not a COPC.

Uranium was detected above the soil and sediment BVs (1.82 mg/kg and 2.22 mg/kg) in seven soil samples and two sediment samples with a maximum concentration of 10.4 mg/kg. The Gehan and quantile tests indicated site concentrations of uranium in soil are statistically different from background (Figure G-205 and Table G-27). Uranium is retained as a COPC.

Zinc was detected above the soil and Qbt 2,3,4 BVs (48.8 mg/kg and 63.5 mg/kg) in seven soil samples and one tuff sample with a maximum concentration of 1320 mg/kg. The Gehan and quantile tests indicated site concentrations of zinc in soil are statistically different from background (Figure G-206 and Table G-27). Zinc is retained as a COPC.

Organic Chemicals

A total of 16 samples (9 soil, 6 sediment, and 1 tuff) were collected and analyzed for SVOCs, VOCs, and explosive compounds. A total of 31 samples (23 soil, 1 sediment, and 7 tuff) were also analyzed for PCBs. Table 9.4-3 summarizes the analytical results for detected organic chemicals. Plate 27 shows the spatial distribution of detected organic chemicals.

As described in section 9.4.4.3, PAHs are not related to historic Laboratory site operations at SWMU C-36-003 and are not COPCs. Other organic chemicals detected at SWMU C-36-003 include Aroclor-1254; Aroclor-1260; benzoic acid; bromodichloromethane; chlorodibromomethane; chloroform; di-n-butylphthalate; 4-isopropyltoluene; methylene chloride; RDX; toluene; 1,2,4-trimethylbenzene; and 1,3-xylene+1,4-xylene. The detected organic chemicals listed are retained as COPCs.

Radionuclides

A total of 16 samples (9 soil, 6 sediment, and 1 tuff) were collected and analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, and tritium. Table 9.4-4 summarizes radionuclides detected or detected above BVs/FVs. Plate 28 shows the spatial distribution of detected radionuclides.

Cesium-137 was detected above the sediment FV (0.9 pCi/g) in one sample and was detected below 1 ft bgs in five soil samples with a maximum activity of 2.02 pCi/g. Cesium-137 is retained as a COPC.

Plutonium-238 was detected above the sediment FV (0.006 pCi/g) in 1 sample at an activity of 0.026 pCi/g. The activity was only 0.02 pCi/g above the FV. Plutonium-238 was not detected in the other 15 samples. Plutonium-238 is not a COPC.

Plutonium-239/240 was detected above the sediment FV (0.068 pCi/g) in 1 sample at an activity of 0.0762 pCi/g. The activity was only 0.0082 pCi/g above the FV. Plutonium-239/240 was not detected in the other 15 samples. Plutonium-239/240 is not a COPC.

Tritium was detected in five samples with a maximum activity of 0.154 pCi/g. Tritium is retained as a COPC.

Uranium-234 was detected above the soil BV (2.59 pCi/g) in six samples with a maximum activity of 6.1 pCi/g. Uranium-234 is retained as a COPC.

Uranium-235/236 was detected above the soil and Qbt 2,3,4 BVs (0.2 pCi/g and 0.09 pCi/g) in one soil sample and one tuff sample with a maximum activity of 0.278 pCi/g. Uranium-235/236 is retained as a COPC.

Uranium-238 was detected above the soil BV (2.29 pCi/g) in six samples with a maximum activity of 4.51 pCi/g. Uranium-238 is retained as a COPC.

9.5.4.4 Nature and Extent of Contamination

Section 9.4.4.4 discusses the nature and extent of contamination for SWMUs 36-008 and C-36-003. The nature and extent of inorganic, organic, and radionuclide COPCs at SWMU C-36-003 are discussed below.

Inorganic Chemicals

Inorganic COPCs at SWMU C-36-003 include antimony, cadmium, calcium, chromium, copper, cyanide, lead, manganese, mercury, nickel, nitrate, perchlorate, selenium, silver, uranium, and zinc.

Antimony was not detected above the soil, sediment, and Qbt 2,3,4 BVs but had DLs (0.955 mg/kg to 1.49 mg/kg) above the BVs in nine soil samples, six sediment samples, and one tuff sample. Because antimony was not detected above BVs and the residential SSL was approximately 21 times the maximum DL, further sampling for extent of antimony is not warranted.

Cadmium was detected above the soil BV in five samples with a maximum concentration of 3.35 mg/kg and had DLs (0.478 mg/kg to 0.745 mg/kg) above the soil and sediment BVs in two soil samples and six sediment samples. Concentrations increased with depth at locations 36-610824 and 36-610827 and decreased with depth at locations 36-610825 and 36-610826. Concentrations decreased downgradient. The residential SSL was approximately 21 times the maximum concentration and 95 times the maximum DL. The lateral extent of cadmium is defined, and further sampling for vertical extent is not warranted.

Calcium was detected above the soil and sediment BVs in one soil sample and one sediment sample with a maximum concentration of 11,700 mg/kg. Concentrations decreased with depth at all locations and decreased downgradient. The lateral and vertical extent of calcium are defined.

Chromium was detected above the soil, sediment, and Qbt 2,3,4 BVs in seven soil samples, four sediment samples, and one tuff sample with a maximum concentration of 192 mg/kg. Concentrations increased with depth at locations 36-610824 and 36-610825, did not change substantially with depth (1.2 mg/kg) at location 36-610822 (the concentration in the surface sample at location 36-610822 was 9.5 mg/kg and below the sediment BV [Appendix E, Pivot Tables]), and decreased with depth at all other locations. Concentrations decreased downgradient. As discussed in section 4.2, because there was no known use of hexavalent chromium at this site, the results were compared with the residential SSL for trivalent chromium (117,000 mg/kg). The residential SSL was approximately 610 times the maximum concentration. The lateral extent of chromium is defined, and further sampling for vertical extent is not warranted.

Copper was detected above the soil and Qbt 2,3,4 BVs in five soil samples and one tuff sample with a maximum concentration of 2720 mg/kg. Concentrations increased with depth at locations 36-610824 and 36-610827 and decreased with depth at location 36-610825. Concentrations decreased downgradient. The residential and industrial SSLs were approximately 7.5 times and 120 times respectively the maximum concentration of the locations where concentrations were increasing with depth (27.8 mg/kg at location 36-610824). The lateral extent of copper is defined, and further sampling for vertical extent is not warranted.

Cyanide was detected above the soil BV in seven samples with a maximum concentration of 2.18 mg/kg. Concentrations did not change substantially with depth (0.28 mg/kg and 0.18 mg/kg) at locations 36-610824 and 36-610827 and decreased with depth at locations 36-610825 and 36-610826. Concentrations decreased downgradient. The residential and industrial SSLs were approximately 5.1 times and 29 times the maximum concentration, respectively. The lateral extent of cyanide is defined, and further sampling for vertical extent is not warranted.

Lead was detected above the soil and Qbt 2,3,4 BVs in one soil sample and one tuff sample with a maximum concentration of 144 mg/kg. Concentrations of lead decreased with depth at location 36-610825 and decreased downgradient. The lateral and vertical extent of lead are defined.

Manganese was detected above the sediment BV in two soil samples with a maximum concentration of 860 mg/kg. Concentrations decreased with depth at locations 36-610821 and 36-610828 and decreased downgradient. The lateral and vertical extent of manganese are defined.

Mercury was detected above the soil, sediment, and Qbt 2,3,4 BVs in seven soil samples, three sediment samples, and one tuff sample with a maximum concentration of 0.815 mg/kg. Concentrations did not change substantially with depth (0.057 mg/kg to 0.233 mg/kg) at locations 36-610824, 36-610825, 36-610826, and 36-610827; and decreased with depth at locations 36-610821, 36-610822, and 36-610828. Concentrations decreased downgradient. The residential SSL was approximately 29 times the maximum concentration. The lateral extent of mercury is defined, and further sampling for vertical extent is not warranted.

Nickel was detected above the soil BV in one sample with a maximum concentration of 53 mg/kg. Concentrations of nickel decreased with depth and decreased downgradient. The lateral and vertical extent of nickel are defined.

Nitrate was detected in 14 samples with a maximum concentration of 540 mg/kg. Concentrations were consistent with naturally occurring levels of nitrate at most locations. Nitrate was elevated at three locations: 36-610824, 36-610825, and 36-610826. Concentrations decreased with depth at these locations. Concentrations decreased downgradient. The residential SSL was approximately 230 times the maximum concentration. The lateral extent of nitrate is defined, and further sampling for vertical extent is not warranted.

Perchlorate was detected in 13 samples with a maximum concentration of 0.688 mg/kg. Concentrations increased with depth at location 36-610822; did not change substantially with depth (0.000065 mg/kg to 0.0054 mg/kg) at locations 36-610821, 36-610824, 36-610827, and 36-610828; and decreased with depth at locations 36-610825 and 36-610826. Concentrations decreased downgradient. The residential SSL was approximately 80 times the maximum concentration. The lateral extent of perchlorate is defined, and further sampling for vertical extent is not warranted.

Selenium was detected above the Qbt 2,3,4 BV in one sample at a concentration of 0.635 mg/kg and had DLs (1.04 mg/kg to 1.56 mg/kg) above the sediment BV in six samples. Concentrations decreased with depth at location 36-610825 (the concentration in the surface sample at location 36-610825 was

1.35 mg/kg and below the soil BV [Appendix E, Pivot Tables]) and decreased downgradient. The residential SSL was approximately 250 times the maximum DL. Further sampling for extent of selenium is not warranted.

Silver was detected above the soil, sediment, and Qbt 2,3,4 BVs in nine soil samples, two sediment samples, and one tuff sample with a maximum concentration of 348 mg/kg. Concentrations increased with depth at locations 36-610825 and 36-610827 and decreased with depth at the other locations. Concentrations decreased downgradient. The industrial SSL was approximately 21 times the maximum concentration at locations 36-610825 and 36-610827. The lateral extent of silver is defined, and further sampling for vertical extent is not warranted.

Uranium was detected above the soil and sediment BVs in seven soil samples and two sediment samples with a maximum concentration of 10.4 mg/kg. Concentrations increased with depth at location 36-610824 and decreased with depth at the other locations. Concentrations decreased downgradient. The residential SSL was approximately 22 times the maximum concentration. The lateral extent of uranium is defined, and further sampling for vertical extent is not warranted.

Zinc was detected above the soil and Qbt 2,3,4 BVs in seven soil samples and one tuff sample with a maximum concentration of 1320 mg/kg. Concentrations decreased with depth at all locations and decreased downgradient. The residential SSL was approximately 18 times the maximum concentration, and the industrial SSL was approximately 295 times the maximum concentration. The lateral extent of zinc is defined, and further sampling for vertical extent is not warranted.

Organic Chemicals

Organic COPCs at SWMU C-36-003 include Aroclor-1254; Aroclor-1260; benzoic acid; bromodichloromethane; chlorodibromomethane; chloroform; di-n-butylphthalate; 4-isopropyltoluene; methylene chloride; RDX; toluene; 1,2,4-trimethylbenzene; and 1,3-xylene+1,4-xylene.

Aroclor-1254 was detected in eight samples with a maximum concentration of 1.03 mg/kg. Concentrations did not change substantially with depth (0.0037 mg/kg to 0.034 mg/kg) at locations 36-610824, 36-610826, and 36-610827 and decreased with depth at the other locations. Concentrations decreased downgradient. The residential and industrial SSLs were approximately 8.3 times and 84 times respectively the maximum concentration at the locations listed above. The lateral extent of Aroclor-1254 is defined, and further sampling for vertical extent is not warranted.

Aroclor-1260 was detected in seven samples with a maximum concentration of 0.617 mg/kg. Concentrations did not change substantially with depth (0.0043 mg/kg and 0.045 mg/kg) at locations 36-610824, 36-610826, and 36-610827 and decreased with depth at the other locations. Concentrations decreased downgradient. The residential and industrial SSLs were approximately 24 times and 110 times respectively the maximum concentration at the locations listed above. The lateral extent of Aroclor-1260 is defined, and further sampling for vertical extent is not warranted.

Benzoic acid was detected in one sample at a concentration of 0.355 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of benzoic acid are defined.

Bromodichloromethane was detected in one sample at a concentration of 0.00117 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of bromodichloromethane are defined.

Chlorodibromomethane was detected in one sample at a concentration of 0.000635 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of chlorodibromomethane are defined.

Chloroform was detected in two samples with a maximum concentration of 0.00982 mg/kg. Concentrations did not change substantially with depth (0.0093 mg/kg) and decreased downgradient. The residential SSL was approximately 6000 times the maximum concentration. The lateral extent of chloroform is defined, and further sampling for vertical extent is not warranted.

Di-n-butylphthalate was detected in six samples with a maximum concentration of 8.07 mg/kg. Concentrations did not change substantially with depth (0.19 mg/kg) at location 36-610826, decreased with depth at the other locations, and decreased downgradient. The residential SSL was approximately 760 times the maximum concentration. The lateral extent of di-n-butylphthalate is defined, and further sampling for vertical extent is not warranted.

Isopropyltoluene[4-] was detected in eight samples with a maximum concentration of 0.0124 mg/kg. Concentrations did not change substantially with depth (0.0114 mg/kg and 0.00774 mg/kg) at locations 36-610823 and 36-610826, and decreased with depth at the other locations, and did not change substantially downgradient (0.012 mg/kg or less). The residential SSL was approximately 190,000 times the maximum concentration. Further sampling for extent of 4-isopropyltoluene is not warranted.

Methylene chloride was detected in two samples with a maximum concentration of 0.00378 mg/kg. Concentrations were below the EQLs. Concentrations decreased with depth at both sample locations and decreased downgradient. The lateral and vertical extent of methylene chloride are defined.

RDX was detected in one sample at a concentration of 0.106 mg/kg. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of RDX are defined.

Toluene was detected in 11 samples with a maximum concentration of 0.00135 mg/kg. Concentrations increased with depth at locations 36-610823 and 36-610827; did not change substantially with depth (0.00006 mg/kg to 0.00068 mg/kg) at locations 36-610824, 36-610826, and 36-610828; and decreased with depth at locations 36-610821, 36-610822, and 36-610825. Concentrations did not change substantially (0.00102 mg/kg) downgradient. The residential SSL was approximately 3,900,000 times the maximum concentration. Further sampling for extent of toluene is not warranted.

Trimethylbenzene[1,2,4-] was detected in one sample at a concentration of 0.001 mg/kg. The detected concentration was below the EQL. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of 1,2,4-trimethylbenzene are defined.

Xylene[1,3-]+1,4-xylene was detected in one sample at a concentration of 0.000822 mg/kg. The detected concentration was below the EQL. Concentrations decreased with depth and decreased downgradient. The lateral and vertical extent of 1,3-xylene+1,4-xylene are defined.

Radionuclides

Radionuclide COPCs at SWMU C-36-003 include cesium-137, tritium, uranium-234, uranium-235/236, and uranium-238.

Cesium-137 was detected above the sediment FV in one sample and was detected below 1 ft bgs in five soil samples with a maximum activity of 2.02 pCi/g. Activities decreased with depth at all locations (activities in the shallow samples at locations 36-610824, 36-610826, 36-610827, and 36-610828 were 0.625 pCi/g, 0.335 pCi/g, 0.669 pCi/g, and 0.58 pCi/g, respectively, and below the soil FV [Appendix E,

Pivot Tables]). Activities decreased downgradient. The lateral and vertical extent of cesium-137 are defined.

Tritium was detected in five samples with a maximum activity of 0.154 pCi/g. Activities increased with depth at location 36-610825, did not change substantially with depth (0.0037 pCi/g) at location 36-610826, and decreased with depth at location 36-610827. Activities decreased downgradient. The residential SAL was approximately 11,000 times the maximum activity. The lateral extent of tritium is defined, and further sampling for vertical extent is not warranted.

Uranium-234 was detected above the soil BV in six samples with a maximum activity of 6.1 pCi/g. Activities did not change substantially with depth (0.06 pCi/g) at location 36-610824, decreased with depth at locations 36-610826 and 36-610827, and decreased downgradient. The residential SAL was approximately 48 times the maximum activity. The lateral extent of uranium-234 is defined, and further sampling for vertical extent is not warranted.

Uranium-235/236 was detected above the soil and Qbt 2,3,4 BVs in one soil sample and one tuff sample with a maximum activity of 0.278 pCi/g. Activities decreased with depth at locations 36-610825 and 36-610827 (the activity in the shallow sample at location 36-610825 was 0.134 pCi/g and below the soil BV [Appendix E, Pivot Tables]) and decreased downgradient. The lateral and vertical extent of uranium-235/236 are defined.

Uranium-238 was detected above the soil BV in six samples with a maximum activity of 4.51 pCi/g. Activities did not change substantially with depth (<1 pCi/g) at locations 36-610824 and 36-610826, decreased with depth at location 36-610827, and decreased downgradient. The residential SAL was approximately 33 times the maximum activity. The lateral extent of uranium-238 is defined, and further sampling for vertical extent is not warranted.

9.5.5 Summary of Human Health Risk-Screening Assessments~~The human health risk screening for SWMU C-36-003 was conducted in conjunction with SWMU 36-008, and the results are presented in section 9.4.5.~~

Industrial Scenario

The total excess cancer risk for the industrial scenario is 4×10^{-6} , which is less than the NMED target risk level of 1×10^{-5} . The industrial HI is 0.2, which is less than the NMED target HI of 1. The total dose is 0.9 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-5} , which is equivalent to the NMED target risk level of 1×10^{-5} . The residential HI is 1, which is equivalent to the NMED target HI of 1. The noncarcinogenic risk is primarily from silver, copper, Aroclor-1254, and lead. The total dose is 2.3 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Construction Worker Scenario

The residential exposure scenario is protective of construction workers for carcinogenic and radionuclide COPCs. The construction worker HI is 1, which is equivalent to the NMED target HI of 1.

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial, residential, and construction worker scenarios at SWMU C-36-003.

9.5.6 Summary of Ecological Risk-Screening Assessment

~~The ecological risk screening for SWMU C-36-003 was conducted in conjunction with SWMU 36-008, and the results are presented in section 9.4.6. Based on the evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at SWMU C-36-003.~~

10.0 CONCLUSIONS

10.1 Nature and Extent of Contamination

Based on the revised evaluation of the data, the nature and extent of contamination have been defined, and/or no further sampling for extent is warranted for ~~20~~4 sites investigated previously or during the 2009–2010 Threemile Canyon Aggregate Area investigation. The nature and extent of contamination have not been defined, and further sampling is warranted for ~~four~~5 sites. Summaries of the nature and extent of contamination and remaining characterization requirements for the sites at former TA-12, TA-14, TA-15, and TA-36 are presented below.

10.1.1 Former TA-12

The nature and extent of contamination have been defined, and/or no further sampling for extent is warranted for the following sites at former TA-12:

- SWMU 12-001(a), Steel-lined Firing Pit
- SWMU 12-001(b), Former Firing Pit
- SWMU 12-002, Potential Soil Contamination
- AOC 12-004(a), Radiation Test Site
- AOC 12-004(b), Belowground Pipe
- AOC C-12-001, Potential Soil Contamination Associated with Former Building
- AOC C-12-002, Potential Soil Contamination Associated with Former Building
- AOC C-12-003, Potential Soil Contamination Associated with Former Building
- AOC C-12-004, Potential Soil Contamination Associated with Former Building
- AOC C-12-005, Potential Soil Contamination Associated with Former Junction Box

10.1.2 TA-14

The nature and extent of contamination have been defined, and/or no further sampling for extent is warranted for the following site at TA-14:

- AOC C-14-006, Potential Soil Contamination Associated with Former Building

10.1.3 TA-15

The nature and extent of contamination have been defined, and/or no further sampling for extent is warranted for the following sites at TA-15:

- AOC 15-005(c), Container Storage Area
- SWMU 15-007(d), Shaft
- SWMU 15-009(c), Septic System
- SWMU 15-009(h), Septic System
- ~~SWMU 15-010(b), Settling Tank~~
- AOC 15-014(h), Outfalls from Building 15-40

The nature and extent of contamination have not been defined, and further sampling is warranted for ~~four~~ five sites at TA-15. Additional sampling is needed to define the extent of contamination for one or more inorganic chemicals, organic chemicals, or radionuclides at the following sites:

- SWMU 15-007(c), Shaft—Vertical extent of lead
- SWMU 15-008(b), Surface Disposal Area—Vertical extent of uranium and uranium-238
- AOC 15-008(g), Surface Disposal Associated with Firing Site R-45—Lateral extent of lead
- SWMU 15-009(b), Septic System—Lateral extent of uranium, uranium-234, uranium-235/236, and uranium-238
- SWMU 15-010(b), Settling Tank—Vertical extent of inorganic and organic chemicals and radionuclides beneath the tank, tank inlet, and tank outlet-

In addition, barium and 4-nitrotoluene data from sampling locations 15-610565, 15-610566, 15-610567, and 15-610568 at AOC 15-008(g) were rejected during the data validation process, and resampling to replace the rejected data is warranted.

10.1.4 TA-36

The nature and extent of contamination have been defined, and/or no further sampling for extent is warranted for the following sites at TA-36:

- SWMU 36-002, Former Sump
- SWMU 36-003(a), Septic System
- SWMU 36-008, Surface Disposal Area
- SWMU C-36-003, Outfall from Building 36-1

10.2 Summary of Risk-Screening Assessments

Twenty-five SWMUs/AOCs were evaluated for potential risk by human health and ecological risk-screening assessments.

10.2.1 Human Health Risk-Screening Assessment

For the industrial scenario, the total excess cancer risks were less than the 1×10^{-5} target risk level at all sites. The industrial HIs were less than the target level of 1 at all SWMUs/AOCs, except for SWMUs 15-007(c) and 15-008(b). The elevated HIs at these two SWMUs under the industrial scenario were from lead. SWMUs 15-007(d), 15-009(h), and 36-002 were not evaluated under the industrial scenario because no samples were collected in the 0.0–1.0 ft bgs depth interval.

The recreational scenario was applicable at SWMUs 12-001(a), 12-001(b), and 12-002, and AOC C-12-005. There were no potential unacceptable risks for any of the sites evaluated under the recreational scenario. The total excess cancer risks were less than 1×10^{-5} and HIs were less than 1.

Twenty-two SWMUs/AOCs had total excess cancer risks and HIs below or equivalent to the target risk levels under the residential scenario. Three SWMUs had HIs above 1 under the residential scenario. The SWMUs with HIs greater than 1 were SWMU 15-007(c) (lead and antimony), SWMU 15-008(b) (lead), and SWMU 15-009(b) (uranium).

The total doses were below the target dose limit of 25 mrem/yr as authorized by DOE Order 458.1 for the industrial, recreational, and residential scenarios at all but one site. The residential total dose was greater than the target dose limit at SWMU 15-009(b) from isotopic uranium.

For SWMUs/AOCs not posing an unacceptable residential risk or dose, the residential scenario was also protective of construction workers, except for potential noncarcinogenic risk at SWMUs 12-001(a) and 12-001(b) and SWMU C-36-003, where manganese was a COPC. Noncarcinogenic construction worker risk was evaluated for SWMUs 12-001(a) and 12-001(b) and SWMU C-36-003 and HIs were equivalent to or below the target level of 1.

Sites at former TA-12 and TA-14, TA-15, and TA-36 are not accessible by the public and are not planned for release by DOE in the foreseeable future. Therefore, an as low as reasonably achievable (ALARA) evaluation for radiological exposure to the public is not currently required. Should DOE's plans for releasing these areas change, an ALARA evaluation will be conducted at that time. ~~Note that the Laboratory addresses considerations for radiation exposures to workers under the Laboratory's occupational radiological protection program in compliance with 10 Code of Federal Regulations 835. The Laboratory's radiation protection program implements ALARA and consists of the following elements: management commitment, training, design review, radiological work review, performance assessments, and documentation.~~

10.2.2 Ecological Risk-Screening Assessment

Based on evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at 24 of the Threemile Canyon Aggregate Area sites. There is the potential for adverse effects to the American robin, montane shrew, deer mouse, earthworm, and plant at SWMU 15-008(b).

11.0 RECOMMENDATIONS

The determination of site status is based on the results of the risk-screening assessments and the nature and extent evaluation. Depending upon 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; that is, no additional corrective actions or conditions are necessary. The other decision scenarios (industrial and recreational) result in corrective action complete with controls; that is, some type of institutional controls must be in place to ensure land use remains consistent with site cleanup levels. The current and reasonably foreseeable future land use for the Threemile Canyon Aggregate Area is industrial and possibly recreational for some sites.

11.1 Additional Field Characterization and Remediation Activities

The nature and extent of contamination have not been defined for ~~four~~five sites investigated in the Threemile Canyon Aggregate Area (Table 11.1-1). Additional sampling is needed to define the extent of contamination for one or more inorganic and/or organic chemicals at the following sites:

- SWMU 15-007(c), SWMU 15-008(b), AOC 15-008(g), ~~and~~ SWMU 15-009(b), and SWMU 15-010(b)

SWMUs 15-007(c) and 15-008(b) also pose an unacceptable risk under the industrial scenario [as well as to ecological receptors at SWMU 15-008(b)], and removal of contaminated soil to reduce risk is recommended at these two sites. A revised Phase II investigation work plan will be developed based on the conclusions and recommendations presented in this supplemental investigation report. The revised Phase II investigation work plan will specify sampling locations, numbers of samples, and analytical suites required to define the extent of contamination for the above sites and areas requiring soil removal to meet risk targets. Upon completion of the proposed Phase II sampling, the data will be used to confirm the extent of contamination has been defined and to revise the human health and ecological risk-screening assessments for the four sites listed above. The results will be presented in a Phase II investigation report for the Threemile Canyon Aggregate Area.

11.2 Recommendations for Corrective Actions Complete

Twenty~~one~~ sites do not pose a potential unacceptable risk or dose under the industrial, recreational, and residential scenarios; have no potential ecological risks for any receptor; and have the nature and extent of contamination defined and/or no further sampling for extent is warranted. At these sites, Newport News Nuclear BWXT – Los Alamos, LLC (N3B)~~the Laboratory~~ recommends no further investigations or remediation activities are warranted (Table 11.1-1).

Twenty~~one~~ sites have been found to pose no potential unacceptable risks or doses to human health under the industrial and residential scenarios (also under the recreational scenario for four sites) and to ecological receptors and are appropriate for corrective actions complete without controls (Table 11.1-1). They include the following:

- SWMU 12-001(a), Steel-lined Firing Pit
- SWMU 12-001(b), Former Firing Pit
- SWMU 12-002, Potential Soil Contamination
- AOC 12-004(a), Radiation Test Site
- AOC 12-004(b), Belowground Pipe
- AOC C-12-001, Potential Soil Contamination Associated with Former Building
- AOC C-12-002, Potential Soil Contamination Associated with Former Building
- AOC C-12-003, Potential Soil Contamination Associated with Former Building

- AOC C-12-004, Potential Soil Contamination Associated with Former Building
- AOC C-12-005, Potential Soil Contamination Associated with Former Junction Box
- AOC C-14-006, Potential Soil Contamination Associated with Former Building
- AOC 15-005(c), Container Storage Area
- SWMU 15-007(d), Shaft
- SWMU 15-009(c), Septic System
- SWMU 15-009(h), Septic System
- ~~SWMU 15-010(b), Settling Tank~~
- AOC 15-014(h), Outfalls from Building 15-40
- SWMU 36-002, Former Sump
- SWMU 36-003(a), Septic System
- SWMU 36-008, Surface Disposal Area
- SWMU C-36-003, Outfall from Building 36-1

11.3 Schedule for Recommended Activities

A revised Phase II investigation work plan will be developed and submitted to NMED after this supplemental investigation report is approved. The Phase II work plan will provide details and a schedule for implementing sampling activities and submitting a Phase II investigation report.

12 0 REFERENCES AND MAP DATA SOURCES

12.1 References

The following reference list includes documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. This information is also included in text citations. ERIDs were assigned by the Laboratory's Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above). IDs are used to locate documents in N3B's Records Management System and in the Master Reference Set. The NMED Hazardous Waste Bureau and N3B maintain copies of the Master Reference Set. The set ensures that NMED has the references to review documents. The set is updated when new references are cited in documents.

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12.2 Map Data Sources

Data sources for all figures are provided below, unless otherwise indicated on the figures themselves.

Sampling location- er_location_ids_pnt; Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, Waste and Environmental Services Division, EP2010-0035; 21 January 2010.

SWMU or AOC: er_prs_all_reg, Potential Release Sites; Los Alamos National Laboratory, Waste and Environmental Services Division, Environmental Data and Analysis Group, EP2009-0633; 1:2,500 Scale Data; 25 January 2010.

Structure or Building: ksl_structures_ply; Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Fence: ksl_fences_arc; Security and Industrial Fences and Gates; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Paved road: ksl_paved_rds_arc; Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Dirt road: ksl_dirt_rds_arc; Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Storm drain: ksl_stormdrn_arc; Storm Drain Line Distribution System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Contours: lanl_contour1991_; Hypsography, 2, 10, 20, 100 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

Communication: ksl_comm_arc; Communication Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 08 August 2002; as published 28 May 2009.

Electric: ksl_electric_arc; Primary Electric Grid; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Gas: ksl_gas_arc; Primary Gas Distribution Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Industrial waste: wfm_indstrl_waste_arc; Primary Industrial Waste Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 January 2009.

Sewer: ksl_sewer_arc; Sewer Line System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Steam: ksl_steam_arc; Steam Line Distribution System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Water: ksl_water_arc; Water Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

LANL Boundary: plan_ownerclip_reg; Ownership Boundaries Around LANL Area; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; 19 September 2007; as published 04 December 2008.

Roads: lac_streets_arc; Streets; County of Los Alamos, Information Services; as published 16 May 2006.

Landscape: ksl_landscape_arc; Primary Landscape Features; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

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

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

Inactive Outfall: wqh_inact_outfalls_pnt; WQH Inactive Outfalls; Los Alamos National Laboratory, ENV Water Quality and Hydrology Group; Edition 2002.01; 01 September 2003.

NPDES Outfalls: wqh_npdes_outfalls_pnt; WQH NPDES Outfalls; Los Alamos National Laboratory, ENV Water Quality and Hydrology Group; Edition 2002.01; 01 September 2003.

Outfalls: er_outfalls_pnt; Outfalls; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; Unknown publication date.

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Drainage: wqh_drainage_arc; WQH Drainage_arc; Los Alamos National Laboratory, ENV Water Quality and Hydrology Group; 1:24,000 Scale Data; 03 June 2003.

Aggregate Area: er_agg_areas_ply; Aggregate Areas; Los Alamos National Laboratory, ENV Environmental Remediation & Surveillance Program, ER2005-0496; 1:2,500 Scale Data; 22 September 2005.

Canyon Reaches: er_reaches_ply; Canyon Reaches; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2002-0592; 1:24,000 Scale Data; Unknown publication date.

Springs: er_springs_pnt; Locations of Springs; Los Alamos National Laboratory, Waste and Environmental Services Division in cooperation with the New Mexico Environment Department, Department of Energy Oversight Bureau, EP2008-0138; 1:2,500 Scale Data; 17 March 2008.

Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

