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MAY 2011

National Nuclear Security Administration
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Los Alamos, New Mexico 87544
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Date: MAY 03 2011
Refer To: EP2011-0148

James Bearzi, Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Subject: Submittal of the Response to the Notice of Disapproval for the Phase II Investigation Work Plan for Upper Mortandad Canyon Aggregate Area and Revision 1

Dear Mr. Bearzi:

Enclosed please find two hard copies with electronic files of the response to the notice of disapproval for the Phase II Investigation Work Plan for Upper Mortandad Canyon Aggregate Area and Revision 1 of the plan. Also enclosed is an electronic copy of a redline strikeout version of the plan that includes all changes made in response to the New Mexico Environment Department's (NMED's) notice of disapproval, dated April 1, 2011. A table detailing where revisions have been made to the plan with cross-references to NMED's numbered comments is also included.

If you have any questions, please contact Kent Rich at (505) 665-4272 (krich@lanl.gov) or Cheryl Rodriguez at (505) 665-5330 (crodriguez2@doeal.gov).

Sincerely,

Michael J. Graham, Associate Director
Environmental Programs
Los Alamos National Laboratory

Sincerely,

George J. Rael, Manager
Environmental Projects Office
Los Alamos Site Office

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MG/GR/DM/KR:sm

Enclosures: Two hard copies with electronic files:
(1) Response to the Notice of Disapproval for the Phase II Investigation Work Plan for Upper Mortandad Canyon Aggregate Area (LA-UR-11-2488)
(2) Cross-reference table of NMED NOD comments and revisions to the plan
(3) An electronic copy of the redline-strikeout version of the plan that includes all changes and edits to the document
(4) Phase II Investigation Work Plan for Upper Mortandad Canyon Aggregate Area, Revision 1 (LA-UR-11-2489)

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Cross-Reference of NMED NOD Comments and Revisions to the Upper Mortandad Canyon Aggregate Area Phase II Investigation Work Plan

NMED NOD Comment No.	Summary of NOD Comment	Section(s)/Page(s) in Original Report	Section(s)/Page(s) in Revised Report	Nature of Revision
General Comments				
1	Add polychlorinated biphenyl (PCB) analysis to the analytical suite for samples proposed at location MO-605025 to define the vertical extent at that location, and to the samples at location 49b-1 to define the lateral extend of PCBs.	Section 4.1.6.3, p. 13	Sections 4.1.6.2, 4.1.6.3, Table 4.1-6	PCB analysis has been added to samples at locations MO-605025, 49b-1, and 49b-2.
2	Revise the investigation work plan (IWP)to provide information on proposed soil removal area and justification for proposed sampling locations and depths.	Section 4.1.7.3, p. 14	Section 4.1.7.3	Section heading is incorrect. No soil removal is proposed at this site. Revised heading: "Proposed Sampling at SWMU 03-049(e)"
3	Revise text to state that location MO-604994 is north of locations MO-604990 and MO-604991 as shown in Figure 4.1-16.	Section 4.1.9.2, pp. 16–17	Section 4.1.9.2	Revised text to state concentrations of chromium decreased to the north.
4	Revise text to state that location MO-604942 is near the southwest corner of building 48-1, not the southeast corner.	Section 4.4.1.3, p. 23	Section 4.4.1.3	Revised text to state location MO-604942 is near the southwest corner of building 48-1.
5	Revise text to state that Solid Waste Management Unit (SWMU) 48-002(a) is located south and southeast of building 48-1, not southwest as reported.	Section 4.4.2.1, p. 23	Section 4.4.2.1	Revised text to state the former container storage area at SWMU 48-002(a) was located at the south end of building 48-1.
6	Add chromium analysis for samples to be collected at location MO-605165 to define vertical extent.	Section 4.4.6.3, p. 28	n/a*	No revision necessary. The concentration of chromium is less than maximum tuff background concentration.
7a	Resolve apparent discrepancy between stated number of locations in section 4.5.1.3 and list of proposed sampling locations in Table 4.5-1	Section 4.5.1.3, p. 32 Table 4.5-1	Section 4.5.1.3 Table 4.5-1	Revised text and table to present the 18 locations where samples are proposed to be collected.
7b	Include barium in analytical suite for samples to be collected at location MO-605473.	Section 4.5.1.3, p. 32 Table 4.5-1	Table 4.5-1	Footnote "g" revised to include barium at location MO-605473.

NMED NOD Comment No.	Summary of NOD Comment	Section(s)/Page(s) in Original Report	Section(s)/Page(s) in Revised Report	Nature of Revision
7c	Include cobalt in analytical suite for samples to be collected at location MO-605458.	Section 4.5.1.3, p. 32 Table 4.5-1	Table 4.5-1	Footnote “e” revised to include cobalt at location MO-605458.
7d	Include copper in analytical suite for samples to be collected at location MO-605458.	Section 4.5.1.3, p. 32 Table 4.5-1	Table 4.5-1	Footnote “e” revised to include copper at location MO-605458.
7e	Revise Table 4.5-1 to provide information on proposed analyses for samples at location MO-605468.	Section 4.5.1.3, p. 32 Table 4.5-1	Table 4.5-1 Figure 4.5-1	Deleted location MO-605468 from table (no proposed sampling because extent is defined at that location). Revised figure to remove proposed sampling location symbol.
8a	Resolve discrepancy of whether vertical extent of perchlorate is defined at locations MO-605084 and MO-605087, propose sampling or provide justification for not sampling.	Section 4.5.3.2, pp. 35-36	Sections 4.5.3.2, 4.5.3.3, Table 4.5-3	Deleted location MO-605084 from text of 5th paragraph, section 4.5.3.2, added location MO-605087. Added location MO-605087 to text of 1st paragraph section 4.5.3.3. Deleted perchlorate analysis for location MO-605084 in Table 4.5-3. Added location MO-605087 to Table 4.5-3 (2 sampling depths, perchlorate analysis only).
8b	Resolve discrepancy of whether vertical extent of thorium-232 is defined. Include thorium-232 in proposed analytical suite or provide justification for not including.	Section 4.5.3.2, pp. 35-36	Section 4.5.3.2 Figure 4.5-4	The1993 Resource Conservation and Recovery Act facility investigation (RFI) locations where thorium-232 was detected are below the toe of the slope in the bottom of Effluent Canyon and are beyond the scope of this investigation. These locations are included in reaches E-1E of Effluent Canyon and M-2W of Mortandad Canyon, which have been investigated separately. No additional sampling and analysis for thorium-232 is necessary.

NMED NOD Comment No.	Summary of NOD Comment	Section(s)/Page(s) in Original Report	Section(s)/Page(s) in Revised Report	Nature of Revision
9a	Revise IWP to provide information on proposed excavation and justification for proposed sampling locations and depths.	Section 4.5.3.3, p. 35	Section 4.5.3.3	Section heading is incorrect. No soil removal is proposed at this site. Revised heading: "Proposed Sampling at SWMU 50-006(d)"
9b	Propose additional sampling to define vertical extent of americium-241 at locations 50-06000, 50-06001, 50-06006, 50-06013, 50-06025, and 50-06026, or provide justification for not sampling.	Section 4.5.3.3, p. 35	Sections 4.5.3.2, 4.5.3.3 Figure 4.5-4	All of the locations noted by the New Mexico Environment Department (NMED) are below the toe of the slope in Effluent Canyon or Mortandad Canyon, and are beyond the scope of this investigation. The area encompassing the sampling locations is included in reaches E-1E of Effluent Canyon and M-2W of Mortandad Canyon, which have been investigated separately. Sections 4.5.3.2 and 4.5.3.3 have been revised to include this discussion. Figure 4.5-4 has been revised to show reaches E-1W, E-1E, and M-2W in Effluent and Mortandad Canyons. No additional sampling for radionuclides in Effluent and Mortandad Canyons is necessary. Sampling for nitrate and perchlorate has been added to location 6d-1.
9c	Propose additional sampling to define vertical extent of cesium-137 at locations 50-06000, 50-06001, 50-06002, 50-06003, 50-06006, 50-06007, 50-06010, 50-06011, 50-06012, 50-06016, 50-06018, 50-06022, 50-06023, 50 06024, 50-06025, and 50-06026, or provide justification for not sampling.	Section 4.5.3.3, p. 35		
9d	Propose additional sampling to define vertical extent of cobalt-60.	Section 4.5.3.3, p. 35		
9e	Propose additional sampling to define vertical extent of plutonium-238 at locations where concentrations increased with depth or only one depth was sampled.	Section 4.5.3.3, p. 35		
9f	Propose additional sampling to define vertical extent of plutonium-239/240 at locations where concentrations increased with depth or only one depth was sampled.	Section 4.5.3.3, p. 35		
9g	Propose additional sampling to define vertical extent of strontium-90 where concentrations increased with depth or only one depth was sampled.	Section 4.5.3.3, p. 35		
9h	Propose additional sampling to define vertical extent of tritium at locations 50-06013, 50-06016, and 50-06018.	Section 4.5.3.3, p. 35		
10	Update text to provide correct reference to effective Hazardous Waste Facility Permit.	Appendix B, Section B-2.0, p. B-1	Appendix B, Section B-2.0, p. B-1	Revised text to use correct reference. Removed Module VIII.

*n/a = Not applicable.

Response to the Notice of Disapproval for the Phase II Investigation Work Plan for Upper Mortandad Canyon Aggregate Area, Los Alamos National Laboratory, EPA ID No: NM0890010515, HWB-LANL-10-092, Dated April 1, 2011

INTRODUCTION

To facilitate review of this response, the New Mexico Environment Department's (NMED's) comments are included verbatim. Los Alamos National Laboratory's (LANL's or the Laboratory's) responses follow each NMED comment. This response contains data on radioactive materials, including source, special nuclear, and byproduct material. Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with U.S. Department of Energy policy.

NMED Comment

1. Section 4.1.6.3, Proposed Sampling at SWMU 03-049(b)-00, page 13:

The Permittees propose to collect samples only at location MO-605029 to define the vertical extent of polychlorinated biphenyl (PCB) contamination. PCBs were only detected in the deepest sample (8-9 ft) at location MO-605025 indicating that the vertical extent of PCBs is not defined at this location. Even though the Upper Mortandad Canyon Aggregate Area Investigation Report, Revision 1, April 2010 (Report) concluded that the vertical and lateral extent of PCBs was not defined (See page I-62), the IWP does not include the collection of any additional samples to define the lateral extent of PCBs. PCB analysis must be added to the analytical suite for the samples proposed to be collected at location MO-605025 to define the vertical extent at this location, and to the analytical suite for samples proposed to be collected at location 49b-1 to define the lateral extent of PCB contamination at Solid Waste Management Unit (SWMU) 03-049(b)-00.

LANL Response

1. The text in section 4.1.6.2 has been revised to indicate the vertical extent of polychlorinated biphenyls (PCBs) is not defined at location MO-605025, and the lateral extent of PCBs is not defined downgradient of the site. The text in section 4.1.6.3 has been revised to include PCB analysis at locations MO-605025, 49b-1, and 49b-2. Table 4.1-6 has been revised to include the additional PCB analysis. An additional sampling depth has also been added to locations MO-605025, 49b-1, and 49b-2 in Table 4.1-6.

NMED Comment

2. Section 4.1.7.3, Proposed Sampling and Soil Removal at SWMU 03-049(e), page 14:

The section heading indicates that the Permittees intend to remove soil from SWMU 03-049(e). However, neither the text nor Figure 4.1-10 provides information on the area where soils will be removed and the anticipated depth of excavation. During previous investigations, samples were collected from 0-0.5 ft, 0.5-1.5 ft, and 1.0-2.0 ft. To define the vertical extent of inorganic chemicals, the Permittees propose to collect samples from greater depths (3-4 ft and 6-7 ft) at nine previously sampled locations. It is not clear if the proposed sampling depths are relative to the ground surface or the bottom of excavation. Without information on the proposed depth and extent of excavation,

NMED cannot evaluate the proposed sampling locations and depths. Revise the IWP to provide this information on the proposed soil removal area and justification for the proposed sampling locations and depths.

LANL Response

2. The heading of section 4.1.7.3 is incorrect. No soil removal is proposed at Solid Waste Management Unit (SWMU) 03-049(e). The heading of section 4.1.7.3 has been revised to "Proposed Sampling at SWMU 03-049(e)." All proposed sampling depths are below ground surface (bgs).

NMED Comment

3. Section 4.1.9.2, Previous Investigations, pages 16-17:

According to Figure 4.1-16, location MO-604994 is north of locations MO-604990 and MO-604991, not south as reported.

LANL Response

3. The text in section 4.1.9.2 has been revised to state the concentrations of chromium decreased to the north from locations MO-604990 and MO-604991 to location MO-604994.

NMED Comment

4. Section 4.4.1.3, Proposed Sampling at AOC 48-001, page 23:

Sampling location MO-604942 is located near the southwest corner of building 48-1, not the southeast corner as reported.

LANL Response

4. The text in section 4.4.1.3 has been revised to state the previously sampled location MO-604942 is located near the southwest corner of building 48-1.

NMED Comment

5. Section 4.4.2.1, Site Description and Operational History, page 23:

According to Figure 4.4-2, SWMU 48-002(a) is located south and southeast of building 48-1, not southwest as reported.

LANL Response

5. The text in section 4.4.2.1 has been revised to state the former container storage area at SWMU 48-002(a) is located at the south end of building 48-1.

NMED Comment

6. Section 4.4.6.3, Proposed Sampling at SWMU 48-007(c), page 28:

The vertical extent of chromium contamination is not defined at SWMU 48-007(c). In addition to locations MO-605163 and MO-605164, the concentrations of chromium increased at location MO-605165. However, chromium analyses are not proposed for samples to be collected at location MO-605165. Add chromium analysis for samples to be collected at location MO-605165 to define the vertical extent of chromium contamination at this location.

LANL Response

6. The chromium data at location MO-605165 was reevaluated as part of the work plan. The concentration in the deepest sample (11.2 mg/kg) at location MO-605165 is less than the maximum tuff (Qbt 2,3,4) background concentration (13 mg/kg). Therefore, the vertical extent of chromium is defined and additional sampling for chromium at location MO-605165 is not warranted. No revision to the work plan is necessary.

NMED Comment

7. Section 4.5.1.3, Proposed Sampling at Consolidated Unit 50-004(a)-00, page 32:

a. The text states that shallow subsurface samples will be collected at 26 previously sampled locations, extending the depth at these locations to define the vertical extent of radionuclides and inorganic chemicals. However, Table 4.5-1 indicates only 19 locations where additional samples are proposed to be collected. Resolve this discrepancy.

b. Table 6.8-2 of the Report indicates that barium concentrations increased with depth at locations 50-03018, 50-03020, 50-03021, 50-03022, 50-03025, 50-03032, 50-03038, MO-605458, MO-605473, and MO-605626. The Permittees propose to collect samples from location MO-605473, but did not include barium analyses for samples to be collected at this location. Include barium in the analytical suite for samples to be collected at location MO-605473.

c. Cobalt was detected in the deepest samples at locations MO-605458 and MO-605473, indicating that the vertical extent is not defined at these locations. Cobalt analyses are proposed for samples to be collected from location MO-605473 (4.17 mg/kg), but not from location MO-605458 (6.95 mg/kg). Include cobalt in the analytical suite for samples to be collected at location MO-605458 to define the vertical extent.

d. Copper was detected in the deepest samples at locations 50-03038, MO-605458, and MO-605473. The IWP includes collection of samples from deeper depths at all three locations, but did not include copper analyses for samples that will be collected from location MO-605458. Add copper to the analytical suite for the samples to be collected from location MO-605458.

e. Table 4.5-1 indicates that samples are proposed to be collected from location MO-605468 from two depths (14-15 ft and 24-25 ft). However, the table does not indicate what analyses will be conducted on these samples. Revise Table 4.5-1 to provide information on proposed analyses for these samples.

LANL Response

7. a. The text of section 4.5.1.3 has been revised to clarify the numbers and relationships of proposed sampling locations. Sampling is proposed at 18 locations to define the vertical extent. However, because some of these locations are collocated or near other sampling locations, the data will also be used to evaluate vertical extent at the collocated or nearby locations. The use of collocated samples for vertical extent is discussed in the second paragraph of section 4.5.1.3. Table 4.5-1 has been revised to indicate sampling at 18 locations rather than 19 locations (see response 7e).

   b. Table 4.5-1 (footnote g) has been revised to include analysis of barium for proposed samples at location MO-605473.

   c. Table 4.5-1 (footnote e) has been revised to include analysis of cobalt for proposed samples at location MO-605458.

   d. Table 4.5-1 (footnote e) has been revised to include analysis of copper for proposed samples at location MO-605458.

   e. Location MO-605468 was incorrectly identified for proposed sampling in Table 4.5-1. All detected inorganic chemicals, organic chemicals, and radionuclides at that location decreased with depth. Therefore, the vertical extent is defined at location MO-605468. Table 4.5-1 has been revised to delete location MO-605468. Location MO-605468 has also been removed from the list of proposed locations in section 4.5.1.3. Figure 4.5-1 has been revised to show location MO-605468 as an existing sampling location rather than a proposed sampling location.

NMED Comment

8. Section 4.5.3.2, Previous Investigations, page 35-36:

a. The text states that the vertical extent of perchlorate is not defined at location MO-605084. However, Table 6.11-2 of the Report indicates that the vertical extent of perchlorate is defined at location MO-605084, but is not defined at location MO-605087. Resolve this discrepancy. Propose to collect additional samples at this location, or provide justification for not collecting them.

b. The text states that the vertical extent of americium-241, cesium-137, plutonium-238, strontium-90, tritium, and uranium-235/236 is not defined at SWMU 50-006(d). Section 9.1 (Additional Field Characterization Activities) of the Report concluded that the vertical extent was also not defined for cobalt-60, plutonium-239/240, thorium-232, and uranium-234. However, analyses of cobalt-60, isotopic uranium, and isotopic plutonium are included in Table 4.5-3 (Proposed Sampling at SWMU 50-006(d)), but thorium-232 is not included. Resolve this discrepancy between the text and table, or provide justification for not including thorium-232 in the analytical suite.

LANL Response

8. a. The text in section 4.5.3.2 incorrectly stated that the vertical extent of perchlorate is not defined at location MO-605084.Perchlorate was not detected in the deepest sample (6.5–7.5 ft bgs) at that location. Therefore, the vertical extent of perchlorate is defined at location MO-605084. However, at location MO-605087 the concentrations of perchlorate increased with depth and the vertical extent is not defined. The text in section 4.5.3.2 has been revised to indicate that vertical extent of

perchlorate is not defined at location MO-605087, not location MO-605084, as indicated in the Phase II Investigation Work Plan. Table 4.5-3 has also been revised to remove the analysis of perchlorate at location MO-605084 and to add analysis of perchlorate for location MO-605087 at depths of 8–9 ft bgs and 12–13 ft bgs.

b. The vertical extent of thorium-232 is not defined at locations 50-06002, 50-06019, and 50-06026. These 1993 Resource Conservation and Recovery Act facility investigation (RFI) locations are located in Effluent Canyon and Mortandad Canyon. Section 4.5.3.2 has been revised to explain that the area encompassing these locations is included in reaches E-1E of Effluent Canyon and M-2W of Mortandad Canyon, which have been investigated separately (LANL 2006, 094161). Thorium-232 was not detected above background value in sediment in either of these reaches (LANL 2006, 094161, Table 6.2-3), and was not identified as a chemical of potential concern in either reach (LANL 2006, 094161, Table 8.2-3).The Mortandad Canyon investigation report stated, on the basis of multiple years of sediment and water sampling data, Effluent Canyon reach E-1E has been a primary source of radionuclide contamination in Mortandad Canyon, but that the concentrations of radionuclides have generally declined substantially with time (LANL 2006, 094161, p. 136). The Canyons investigation report also found the human health risk from contamination to be below the target level, although there is a potential for an excess radiological dose due mainly to cesium-137 in reach E-1E under a trail user scenario. This potential dose is mitigated by the fact that there is no developed trail in the contaminated area of the reach and the canyon is closed to recreational use, and no remedial action was recommended (LANL 2006, 094161, p. 137). Because Effluent Canyon and Mortandad Canyon have been investigated, no additional sampling and analysis for thorium-232 in the canyon is necessary. Figure 4.5-4 has been revised to show reaches E-1W, E-1E, and M-2W in Effluent Canyon and Mortandad Canyon.

NMED Comment

9. Section 4.5.3.3, Proposed Sampling and Soil Removal at SWMU 50-006(d), page 35:

a. The section heading indicates that the Permittees intend to remove soil from the SWMU 50-006(d). However, neither the text nor Figure 4.5-4 provides information on location where soil removal is proposed or the anticipated depth of the excavation (See Comment 3). Without information on the anticipated dimensions of the excavation, NMED cannot evaluate if the proposed sampling locations and depths will be adequate to define the nature and extent of contamination. Revise the IWP to provide information on the proposed excavation and justification for the proposed sampling locations and depths.

b. The vertical extent of americium-241 is not defined at locations MO-605088, 50-06007 and 50-06024 (See Table 6.11-4 of the Report). The Permittees propose to collect additional samples only at location MO-605088 to define the vertical extent of americium-241 contamination. Additional samples at the other two locations are required to define the vertical extent of contamination. In addition, americium-241 was detected at concentrations above background/fallout values (BV/FV) at locations 50-06000, 50-06001, 50-06006, 50-06013, 50-06025, 50-06026 in surface samples; samples were not collected from greater depths to define the vertical extent. Propose additional sampling to define the vertical extent of americium-241 at these locations, or provide justification for not proposing to collect additional samples at these locations.

c. *The concentrations of cesium-137 increased with depth at locations 50-06002, 50-06007, 50-06012, 50-06016, 50-06018, 50-06022, 50-06023, 50-06024, MO-605085, and MO-605088. In addition, samples collected from locations 50-06000, 50-06001, 50-06003, 50-06006, 50-06010, 50-06011, 50-06025, and 50-06026 (where samples were collected from only one depth) contained concentrations of cesium-137 several orders of magnitude higher than the BV/FVs. The highest concentration of cesium-137 (373.11 mg/kg) was detected in the deepest sample collected (3.0 ft-4.0 ft) at location 50-06022. The IWP includes collection of additional samples only at locations MO-605085 and MO-605088 to define the vertical extent. Propose the collection of additional samples at all these locations to define the vertical extent of contamination, or provide justification for not proposing to collect additional samples at these locations.*

d. *The Report concluded that the vertical extent of cobalt-60 was not defined at SWMU 50-006(d). Propose analysis of additional samples for cobalt-60, or provide a justification for not collecting samples to define vertical extent of cobalt-60.*

e. *Plutonium-238 was detected at several locations where either only surface samples were collected or concentrations increased with depth. However, the Permittees propose to collect additional samples only from two locations MO-605085 and MO-605088. For example, concentration increased with depth at locations 50-06007, 50-06021, 50-06022, and 50-06024, but no additional sampling is proposed. Review the data presented in the Report and propose to collect additional samples at locations where concentrations increased with depth or where samples were collected from one depth and concentrations were above BV/FVs.*

f. *Plutonium-239/240 was detected at several locations where either only surface samples were collected or concentrations increased with depth. However, the Permittees propose to collect additional samples only from two locations MO-605085 and MO-605088. Plutonium-239/240 concentrations also increased with depth at location 50-06024 and concentrations were above BV/FVs at locations 50-06025 and 50-06026 (samples collected form only one depth). Review the data presented in the Report and propose to collect additional samples at locations where concentrations increased with depth or where samples were collected only from one depth and concentrations were above BV/FVs.*

g. *Strontium-90 concentrations increased with depth at several locations in the drainage but no additional sampling to define the vertical extent is proposed. For example, concentrations increased with depth at 50-06015, 50-06018, 50-06022, and 50-06023, but no additional sampling is proposed to define the vertical extent of contamination. Review the data presented in the Report and propose to collect additional samples at locations where concentrations increased with depth or where samples were collected only from one depth and concentrations were above BV/FVs.*

h. *Tritium concentrations increased with depth at several locations. In addition to sampling proposed at locations MO-605084, MO-605085, MO-605088, and MO-605506, propose to collect additional samples at locations 50-06013, 50-06016, and 50-06018 to define the vertical extent of tritium at these locations.*

LANL Response

9. a. The heading of section 4.5.3.3 is incorrect. No soil removal is proposed at SWMU 50-006(d). The heading of section 4.5.3.3 has been revised to "Proposed Sampling at SWMU 50-006(d)."

   b–h. With the exception of locations MO-605085 and MO-605088, all of the locations are 1993 RFI samples located in Effluent Canyon or Mortandad Canyon. Section 4.5.3.2 has been revised to explain that the area encompassing the identified sampling locations is included in reaches E-1E of Effluent Canyon and M-2W of Mortandad Canyon, which have been investigated separately (LANL 2006, 094161). The Mortandad Canyon investigation report stated, on the basis of multiple years of sediment and water sampling data, that Effluent Canyon reach E-1E has been a primary source of radionuclide contamination in Mortandad Canyon, but that the concentrations of radionuclides have generally declined substantially with time (LANL 2006, 094161, p. 136). That investigation report also found the risk from contamination to be below the target level, although there is a potential for an excess radiological dose due mainly to cesium-137 in reach E-1E under a trail user scenario. This potential dose is mitigated by the fact that there is no developed trail in the contaminated area of the reach and the canyon is closed to recreational use, and no remedial action was recommended (LANL 2006, 094161, p. 137). Because Effluent Canyon and Mortandad Canyon have been investigated, no additional sampling and analysis is necessary. Figure 4.5-4 has been revised to show reaches E-1W, E-1E, and M-2W in Effluent Canyon and Mortandad Canyon.

   The Mortandad Canyon investigation, however, did not analyze samples for nitrate or perchlorate. Because the extent of these contaminants was not defined in the Upper Mortandad Canyon Aggregate Area investigation report, samples from location MO-605085 will be collected and analyzed for nitrate and perchlorate only. The text in section 4.5.3.3 has been revised to state that samples will be collected and analyzed for nitrate and perchlorate at location 6d-1 because those analytes were not addressed in the Mortandad Canyon investigation report. Table 4.5-3 has been revised to include only nitrate and perchlorate analyses at existing location MO-605085 (to determine vertical extent) and at new location 6d-1, downgradient of MO-605085 (to determine lateral extent). Lateral extent for all of the other contaminants, including chromium, copper, and mercury, is determined by samples collected for the Mortandad Canyon investigation.

NMED Comment

10. Appendix B, Section B-2.0, IDW, page B-1:

Module VIII of the Laboratory Hazardous Waste Facility Permit is no longer in effect. Update the text to provide the correct reference to effective Hazardous Waste Facility Permit.

LANL Response

10. The text of the third paragraph of section B-2.0 has been revised to state that the Laboratory's Hazardous Waste Minimization Report is updated annually as a requirement of the Laboratory's Hazardous Waste Facility Permit. Reference to Module VIII has been removed.

REFERENCE

LANL (Los Alamos National Laboratory), October 2006. “Mortandad Canyon Investigation Report,” Los Alamos National Laboratory document LA-UR-06-6752, Los Alamos, New Mexico. (LANL 2006, 094161)

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Phase II Investigation Work Plan for Upper Mortandad Canyon Aggregate Area, Revision 1

Los Alamos
NATIONAL LABORATORY
EST. 1943

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Prepared by the Environmental Programs Directorate

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EP2011-0149

Phase II Investigation Work Plan for Upper Mortandad Canyon Aggregate Area, Revision 1

May 2011

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EXECUTIVE SUMMARY

The Upper Mortandad Canyon Aggregate Area is located in Technical Area 03 (TA-03), TA-48, TA-50, TA-55, and former TA-42 of Los Alamos National Laboratory and includes a total of 119 solid waste management units and areas of concern. Sixty-three of the sites were investigated in 2009 and the results reported in the investigation report for the Upper Mortandad Canyon Aggregate Area. Two additional sites at TA-35 were also investigated in 2009 and the results reported in the investigation report. Of these 65 sites, 31 require additional sampling to define the extent of contamination. This Phase II investigation work plan presents the proposed sampling and analyses needed to define the vertical and/or lateral extent of one or more contaminants at each of the 31 sites. The results of the Phase II investigation activities will be reported in a Phase II investigation report.

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1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility owned by the U.S. Department of Energy (DOE) and managed by Los Alamos National Security, LLC. 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 40 mi^2 of the Pajarito Plateau, which consists of a series of fingerlike mesas separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation from approximately 6200 to 7800 ft above mean sea level. The location of Upper Mortandad Canyon Aggregate Area with respect to the Laboratory technical areas (TAs) and surrounding land holdings is shown in Figures 1.1-1 and 1.1-2.

The solid waste management units (SWMUs) and areas of concern (AOCs) addressed in this Phase II investigation work plan are potentially contaminated with both hazardous and radioactive components. The New Mexico Environment Department (NMED), pursuant to the New Mexico Hazardous Waste Act, regulates cleanup of hazardous wastes and hazardous constituents. DOE regulates cleanup of radioactive contamination, pursuant to DOE Order 5400.5, Radiation Protection of the Public and the Environment; DOE Order 435.1, Radioactive Waste Management; and DOE Order 458.1, Administrative Change 1, Radiation Protection of the Public and the Environment. 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 Phase II work plan describes work activities that will be executed and completed in accordance with the Consent Order.

1.1 Work Plan Overview

The Upper Mortandad Canyon Aggregate Area is located in TA-03, TA-48, TA-50, TA-55, and former TA-42 of the Laboratory and includes a total of 119 SWMUs and AOCs. Sixty-three of the sites were investigated in 2009, and the results were reported in the April 2010 Investigation Report for Upper Mortandad Canyon Aggregate Area, Revision 1 (LANL 2010, 109180.28), which was approved by NMED in June 2010 (NMED 2010, 109653). Two additional sites at TA-35 were also investigated in 2009 and results reported in the investigation report. Of these 65 sites, 31 require additional sampling to define the extent of contamination. This Phase II investigation work plan presents the proposed sampling and analyses needed to define the vertical and/or lateral extent of one or more contaminants at each of the 31 sites. A brief description and additional sampling requirements for the 31 sites are summarized in Table 1.1-1.

Section 2 of this Phase II investigation work plan presents the background and conceptual site model of the Upper Mortandad Canyon Aggregate Area. Sections 3 presents site conditions, and section 4 summarizes previous investigations and data collected and presents the scope of proposed activities for each site. Section 5 presents investigation methods for proposed field activities. Ongoing monitoring and sampling programs in the Upper Mortandad Canyon Aggregate Area are presented in section 6. Section 7 is an overview of the anticipated schedule of the Phase II investigation and reporting activities. The references cited in this report and the map data sources are provided in section 8. Appendix A of this work plan includes a list of acronyms and abbreviations, a glossary, and metric conversion and data qualifier definitions tables. Appendix B describes the management of investigation-derived waste (IDW).

1.2 Work Plan Objectives

The objective of the Phase II work plan is to complete the activities recommended in the investigation report (LANL 2010, 109180.28) for 31 sites requiring additional sampling to define the extent of contamination.

To accomplish this objective, this Phase II work plan

- presents historical and background information on the sites,
- describes the rationale for proposed data collection activities,
- identifies and presents appropriate methods for achieving the investigation objectives and managing IDW, and
- presents a schedule for conducting the investigation activities and reporting the investigation results.

2.0 BACKGROUND

2.1 General Site Information

TA-03, located on South Mesa between Los Alamos Canyon to the north and Twomile Canyon to the south, is the Laboratory's main TA. It contains most of the Laboratory's administrative buildings and public and corporate access facilities. In addition, TA-03 houses several Laboratory activities such as experimental sciences, special nuclear materials, theoretical/computations, and physical support operations. Security requirements at TA-03 range from buildings open to the general public to buildings that have the strictest security.

TA-35, also referred to as Ten Site, is used for nuclear-safeguards research and development (primarily in the areas of lasers, physics, fusion work, materials development, and biochemistry); physical chemistry research and development; research in reactor safety; optical science; and pulsed-power systems. Metallurgy, ceramic technology, and chemical plating also occur at this site. Formerly, the TA was used in source manufacturing, specialty-materials manufacturing, and reactor development, including the construction and operation of several reactors.

Former TA-42 lies within the current boundaries of TA-55. TA-42 was built in 1951 as an incinerator site for radionuclide-contaminated waste. However, the TA was never fully operational, and all the buildings were removed in 1978. In the interim, TA-42 was used for decontamination work and for storage.

TA-48 consists of a building complex used for research and development in nuclear chemistry and radiochemistry, geochemistry, production of medical radioisotopes, and chemical synthesis.

TA-50 manages various wastes for the Laboratory. Waste management activities at TA-50 include treating radioactive liquid waste (RLW), reducing the size and volume of transuranic wastes, and characterizing transuranic wastes. The TA has been in operation since 1963. The TA-50 complex supports a number of waste-management activities for several types of waste, including storing, treating, or disposing of solid and liquid, low-level radioactive waste (LLW), mixed low-level waste, transuranic waste, and hazardous waste. Major facilities at TA-50 are the Radioactive Liquid Waste Treatment Facility (RLWTF) and the Waste Characterization, Reduction, and Repackaging Facility.

2.2 Operational History

Originally, before 1945, TA-03 was built as a firing site. It contained several wooden structures that served as an administration building; a shop; hutments (10- × 10-ft fiberboard buildings used for storage, minor assembly, and checkout of scientific hardware); and magazines. The area also contained a burn pit for destroying explosives (LASL 1947, 005581). The site was decommissioned and cleared in 1949.

In 1950, construction began on the major buildings at TA-03 to replace operational facilities in the Los Alamos townsite. The Van de Graaf accelerator was built on the rim of Twomile Canyon. The Chemistry and Metallurgy Research (CMR) Building (03-29), built in 1952, is a large laboratory facility that houses diverse chemical and metallurgical operations involving plutonium, uranium, other radionuclides, metals, inorganic and organic chemicals, acids, and solvents.

The Administration Building was completed in 1956. In addition to offices, it housed laboratory and shop facilities and extensive photographic operations. In 1959, the Sigma Building (03-66) was completed at the eastern end of the site. The building houses a complex array of equipment and activities concerned with metallurgical and ceramics research and fabrication. Construction of new facilities continued through the 1960s and 1970s. Office buildings, shops, storage areas, an addition to the wastewater treatment plan, a cement batch plant, and numerous transportable buildings filled the areas between the initial buildings. In 1977, the Oppenheimer Study Center was constructed, and in 1981, the Otowi Building was built as an annex to the Administration Building. A computer facility and several national centers for various scientific activities were constructed in the 1990s. A parking structure was completed in 2006.

The first laboratories and offices at TA-35 were completed in 1951. Initial operations involved the preparation of kilocurie sources of radioactive lanthanum. Experimentation with several radionuclides, mainly plutonium and tritium, was conducted at TA-35 in the 1950s and 1960s. Three experimental fission reactors were developed and operated for short periods between 1956 and 1964. By the 1970s, most of the work with radioactive materials was phased out and attention was focused on laser operations. In addition, research on optics, robotics, and nuclear safeguards is conducted at TA-35.

In 1951, an incinerator was built at former TA-42 for volume reduction of low-level plutonium-contaminated wastes. The incinerator, which was never fully operational, was shut down in 1952. In 1978, all structures, debris, and contaminated soil were removed and disposed of at Area G, TA-54. Following removal of contaminated materials, the site was contoured and revegetated (LANL 1992, 007666).

TA-48 was established in 1957 for work in radiochemistry. Initially, the major work was to study samples from bomb tests; however, that work evolved into other types of studies related to weapon tests, research in geochemistry and radiochemistry, and production of radioisotopes for nuclear medicine (DOE 1987, 008663; DOE 1987, 008664; LANL 1992, 007666). TA-48 facilities also have historically been and are currently used to study nuclear properties of radioactive materials using analytical and physical chemistry. Measurements of radioactive substances are performed, and hot cells are used for remote handling of radioactive materials (LANL 1988, 000344; LANL 1992, 007666).

The TA-50 RLWTF was built in 1963 to meet the need for expanded treatment capability and to locate a treatment facility nearer the TAs that were generating the waste. This treatment plant treats low-level wastewater from various areas of the Laboratory. The incinerator complex, built in 1975, and the volume-reduction facility, built in 1983, were prototype facilities for developing and testing improved methods of handling and treating certain types of radioactive waste.

2.3 Conceptual Site Model

The sampling proposed in this Phase II work plan uses a conceptual site model to predict areas of potential contamination and to allow for adequate characterization of these areas. A conceptual site model describes potential contaminant sources, transport mechanisms, and receptors.

2.3.1 Potential Contaminant Sources

Releases at the sites within the Upper Mortandad Canyon Aggregate Area may have occurred as a result of air emissions; potential leaks from septic systems, sumps, tanks, waste lines, and drains; discharges from cooling towers and outfalls; and releases from storage areas, firing sites, and an incinerator. Previous sampling results indicate contamination from inorganic chemicals, organic chemicals, and radionuclides (LANL 2010, 109180.28). Additional sampling is needed to define the extent of contamination at 31 sites.

2.3.2 Potential Contaminant Transport Mechanisms

Current potential transport mechanisms that may lead to exposure include

- dissolution and/or particulate transport of surface contaminants during precipitation and runoff events,
- airborne transport of contaminated surface soil,
- continued dissolution and advective/dispersive transport of chemical contaminants contained in subsurface soil and tuff as a result of past operations,
- disturbance of contaminants in shallow soil and subsurface tuff by Laboratory operations, and
- disturbance and uptake of contaminants in shallow soil by plants and animals.

2.3.3 Potential Receptors

Potential receptors at one or more of the sites may include

- Laboratory workers,
- construction workers, and
- plants and animals both on-site and in areas immediately surrounding the sites.

Laboratory workers could potentially be exposed to contaminants in soil, tuff, and sediment by direct contact, ingestion, or inhalation. Ecological receptors may also be exposed to soil and sediment contaminants.

2.3.4 Cleanup Standards

Soil screening levels (SSLs) for chemicals or screening action levels (SALs) for radionuclides will be used as soil cleanup levels unless they are determined to be impractical or unless values do not exist for the current and reasonable foreseeable future land use scenarios. In some cases where NMED SSLs do not exist, U.S. Environmental Protection Agency (EPA) regional screening values are used.

2.4 Data Overview

This work plan summarizes the available decision-level data used to evaluate whether the nature and extent of contamination are defined for each site. In addition, this work plan proposes sampling and analyses for those sites at which the extent of contamination has not been defined. The data collected during this investigation, along with existing decision-level data, will be used to define nature and extent and perform risk-screening assessments.

3.0 SITE CONDITIONS

Surface and subsurface features and geologic characteristics of the Upper Mortandad Canyon Aggregate Area are described in detail in the investigation report (LANL 2010, 109180.28). Conditions at the sites included in this Phase II investigation work plan are predominantly influenced by

- a semiarid climate with low precipitation and a high evapotranspiration rate that limits the extent of subsurface moisture percolation and, therefore, the amount of moisture available to transport radionuclides or hazardous waste constituents in the subsurface, and
- a thick, relatively dry, unsaturated (vadose) zone that greatly restricts or prevents downward migration of contaminants to the regional aquifer.

These and other elements of the environmental setting in the Upper Mortandad Canyon Aggregate Area are considered when the investigation data are evaluated with respect to the fate and transport of contaminants.

4.0 SITE DESCRIPTIONS AND PROPOSED INVESTIGATION ACTIVITIES

4.1 TA-03

TA-03 is located on the western end of South Mesa and is almost completely developed. The core operational facilities for the Laboratory are located at TA-03, including the principal administration buildings, the library, the CMR Building, the Beryllium Technology Facility, a gas-fired electrical generating plant, and a former sanitary wastewater treatment plant and supporting structures.

4.1.1 AOC 03-004(c), Storage Area, CMR Building Loading Dock

4.1.1.1 Site Description and Operational History

AOC 03-004(c) is an active 85-ft x 50-ft dumpster storage area at the main loading dock of the CMR Building (03-29) (Figure 4.1-1). The area is level and paved with asphalt. Two dumpsters occupying the area are used to stage boxed LLW before disposal. The waste is generated from offices and material-handling areas in the CMR Building. One dumpster receives compactable waste, and the other receives noncompactable waste. Waste consists of gloves, paper products, glass, plastic, and metal. Runoff from the dumpster storage area flows to a storm drain inlet grate about 50 ft southwest of the area. The storm drain eventually discharges at an outfall [SWMU 03-054(e)] in Mortandad Canyon (LANL 1995, 057590).

4.1.1.2 Previous Investigations

In 1997 and 2009, a total of 26 samples (12 soil or fill and 14 tuff) were collected from 12 locations at AOC 03-004(c). Previously sampled locations are shown in Figure 4.1-1. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In July 1997, a Resource Conservation and Recovery Act facility investigation (RFI) was conducted at AOC 03-004(c). Samples were collected and field screened for organic vapors and radioactivity. Screening results did not indicate the presence of organic vapors, and radioactivity was at or below background. Five samples were analyzed for target analyte list (TAL) metals, semivolatile organic compounds (SVOCs), and volatile organic compounds (VOCs). The RFI activities and results were presented in the RFI report, which included the results of five asphalt samples analyzed for isotopic plutonium and isotopic uranium (LANL 1997, 056660.289). These asphalt samples were collected from the asphalt pavement and were all surface samples (0–0.42 ft below ground surface [bgs]). The results of the asphalt samples are screening-level data. Because the samples are engineered material, the results have no applicable background values (BVs), and the results are not directly comparable with the results from soil, fill, or tuff samples. Section 2.3.1 of the HIR provides additional details of previous investigations (LANL 2007, 098955).

Sampling at AOC 03-004(c) consisted of the following activities in 2009:

- Soil and tuff samples were collected at seven sampling locations from three depth intervals: beneath the asphalt, at the soil-tuff-interface interval, and at the interval beginning 5 ft below the soil-tuff interface. Three of the sampling locations were sited next to the two dumpsters, and four were downgradient of the dumpsters.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, polychlorinated biphenyls (PCBs), gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 18), the lateral extent of barium, chromium, copper, and manganese and the vertical extent of chromium are not defined at AOC 03-004(c). The highest concentrations of barium (121 mg/kg), chromium (48.2 mg/kg), copper (16.6 mg/kg), and manganese (599 mg/kg) were detected at the farthest downslope location MO-605048 (Figure 4.1-2). The vertical extent of chromium is not defined at location MO-605048.

4.1.1.3 Proposed Sampling at AOC 03-004(c)

Shallow subsurface samples will be collected at previously sampled location MO-605048, extending the depth at that location to define the vertical extent of chromium. Samples at location MO-605048 will be analyzed for chromium only. Two new sampling locations (4c-1 and 4c-2) will be placed south and west of existing location MO-605048 to define the lateral extent of barium, chromium, copper, and manganese. Samples at locations 4c-1 and 4c-2 will be analyzed for barium, chromium, copper, and manganese. The proposed sampling and analyses at AOC 03-004(c) are presented in Table 4.1-1, and the proposed sampling locations are shown in Figure 4.1-1.

4.1.2 AOC 03-004(d), Former Storage Area at CMR Building

4.1.2.1 Site Description and Operational History

AOC 03-004(d) is a former 75-ft x 20-ft dumpster storage area located on a level, asphalt-covered surface south of the steps at the west end of Wing 9 at the CMR Building (03-29) (Figure 4.1-3). Runoff from this AOC flows to a storm drain inlet grate located approximately 100 ft west of the area. The storm drain discharges at an outfall [SWMU 03-054(e)] into Mortandad Canyon. The dumpster at AOC 03-004(d) was relocated in 1992 to inside Wing 9 of the CMR Building. It typically received contact-handled waste generated from operations of Wing 9 hot cells. The waste consisted of rags, small hardware, paper, machine-shop waste, cleaning materials, and occasionally a decontaminated hot-cell item. All waste was bagged and boxed before it was placed in the dumpster.

4.1.2.2 Previous Investigations

In 1997 and 2009, a total of 37 samples (23 soil or fill and 14 tuff) were collected from 14 locations at AOC 03-004(d). Previously sampled locations are shown in Figure 4.1-3. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

An RFI was conducted at this site in July 1997. Samples were collected and field screened for organic vapors and radioactivity. Screening results were negative for organic vapors, and radioactivity was at or below background. Samples were analyzed for TAL metals, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, SVOCs, and VOCs. The RFI activities and results were presented in the RFI report (LANL 1997, 056660.289). Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at AOC 03-004(d) consisted of the following activities in 2009:

- Soil and tuff samples were collected at seven sampling locations from three depth intervals: beneath the asphalt, at the soil-tuff-interface interval, and at the interval beginning 5 ft below the soil-tuff interface. Three of the sampling locations were within the former dumpster storage area, and four were downgradient of the former storage area.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, PCBs, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 20), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at AOC 03-004(d), except for the lateral extent of chromium downgradient of location MO-605041 (Figure 4.1-4).

4.1.2.3 Proposed Sampling at AOC 03-004(d)

Shallow subsurface samples will be collected at two new sampling locations (4d-1 and 4d-2) to define the lateral extent of chromium. Samples will be analyzed for chromium only. The proposed sampling and analyses at AOC 03-004(d) are presented in Table 4.1-2, and the proposed sampling locations are shown in Figure 4.1-3.

4.1.3 AOC 03-007, Decommissioned Firing Site

4.1.3.1 Site Description and Operational History

AOC 03-007 is a decommissioned firing site located southwest of the Beryllium Technology Facility (building 03-141) within the security fence at the Sigma Complex (Figure 4.1-5). This AOC includes a containment building for explosives experiments (building 03-159) and a personnel safety barrier (structure 03-160). Building 03-159 sits on an 8- × 8-ft concrete slab and has 6-in.-thick × 8-ft-high walls. An opening on one side serves as an entrance. Structure 03-160 sits on a concrete slab and has two 8-ft-high × 4-ft-wide × 6-in.-thick walls. From 1970 to 1975, approximately 50 to 75 explosive shot experiments were detonated within building 03-159. The building was rinsed with water after each shot. Washdown water from within building 03-159 was released to the environment (soil immediately surrounding the building) from engineered gaps between the concrete floor and structure walls. The rinse water drained into small drainages and catchment areas and eventually flowed into Mortandad Canyon. The site was remediated in the late 1970s, and no explosive compounds were detected (LANL 1995, 057590). In the mid-1980s, building 03-159 was modified to serve as a storage building for thoria (oxide) and thorium (metal), which were stored in containers within the building (LANL 1995, 057590).

4.1.3.2 Previous Investigations

In 1997 and 2009, a total of 45 samples (11 soil or fill, 4 sediment, and 30 tuff) were collected from 18 locations at AOC 03-007. Previously sampled locations are shown in Figure 4.1-5. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

An RFI was conducted at this site in July 1997. Samples were collected on the north, east, and south sides of building 03-159 and were field screened for organic chemicals and radioactivity. Screening results indicated that organic chemicals were not detected, and radioactivity was at or below background. Samples were analyzed for TAL metals, gamma-emitting radionuclides, isotopic thorium, explosive compounds, SVOCs, and VOCs. The RFI activities and results were presented in the RFI report (LANL 1997, 056660.289). Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at AOC 03-007 consisted of the following activities in 2009:

- Soil and tuff samples were collected at nine locations downgradient of the former firing site. Samples were collected from two or more depth intervals, generally including the surface interval, the soil-tuff-interface interval, and the interval beginning approximately 5 ft below the soil-tuff interface. Where tuff was found at the surface, only two depth intervals were sampled.
- Sediment and soil samples were collected at five locations within the drainage from two depth intervals: surface sediment or soil and the underlying tuff.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, PCBs, explosive compounds, gamma-emitting radionuclides, isotopic plutonium, isotopic thorium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 23), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at AOC 03-007, except for the lateral and vertical extent of chromium. The vertical extent of chromium is not defined at locations MO-604997, MO-604998, MO-605005, MO-605007, and MO-605008 (Plate 1).

4.1.3.3 Proposed Sampling at AOC 03-007

Shallow subsurface samples will be collected at five previously sampled locations (MO-604997, MO-604998, MO-605005, MO-605007, and MO-605008), extending the depth at these locations to define the vertical extent of chromium. Samples will be analyzed for chromium only.

Samples will also be collected at four new sampling locations to define the lateral extent of chromium. A new sampling location (7-1) will be placed southwest of existing locations MO-604999 and MO-605000. Another new sampling location (7-2) will be placed downgradient of location 7-1 and just above the unpaved access road. New sampling locations 7-3 and 7-4 will be placed in the drainage downgradient of existing location MO-605008 to define the lateral extent of chromium in the drainage. Samples from locations 7-1, 7-2, 7-3, and 7-4 will be analyzed for chromium only. The proposed sampling and analyses at AOC 03-007 are presented in Table 4.1-3, and the proposed sampling locations are shown in Figure 4.1-5.

4.1.4 SWMU 03-045(h), Former Outfall from Cooling Tower

4.1.4.1 Site Description and Operational History

SWMU 03-045(h) consists of a cooling tower outlet pipe that discharged to a storm drain at the north perimeter of the TA-03 Sigma Complex security fence (Figure 4.1-6), approximately 50 ft north of a cooling tower (structure 03-187). The cooling tower outlet pipe is a former National Pollutant Discharge Elimination System– (NPDES-) permitted outfall (03A024) that was removed from the NPDES permit on August 1, 2007 (EPA 2007, 099009). This outlet pipe discharged treated cooling water onto a small area of ground surface, which drained into a buried corrugated metal storm drain that trended northeast of structure 03-187, where it eventually combined with stormwater runoff from surrounding areas. The drainage continued northeast and joined a channel north of Eniwetok Drive, which ultimately drained into Sandia Canyon (LANL 1995, 057590). The cooling tower outlet pipe was active from 1953 to the late 1980s. The pipe was reactivated in early 1995 and remained active until it was plugged in February 1997.

Routine cooling water treatment began in 1968. Treatment included biocides and fungicides to reduce algae growth and chelating agents (such as ethylenediaminetetraacetic acid [EDTA]) to inhibit corrosion. The potential contamination resulting from the northward flow of the discharge from the cooling water outlet pipe into Sandia Canyon was investigated as part of the Upper Sandia Canyon Aggregate Area investigation report (LANL 2010, 110862.24).

In addition, it is possible that the buried corrugated storm drain into which the cooling tower outlet pipe drained may not have been able to handle the large flow of stormwater that results during sporadic and heavy storm events. Should this have occurred, the overflow would have drained due south across asphalt pavement to a drainage located to the southwest of building 03-66. This drainage discharges into upper Mortandad Canyon.

4.1.4.2 Previous Investigations

In 2009, a total of 22 samples (9 soil or fill, 2 sediment, and 11 tuff) were collected from 11 locations at SWMU 03-045(h). Previously sampled locations are shown in Figure 4.1-6. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

Investigation sampling at SWMU 03-045(h) consisted of the following activities in 2009:

- Sediment or soil samples were collected at 10 locations from two depth intervals: the surface sediment or soil interval and the soil-tuff-interface interval. The sampling locations were in the drainage below SWMU 03-045(h).
- Samples were collected from two depth intervals (surface and soil-tuff interface) at one location at the discharge point north of the cooling tower.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, PCBs, gamma-emitting radionuclides, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, pp. 37–38), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 03-045(h), except for the lateral and vertical extent of barium and cobalt and the lateral extent of antimony. The vertical extent of barium is not defined at locations MO-604948, MO-604952, MO-604971, MO-604973, MO-604974, MO-604976, and MO-604977, and the vertical extent of cobalt is not defined at locations MO-604948, MO-604952, and MO-604974 (Figure 4.1-7).

4.1.4.3 Proposed Sampling at SWMU 03-045(h)

Shallow subsurface samples will be collected at seven previously sampled locations (MO-604948, MO-604952, MO-604971, MO-604973, MO-604974, MO-604976, and MO-604977), extending the depths at these locations to define the vertical extent of barium and cobalt. Samples from locations MO-604948, MO-604952, and MO-604974 will be analyzed for barium and cobalt. Samples from the other four locations will be analyzed for barium only.

A new sampling location (45h-1) will be placed in the drainage downgradient of location MO-604948 to define the lateral extent of antimony, barium, and cobalt. Samples at location 45h-1 will be analyzed for antimony, barium, and cobalt. The proposed sampling and analyses at SWMU 03-045(h) are presented in Table 4.1-4, and the proposed sampling locations are shown in Figure 4.1-6.

4.1.5 SWMU 03-049(a), NPDES-Permitted Outfall from Cooling Tower

4.1.5.1 Site Description and Operational History

SWMU 03-049(a) is a currently permitted NPDES outfall (03A022) located south of the Sigma Building (03-66) (Plate 2). The outfall formerly discharged treated cooling water from a former cooling tower (structure 03-127), which served the Sigma Building, and continues to discharge runoff from six roof drains on the Sigma Building. The cooling tower operated from1960 to 1999. From 1984 to 1990, the outfall also received discharge from rinse tanks associated with the electroplating operation in the Sigma Building. The tanks contained the final rinse from electroplating and surface-finishing experimental components. Although the rinse tanks were flushed continually with tap water to reduce contaminant buildup, trace amounts of metals, acids, cyanide, and depleted uranium were introduced into the rinse water. The NPDES permit allowed discharge of 4680 gal./d of treated cooling water and 24,000 gal./d of electroplating rinse water. Between 1990 and 1999, the outfall received treated cooling water and roof-drain runoff. The outfall currently discharges roof-drain runoff to upper Mortandad Canyon (LANL 1995, 057590).

4.1.5.2 Previous Investigations

In 1997 and 2009, a total of 32 samples (6 soil, 14 sediment, and 12 tuff) were collected from 20 locations at SWMU 03-049(a). Previously sampled locations are shown on Plate 2. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In July 1997, an RFI was conducted at SWMU 03-049(a). The investigation evaluated the point of discharge for the outfall and four associated sediment catchment basins through which the discharge flows before flowing into Mortandad Canyon. Field activities included a site survey, geodetic survey, field screening, and sample collection. Sediment samples were collected from each of the sediment basins. Two water samples were collected: one at the NPDES outfall pipe before it entered the sediment catchment basin and the other from flowing water exiting the last sediment catchment basin before it entered Mortandad Canyon. Screening results did not indicate the presence of organic vapors, and radioactivity was at or below background. The sediment samples were analyzed for hexavalent chromium, TAL metals, cyanide, isotopic uranium, and VOCs. Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 03-049(a) consisted of the following activities in 2009:

- Sediment samples were collected at 11 locations within the drainage from two depth intervals: the surface sediment or soil interval and the sediment-tuff or soil-tuff interface. The sampling locations were downgradient of the outfall.
- Sediment samples were collected at one location below outfall 03A022 from two depth intervals: the surface-sediment interval and the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, PCBs, gamma-emitting radionuclides, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 40), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 03-049(a), except for the vertical extent of chromium at location MO-604985 (Plate 3) and the lateral extent of dioxins/furans (Plate 4).

4.1.5.3 Proposed Sampling at SWMU 03-049(a)

Shallow subsurface samples will be collected at previously sampled location MO-604985, extending the depth at this location to define the vertical extent of chromium. Samples at this location will be analyzed for chromium only.

Samples will be collected at location MO-604981 to define the lateral extent of dioxins/furans because samples at this downgradient location were not analyzed for dioxins/furans in 2009. The proposed sampling and analyses at SWMU 03-049(a) are presented in Table 4.1-5, and the proposed sampling locations are shown on Plate 2.

4.1.6 Consolidated Unit 03-049(b)-00, Soil Contamination

4.1.6.1 Site Description and Operational History

Consolidated Unit 03-049(b)-00 consists of SWMU 03-049(b) and AOC C-03-014 (Figure 4.1-8). These sites were consolidated because surface-water drainage from both sites collects in the same locations, and regrading and paving operations may have distributed contamination from one site to the other.

SWMU 03-049(b) is a 50-ft-long × 20-ft-wide discharge area at the south wall of the press building (03-35). It is associated with an inactive vacuum pump that served furnaces in building 03-35. The press building was built in 1953. The vacuum pump evacuated oil from furnaces used for experiments in building 03-35. Experiments included fabricating enriched uranium-loaded graphite and carbide fuel elements. Enriched uranium was processed in the press building. The outlet is located about 8 ft above the ground on the south wall of the press building. The vacuum pump was deactivated in the late 1980s. At about the same time, a 10-ft × 8-ft area under the exhaust pipe outlet was paved with asphalt. Runoff from this area drains southwest toward low-lying areas. The press building ceased to be used in November 1991, but it was reactivated in 1995 (LANL 1995, 057590).

AOC C-03-014 is a 125-ft × 100-ft equipment-storage area located southwest of the press building (03-35). The area is bounded by security fences to the north, south, and west and by building 03-35 to the east. Most of the area is paved, except for a 15-ft-wide strip of grass along the southern security fence that widens to 30 ft southwest of building 03-35. Various equipment and molds from building 03-35 were stored at AOC C-03-014 for salvage or because of the building's space limitations. Equipment is no longer stored outside the building (LANL 1995, 057590).

4.1.6.2 Previous Investigations

In 1997 and 2009, a total of 48 samples (18 soil or fill and 30 tuff) were collected from 23 locations at Consolidated Unit 03-049(b)-00. Previously sampled locations are shown in Figure 4.1-8. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

An RFI was conducted in July 1997 for Consolidated Unit 03-049(b)-00. Field activities included a site survey, geodetic survey, field screening, and sample collection. Screening results indicated that organic vapors were not detected, and radioactivity was at or below background. Samples were collected and analyzed for TAL metals, isotopic uranium, PCBs, total petroleum hydrocarbons–diesel range organics (TPH-DRO), and VOCs. The RFI activities and results were presented in the RFI report (LANL 1997, 056660.289). Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at Consolidated Unit 03-049(b)-00 consisted of the following activities in 2009:

- Soil and tuff samples were collected at 10 locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 5 ft below the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, PCBs, TPH-DRO, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), gamma-emitting radionuclides, isotopic uranium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 43), the lateral extent of aluminum, chromium, total cyanide, lead, and perchlorate is not defined downgradient of locations MO-605027 and MO-605029 (Plate 5). The vertical extent of PCBs is not defined at locations

MO-605025 and MO-605029, and the lateral extent of PCBs is not defined downgradient of the site (Plate 6). The vertical extent of tritium is not defined at locations MO-605025, MO-605026, MO-605027, and MO-605034, and the lateral extent of tritium is not defined downgradient of location MO-605027 (Figure 4.1-9). The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at Consolidated Unit 03-049(b)-00.

4.1.6.3 Proposed Sampling at Consolidated Unit 03-049(b)-00

Shallow subsurface samples will be collected at two new sampling locations (49b-1 and 49b-2) to define the lateral extent of aluminum, chromium, total cyanide, lead, perchlorate, and PCBs to the south of locations MO-605029 and MO-605027. Samples from locations 49b-1 and 49b-2 will be analyzed for aluminum, chromium, total cyanide, lead, perchlorate, and PCBs.

Shallow subsurface samples will be collected at locations MO-605025 and MO-605029, extending the depths to define the vertical extent of PCBs. Samples at these locations will be analyzed for PCBs. Shallow subsurface samples will be collected at four previously sampled locations (MO-605025, MO-605026, MO-605027, and MO-605034), extending the depths to define the vertical extent of tritium. Samples at these locations will be analyzed for tritium. Samples collected at location 49b-2 will also be analyzed for tritium to define the lateral extent of tritium to the south of location MO-605027.

The proposed sampling and analyses at Consolidated Unit 03-049(b)-00 are presented in Table 4.1-6, and the proposed sampling locations are shown in Figure 4.1-8.

4.1.7 SWMU 03-049(e), Outfall from Sigma Building Roof Drains

4.1.7.1 Site Description and Operational History

SWMU 03-049(e) is identified in the 1990 SWMU report (LANL 1990, 007511) as an area located south of the Sigma Building (03-66) that was potentially contaminated by an outfall pipe of unknown origin (Figures 4.1-6 and 4.1-10). The 1990 SWMU report also states that the outfall discharged to Mortandad Canyon (LANL 1990, 007511). Subsequent investigation of the Sigma Building determined that three of the building's roof drains connect to a single pipe and discharge to the outfall area of SWMU 03-049(e) (LANL 1995, 057590).

4.1.7.2 Previous Investigations

In 2001 and 2009, a total of 28 samples (7 soil or fill, 9 sediment, and 12 tuff) were collected from 16 locations at SWMU 03-049(e). Previously sampled locations are shown in Figure 4.1-10. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 2001, four surface samples were collected from four locations near the outfall and analyzed for anions and TAL metals. Antimony, arsenic, cadmium, chromium, copper, iron, lead, nickel, and zinc were detected above BV at one to four locations. Decision-level data from the 2001 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 03-049(e) consisted of the following activities in 2009:

- Sediment or soil samples were collected at six locations within the drainage, from two depth intervals: the surface-sediment interval and the sediment-tuff- or soil-tuff-interface interval. Four of the sampling locations were sited near the previous 2001 sampling locations, two were downslope of both the previous and new sampling locations, and one was below the outfall.

- Samples were collected at one location at the outfall of the discharge pipe from two depth intervals: the surface-sediment interval and the sediment-tuff-interface interval.
- Sediment or soil samples were collected at five locations from two depth intervals: the surface-sediment interval and the sediment-tuff or soil-tuff interface every 50 ft from the top of the slope to the toe of the colluvium in the drainage downslope of the outfall.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, PCBs, gamma-emitting radionuclides, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 45), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 03-049(e), except for the vertical extent of antimony (MO-605009, and MO-605010); chromium (locations MO-605009, MO-605012, MO-605014, and MO-605018); hexavalent chromium (locations MO-605011, MO-605016, and MO-605017); selenium (location MO-605009); and zinc (locations MO-605010 and MO-605013) (Figure 4.1-11).

4.1.7.3 Proposed Sampling at SWMU 03-049(e)

Shallow subsurface samples will be collected at nine previously sampled locations (MO-605009, MO-605010, MO-605011, MO-605012, MO-605013, MO-605014, MO-605016, MO-605017, and MO-605018), extending the depths at these locations to define the vertical extent of antimony, chromium, hexavalent chromium, selenium, and zinc. The proposed sampling and analyses at SWMU 03-049(e) are presented in Table 4.1-7, and the proposed sampling locations are shown in Figure 4.1-10.

4.1.8 SWMU 03-054(e), Outfall

4.1.8.1 Site Description and Operational History

SWMU 03-054(e) is an outfall located in upper Mortandad Canyon (Figure 4.1-12). The outfall typically discharges a steady, low-volume flow of effluent that originates from several sources at the CMR Building (03-29). These sources include drainage from roofs over the west wing, where towers vent filtered exhaust, and surface water runoff from the asphalt area around the building.

SWMU 03-054(e) also received effluent from an unintentional one-time release in 1974 from an industrial waste manhole (AOC C-03-006). The overflow resulted from a plug in the industrial waste line and was estimated to be between 500 and 1000 gal. of RLW. The overflow spilled to the surrounding paved area, traveled north along Diamond Drive, flowed into the storm sewer through a storm drain grate, and ultimately discharged into upper Mortandad Canyon through the SWMU 03-054(e) outfall. A small dam was built in the streambed at the base of the canyon to contain the effluent. Subsequent cleanup action, based on residual radioactive contamination cleanup levels of 25 pCi/g, removed approximately 142 ft^3 of contaminated soil from Mortandad Canyon (LANL 1995, 057590).

4.1.8.2 Previous Investigations

In 1995 and 2009, a total of 14 samples (8 soil, 4 sediment, and 2 tuff) were collected from 10 locations at SWMU 03-054(e). Previously sampled locations are shown in Figure 4.1-12. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

An RFI was conducted at SWMU 03-054(e) in April 1995. Screening results indicated organic vapors were not detected, and radioactivity was at or below background. Samples were collected from the outfall area and analyzed for TAL metals, total cyanide, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, PCBs, SVOCs, and VOCs. The RFI activities and results were presented in the RFI report (LANL 1997, 072611). Decision-level data from the 1995 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 03-054(e) consisted of the following activities in 2009:

- Sediment samples were collected at four locations, with two depth intervals sampled at two of the locations: the surface-sediment interval within the drainage and the sediment-tuff interface interval.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, PCBs, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 47), the vertical extent of chromium (locations MO-605022 and MO-605023) and zinc (locations 03-02715, 03-02716, 03-02717, 03-02718, 03-02719, MO-605021 and MO-605024) is not defined (Figure 4.1-13). The lateral and vertical extent of phthalates and dioxins/furans are not defined, and the lateral extent of polycyclic aromatic hydrocarbons (PAHs) is not defined (Figure 4.1-14). The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 03-054(e).

4.1.8.3 Proposed Sampling at SWMU 03-054(e)

Shallow subsurface samples will be collected at two previously sampled locations (MO-605022 and MO-605023), extending the depths at these locations to define the vertical extent of chromium. Samples from these locations will be analyzed for chromium only. Shallow subsurface samples will be collected at two previously sampled locations (MO-605021 and MO-605024), extending the depths at these locations to define the vertical extent of zinc. Samples from location MO-605021 will be used to define the vertical extent at nearby locations 03-02715, 03-02716, and 03-02717 (approximately 10 ft away), and samples from location MO-605024 will be used to define the vertical extent at nearby locations 03-02718 and 03-02719 (approximately 5 ft away). Samples from these locations will be analyzed for zinc only.

Shallow subsurface samples will be collected at four previously sampled locations (MO-605021, MO-605022, MO-605023, and MO-605024), extending the depths at these locations to define the vertical extent of bis(2-ethylhexyl)phthalate and diethylphthalate. Samples from these locations will be analyzed for bis(2-ethylhexyl)phthalate and diethylphthalate.

Shallow subsurface samples will be collected at location MO-605021 to define the vertical extent of dioxin/furans. Samples from this location will be analyzed for dioxin/furans.

One new sampling location (54e-1) will be placed downgradient of existing location MO-605022 to define the lateral extent of bis(2-ethylhexyl)phthalate, diethylphthalate, dioxin/furans, and PAHs. Samples at location 54e-1 will be analyzed for bis(2-ethylhexyl)phthalate, diethylphthalate, dioxins/furans, and PAHs.

The proposed sampling and analyses at SWMU 03-054(e) are presented in Table 4.1-8, and the proposed sampling locations are shown in Figure 4.1-12.

4.1.9 AOC C-03-006, One-Time Spill from Industrial Waste Line Manhole

4.1.9.1 Site Description and Operational History

AOC C-03-006 is the site of an unintentional release from a manhole connected to the industrial waste line. The manhole is located near the corner of Diamond Drive and Pajarito Road (Figure 4.1-15) and is part of the liquid industrial waste collection system that runs from TA-03 to the RLWTF at TA-50. In 1974, the manhole overflowed to a storm sewer in TA-03 and discharged to upper Mortandad Canyon. The overflow resulted from a plug in the industrial waste line and was estimated to be between 500 and 1000 gal. of RLW. The overflow spilled to the surrounding paved area, traveled north along Diamond Drive, flowed into the storm sewer via a storm-drain grate, and ultimately discharged into upper Mortandad Canyon through the outfall at SWMU 03-054(e). A cleanup of the overflow-impacted area began the day after the release. A collection and pumping system was used to flush the contaminated storm drain. Approximately 176 m^3 of pavement was cut to the depth of the base course, excavated, and disposed of at Area G at TA-54. Newly exposed surfaces were monitored, and one section of curbing with radioactivity levels exceeding background levels was removed. Additional surveys and subsequent confirmation sampling determined that no radioactivity exceeding the decontamination criteria (25 pCi/g) was present in the base-course material. The area was restored by repaving and replacing the curb along Diamond Drive and around the manhole, removing the dam built in the stream bed at the base of the canyon, and installing engineering controls (LANL 1995, 057590). The area was further excavated in 1984 when the manhole and the industrial waste line were removed.

4.1.9.2 Previous Investigations

In 1995 and 2009, a total of 18 samples (13 soil or tuff and 5 tuff) were collected from 11 locations at AOC C-03-006. Previously sampled locations are shown in Figure 4.1-15. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

RFI activities were conducted in April 1995 around AOC C-03-006 at the outfall and canyon area associated with SWMU 03-054(e). Eight samples were collected from six locations, with two depth intervals sampled at two locations. The samples were analyzed for TAL metals, total cyanide, SVOCs, VOCs, PCBs, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, and tritium. Zinc, Aroclor-1260, PAHs, europium-152, plutonium-238, plutonium-239/240, and sodium-22 were detected or detected above BVs in one or more samples. The RFI activities and results were presented in the RFI report (LANL 1997, 072611). Decision-level data from the 1995 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at AOC C-03-006 consisted of the following activities in 2009:

- Soil-fill samples were collected at five locations from two depth intervals: the surface soil-fill interval and the soil-tuff-interface interval.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, PCBs, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 50), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at AOC C-03-006, except for the vertical extent of chromium at locations MO-604990, MO-604991, MO-604992, and MO-604993 (Figure 4.1-16). The investigation report stated that the lateral extent of chromium is not defined. In reviewing the data, however, the concentrations of chromium decreased to

the north from locations MO-604990 and MO-604991 to location MO-604994 (Figure 4.1-16). Therefore, the lateral extent of chromium is defined.

4.1.9.3 Proposed Sampling and Soil Removal at AOC C-03-006

Shallow subsurface samples will be collected at four previously sampled locations (MO-604990, MO-604991, MO-604992, and MO-604993), extending the depths at these locations to define the vertical extent of chromium. Samples will be analyzed for chromium only.

The proposed sampling and analyses at AOC C-03-006 are presented in Table 4.1-9, and the proposed sampling locations are shown in Figure 4.1-15.

4.2 TA-35

TA-35 is located northeast of the intersection of Pajarito Road and Pecos Drive. The structures at TA-35 are located on a finger mesa between Mortandad Canyon on the north and Ten Site Canyon, a tributary of Mortandad Canyon, on the south.

4.2.1 AOC 35-016(g), Drain and Outfall from Building 35-213

4.2.1.1 Site Description and Operational History

AOC 35-016(g) is a former NPDES outfall (04A127) established in 1979 to handle reverse-osmosis discharge and cooling tower blowdown from room 29 in building 35-213, the Target Fabrication Facility (Figure 4.2-1). The outfall was removed from the NPDES permit in September 1997 (EPA 1997, 109528). The former NPDES outfall now handles only cooling tower blowdown from the same room. The drainage runs approximately 100 ft north to its point of discharge on the south rim of Mortandad Canyon.

4.2.1.2 Previous Investigations

In1997 and 2009, a total of 21 samples (13 sediment and 8 tuff) were collected from 11 locations at AOC 35-016(g). Previously sampled locations are shown in Figure 4.2-1. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In March 1995, an RFI was conducted at AOC 35-016(g), and the samples collected were submitted for analysis of inorganic chemicals, organic chemicals, and radionuclides. The sampling results are screening-level results based on current data quality standards but were reported in a RFI report (LANL 1996, 054422). Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

In 1997, additional sampling was conducted at AOC 35-016(g). Eleven samples from six locations were collected and submitted for analysis of inorganic chemicals, organic chemicals, and radionuclides.

Sampling at AOC 35-016(g) consisted of the following activities in 2009:

- Sediment and tuff samples were collected at five locations from two depth intervals: the surface-sediment interval and the sediment-tuff-interface interval.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, SVOCs, gamma-emitting radionuclides, and tritium.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 53), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at AOC 35-016(g), except for the vertical extent of chromium at locations MO-604933 and MO-604935 (Figure 4.2-2); the vertical extent of cesium-137 at locations MO-604933, MO-604936, and MO-604937; and the lateral extent of cesium-137 in the drainage at location MO-604937 (Figure 4.2-3).

4.2.1.3 Proposed Sampling at AOC 35-016(g)

Shallow subsurface samples will be collected at four previously sampled locations (MO-604933, MO-604935, MO-604936, and MO-604937), extending the depths at these locations to define the vertical extent of chromium and cesium-137. Samples at location MO-604933 will be analyzed for chromium and cesium-137 only. Samples at location MO-604935 will be analyzed for chromium only. Samples at locations MO-604936 and MO-604937 will be analyzed for cesium-137 only.

One new sampling location (16g-1) will be placed downgradient of existing location MO-604937 to define the lateral extent of cesium-137. Samples at location 16g-1 will be analyzed for cesium-137.

The proposed sampling and analyses at AOC 35-016(g) are presented in Table 4.2-1, and the proposed sampling locations are shown in Figure 4.2-1.

4.2.2 AOC 35-016(h), Storm Drains and Outfalls Associated with Building 35-213

4.2.2.1 Site Description and Operational History

AOC 35-016(h) consists of three storm drains located north of building 35-213 (Figure 4.2-1). The storm drains were installed in 1979 to handle stormwater runoff from roof drains of building 35-213, runoff from the nearby parking lot, and discharge from a water deionizer in building 35-213. The drain from the water deionizer was rerouted to the RLW drain system in the mid-1990s and no longer discharges to the stormwater system.

The storm drain that handles the runoff from roof drains is located on the north side of building 35-213. The storm drain that used to handle discharge from the water deionizer is located on the northeast side of building 35-213. This storm drain currently handles only stormwater runoff from the area around building 35-213. The third storm drain that handles stormwater from the nearby parking lot is located northwest of building 35-213. All three storm drains discharge into Mortandad Canyon.

4.2.2.2 Previous Investigations

In 1997 and 2009, a total of 23 samples (11 sediment, 1 fill, and 11 tuff) were collected from 11 locations at AOC 35-016(h). Previously sampled locations are shown in Figure 4.2-1. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In March 1995, an RFI was conducted at AOC 35-016(h), and the samples collected were submitted for analysis of inorganic chemicals, organic chemicals, and radionuclides. The sampling results are screening-level data based on the current data quality standard but were reported in a RFI report (LANL 1996, 054422).

In 1997, additional sampling was conducted at AOC 35-016(h). Three samples were collected from one location and submitted for analysis of inorganic chemicals, organic chemicals, and radionuclides. Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at AOC 35-016(h) consisted of the following activities in 2009:

- Sediment samples were collected at 10 locations from two depth intervals: the surface-sediment interval and the sediment-tuff interface interval.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, SVOCs, gamma-emitting radionuclides, and tritium.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 55), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at AOC 35-016(h), except for the vertical extent of chromium at locations 35-02392, MO-605136, MO-605515, MO-605518, and MO-605520 and the vertical extent of hexavalent chromium at locations MO-605136, MO-605515, and MO-605518, (Figure 4.2-4). The lateral extent of chromium downgradient of locations MO-605136, MO-605520, and MO-605516 and the lateral extent of PAHs downgradient of location MO-605516 are also not defined (Figure 4.2-5).

4.2.2.3 Proposed Sampling at AOC 35-016(h)

Shallow subsurface samples will be collected at six previously sampled locations (35-02392, MO-605136, MO-605515, MO-605518, and MO-605520), extending the depths at these locations to define the vertical extent of chromium. Samples at these locations will be analyzed for chromium. Shallow subsurface samples will be collected at three previously sampled locations (MO-605136, MO-605515, and MO-605518), extending the depths at these locations to define the vertical extent of hexavalent chromium. Samples at these locations will be analyzed for hexavalent chromium.

Three new sampling locations (16h-1, 16h-2, and 16h-3) will be placed downgradient of existing sampling locations to define the lateral extent of chromium and PAHs. Samples from location 16h-1 and 16h-2 will be analyzed for chromium only. Samples from location 16h-3 will be analyzed for chromium and PAHs.

The proposed sampling and analyses at AOC 35-016(h) are presented in Table 4.2-2, and the proposed sampling locations are shown in Figure 4.2-1.

4.3 Former TA-42

Former TA-42, now within the current boundaries of TA-55, was located north of Pajarito Road and Pecos Drive on a narrow mesa formed between Mortandad Canyon on the north and Twomile Canyon on the south. The former TA was near the north edge of the mesa next to the steep slope of the Mortandad Canyon wall.

4.3.1 Consolidated Unit 42-001(a)-99, Former TA-42 Incinerator Complex

4.3.1.1 Site Description and Operational History

Consolidated Unit 42-001(a)-99 consists of SWMUs 42-001(a,b,c), 42-002(b), and 42-003 and AOC 42-002(a) (Figure 4.3-1). These sites are associated with the former TA-42 radioactive waste incinerator that was constructed in 1951 and shut down in 1952. From 1957 to 1969, this incinerator facility was used to store and decontaminate radioactively contaminated equipment. In 1969, an unsuccessful attempt was made to reactivate the incinerator to burn uncontaminated classified wastes. By 1970, all operations were discontinued, and all combustibles were removed from the building. The facility was decommissioned in 1977, and the site was decontaminated in 1978 (LANL 1990, 007513).

SWMU 42-001(a) is the historical location of former building 42-1 that housed the incinerator. Former building 42-1 was a 2000-ft^2 steel-frame structure covered with corrugated metal. The building contained the incinerator, a cyclone dust collector, a spray cooler, a Venturi scrubber, a filter bank, and an ash separator. Combustion products passed through an off-gas cleanup system before they were released through an exhaust stack. The off-gas system consisted of a Venturi scrubber, a filter bank, and an ash separator. Ash trapped in the off-gas system and incinerator was transported by underground drainlines to two holding tanks [SWMUs 42-001(b) and 42-001(c)] located immediately north of the incinerator (LANL 1992, 007666). Building 42-1 and its concrete foundation were removed in 1978 (LANL 1995, 050056, p. 23).

SWMUs 42-001(b) and 42-001(c) are the historical locations of two former aboveground ash-holding tanks (former structures 42-2 and 42-3, respectively) that were associated with the incinerator complex. Each tank was 22 ft in diameter and approximately 13 ft high, with a volume of 37,000 gal. The tanks were built in 1951 and removed in 1978. When the tanks were decommissioned in 1978, the contents were assayed and measured for plutonium. Contaminated sludge was removed, mixed with cement, and taken to Area G for storage. The tanks were excavated and disposed of at MDA G. The tank drainlines were filled with asphalt to contain radioactive contamination. It is not known if the drainlines were removed (LANL 1992, 007666).

AOC 42-002(a) is the historical location of an indoor storage (former building 42-1) and decontamination area. Between 1956 and 1969, the main floor of former building 42-1 was used to store and decontaminate equipment.

SWMU 42-002(b) is the location of a historical outdoor decontamination area. Objects (such as vehicles) that were too large to decontaminate inside building 42-1 were decontaminated at the end of the asphalt driveway located west and north of building 42-1. Wash water from decomtamination activities flowed down the embankment on the northwest side of the parking lot. Potentially contaminated soil in that area was not addressed during the 1978 decontamination and decommissioning (D&D) activities (LANL 1992, 007666).

SWMU 42-003 is the historical location of a former septic system that served the former incinerator building (structure 42-1). The septic system was installed in 1951 and consisted of a 565-gal. septic tank (structure 42-4), a drainline from building 42-1 to the tank, a filter trench, a leach field, and an outfall to Mortandad Canyon. The septic tank received RLW from building 42-1. According to the 1992 work plan, the system probably also received solvents, acids, and grease (LANL 1992, 007666). Contaminated liquids were removed periodically from the septic tank and disposed of in Pit 4 at MDA L. Samples collected in Mortandad Canyon in 1952 downstream of former TA-42 showed radioactive contamination in the canyon. In 1973, the septic tank was observed to contain water and possibly may have overflowed (LANL 1992, 007666). Also in 1973, the tank slurry was sampled and found to be radioactively contaminated. The septic system and associated contaminated soil were removed as part of 1978 D&D activities (Harper and Garde 1981, 006286). Before the tank was removed, liquid in the tank was pumped and transported to the TA-50 RLWTF [SWMU 50-001(a)] for treatment. Tank sludge was solidified by adding cement, the tank and sludge were disposed of at MDA G, and the excavated area was backfilled. In addition, contaminated soil in the drain field was excavated (LANL 1992, 007666).

4.3.1.2 Previous Investigations

In 1992 and 2009, a total of 169 samples (53 soil or fill, 12 sediment, and 104 tuff) were collected from 44 locations at Consolidated Unit 42-001(a)-99. Previously sampled locations are shown in Figure 4.3-1. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

After D&D activities were conducted at the site in 1978, the Environmental Surveillance Group collected soil samples and analyzed them for radionuclides. Although low levels of contamination were found, the concentrations met regulatory standards at that time. After concurrence from DOE's Los Alamos Area Office, the area was contoured and revegetated to minimize erosion (LANL 1992, 007666).

In 1991, the Environmental Protection Group performed a reconnaissance study and collected soil samples that were analyzed for radionuclides, PCBs, SVOCs, VOCs, and metals. These results are screening-level data based on current data-quality validation standards.

In 1992, an RFI was conducted at the historical locations of Consolidated Unit 42-001(a)-99 to determine whether potential contamination at the site would be exposed during construction of a new facility. Sampling locations were selected to bound the extent of contamination detected during the 1991 reconnaissance study and to include locations where construction activities might adversely affect residual contamination around proposed structures or utility lines. Forty samples collected were submitted for analysis of various combinations of americium-241, isotopic plutonium, isotopic thorium, isotopic uranium, and TAL metals. The RFI activities and results were presented in the RFI report (LANL 1995, 050056). Decision-level data from the 1992 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at Consolidated Unit 42-001(a)-99 consisted of the following activities in 2009:

- Soil and tuff samples were collected at 18 locations from six depth intervals: the surface interval, the soil-tuff-interface interval, and the intervals beginning 5 ft, 10 ft, 20 ft, and 30 ft below the soil-tuff interface.
- In the backfilled area in the southeast corner of the site, fill and tuff samples were collected at two locations from four depth intervals: the fill/tuff interface interval and the intervals beginning 10 ft, 20 ft, and 30 ft below the soil-tuff interface.
- Sediment samples were collected at seven locations from two depth intervals: the surface-sediment interval within the drainage and the sediment-tuff-interface interval.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, PCBs, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), explosive compounds, dioxins and furans, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 59), the vertical extent of tritium in the mesa-top portion of the site is not defined at location MO-605054 (Plate 7). The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at Consolidated Unit 42-001(a)-99.

4.3.1.3 Proposed Sampling at Consolidated Unit 42-001(a)-99

Subsurface samples will be collected at previously sampled location MO-605054, extending the depth at this location to define the vertical extent of tritium. Samples will be collected to a total depth of 62.5 ft bgs and will be analyzed for tritium only.

The proposed sampling and analyses at Consolidated Unit 42-001(a)-99 are presented in Table 4.3-1, and the proposed sampling location is shown in Figure 4.3-1.

4.4 TA-48

TA-48 was established in 1957 for work in radiochemistry. Initially, the major work was to study samples from bomb tests; however, that work evolved into other types of studies related to weapon tests, research in geochemistry and radiochemistry, and production of radioisotopes for nuclear medicine (DOE 1987, 008663; DOE 1987, 008664; LANL 1992, 007666). TA-48 facilities also have historically been and are currently used to study the nuclear properties of radioactive materials using analytical and physical chemistry. Measurements of radioactive substances are performed, and hot cells are used for remote handling of radioactive materials (LANL 1988, 000344; LANL 1992, 007666).

4.4.1 AOC 48-001, Air Exhaust System

4.4.1.1 Site Description and Operational History

AOC 48-001 consists of the air exhaust system at the main radiochemistry laboratory in building 48-1 and surface and near-surface soil potentially impacted by deposition from the stack emissions (Figure 4.4-1). The radiochemistry laboratory in building 48-1 was constructed in 1957 to analyze samples collected from nuclear weapons tests. Currently, radiochemical analyses are conducted at building 48-1 to support a variety of programs. The building's exhaust system consists of nine stacks. Three stacks exhaust unfiltered discharges from chemical hoods, three stacks are associated with combustion boilers, one stack exhausts individually filtered glove boxes, one stack exhausts filtered air from hot cell laboratories, and one stack exhausts air from a welding and degreasing booth. Discharges from the chemical hoods are not filtered because the chemicals used in the hoods (e.g., perchloric acid) degrade filters. However, these hoods are equipped with wet scrubbers. The glove box stack (stack FE54) is permitted and monitored under the National Emissions Standards for Hazardous Air Pollutants Program of the Clean Air Act. According to the RFI work plan, monitoring data are available for stack FE54 beginning in 1967 for plutonium and beginning in 1974 for uranium and fission products (LANL 1992, 007666). These data indicate releases of plutonium, uranium, and fission products, primarily cesium-137, cerium-144, and strontium-90.

4.4.1.2 Previous Investigations

In 1993, 1997, and 2009, a total of 186 samples (103 soil or fill, 61 sediment, and 22 tuff) were collected from 119 locations at AOC 48-001. Previously sampled locations are shown in Figure 4.4-1. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 1991, samples were collected east and northwest of building 48-1. These samples contained elevated levels of alpha radioactivity, with surface samples slightly exceeding DOE-guideline levels. Organic chemicals were detected at low concentrations.

In 1993, a Phase I RFI was conducted at AOC 48-001 to determine the presence of soil contamination associated with discharges from the air exhaust system. The EPA computer model, AIRDOS, was used to estimate the areal extent of potential contamination based on historical stack release data. This area was surveyed for radioactivity and organic vapors. Radiation levels were at background levels, and organic vapors were not detected. Samples were collected to the north and east of building 48-1. All samples were field screened for radioactivity and organic chemicals and were submitted for analysis of inorganic vapors, radionuclides, and organic chemicals using a combination of fixed and mobile laboratories. The RFI activities and results were presented in the RFI report (LANL 1995, 050289). An additional 67 samples were collected from 31 locations in a 1997 RFI. Decision-level data from the 1993 and 1997 investigations are included in the investigation report (LANL 2010, 109180.28).

Sampling at AOC 48-001 consisted of the following activities in 2009:

- Soil samples were collected at nine locations from the surface-soil interval (0–0.5 ft bgs).

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, total cyanide, PCBs, SVOCs, dioxin and furans, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic thorium, isotopic uranium, strontium-90, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 63), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at AOC 48-001, except for the lateral extent of total cyanide at location MO-604942 (Plate 8).

4.4.1.3 Proposed Sampling at AOC 48-001

Surface samples will be collected at two new sampling locations (1-1 and 1-2) to define the lateral extent of total cyanide upgradient and downgradient of previously sampled location MO-604942 near the southwest corner of building 48-1. Samples from the new sampling locations will be analyzed for total cyanide only.

The proposed sampling and analyses at AOC 48-001 are presented in Table 4.4-1, and the proposed sampling locations are shown in Figure 4.4-1.

4.4.2 SWMU 48-002(a), Container Storage Area

4.4.2.1 Site Description and Operational History

SWMU 48-002(a) consists of a former container storage area located at the south end of the main radiochemistry laboratory (building 48-1) (Figure 4.4-2). The storage area was located against the south wall of building 48-1 on an area of soil between the building and an asphalt roadway. An inspection of SWMU 48-002(a) in 1986 noted the presence of approximately 200 rusty flasks in decayed and broken wooden-frame holders (Perkins 1986, 000808). Each of the flasks reportedly held about 2 qt of high-purity mercury. The flasks are estimated to have been present at SWMU 48-002(a) since about 1976 and were removed from the site in 1989 (LANL 1990, 007513). The RFI work plan reports that available documentation contained no indication of any spills or leaks associated with this site (LANL 1992, 007666).

4.4.2.2 Previous Investigations

In 1993, 1995, and 2009, a total of 56 samples (17 fill and 39 tuff) were collected from 16 locations at SWMUs 48-002(a) and 48-002(b). Previously sampled locations are shown in Figure 4.4-2. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

A Phase I RFI was conducted at SWMUs 48-002(a) and 48-002(b). In July 1993, five sampling locations were hand-augered to 8 ft, and soil samples were collected at 1-ft intervals. In addition, one surface soil sample was collected. All samples were submitted for analysis of metals, radionuclides, SVOCs, and VOCs using a combination of fixed and mobile laboratories. In October 1993, six surface soil samples were collected to evaluate possible mercury migration from the SWMU. Based on the results of the Phase I sampling for SWMUs 48-002(a) and 48-002(b), an expedited cleanup (EC) plan was prepared (LANL 1995, 046092.38).

In 1995, an EC was implemented at SWMUs 48-002(a) and 48-002(b). The EC involved developing soil cleanup levels for mercury and PAHs; soil sampling and analysis to delineate the area exceeding cleanup levels; excavation of soil contaminated above cleanup levels; confirmation sampling; and site restoration (backfilling, grading, and revegetation). The area of soil to the east of SWMU 48-002(a) was excavated during the cleanup (LANL 1995, 050289). Decision-level data from the 1993 investigation and the 1995 EC are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMUs 48-002(a) and 48-002(b) consisted of the following activities in 2009:

- Soil and tuff samples were collected at 13 locations from three or four depth intervals: the surface interval, soil-tuff-interface interval, the interval beginning 5 ft below the soil-tuff interface, and the interval beginning 10 ft below the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, PCBs, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 65), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMUs 48-002(a) and 48-002(b), except for the vertical extent of perchlorate at locations MO-604925 and MO-604932 (Figure 4.4-3).

4.4.2.3 Proposed Sampling at SWMU 48-002(a)

Subsurface samples will be collected at two previously sampled locations (MO-604925 and MO-604932), extending the depths at these locations to define the vertical extent of perchlorate. Samples will be analyzed for perchlorate only.

The proposed sampling and analyses at SWMUs 48-002(a) and 48-002(b) are presented in Table 4.4-2, and the proposed sampling locations are shown in Figure 4.4-2.

4.4.3 SWMU 48-002(b), Container Storage Area

4.4.3.1 Site Description and Operational History

SWMU 48-002(b) consists of a former container storage area located at a loading dock on the south side of the main radiochemistry laboratory (building 48-1) (Figure 4.4-2). The storage area was located against the south wall of building 48-1, near the southeast corner of the building. A 1986 inspection of SMWU 48-002(b) noted the presence of labeled and unlabeled drums and evidence of spills and leaks (Perkins 1986, 000808). Spills from leaky drums were also observed at the site during a November 1988 field survey (LANL 1990, 007513). The date the materials began to be stored at this site is not known, and no evidence was found that the site was managed as a formal container storage area. All materials were removed from the site by July 1991 (LANL 1992, 007666).

4.4.3.2 Previous Investigations

The summary of previous investigations at SWMU 48-002(b) is presented in the discussion of SWMU 48-002(a) in section 4.4.2.2.

4.4.3.3 Proposed Sampling at SWMU 48-002(b)

Proposed sampling for SWMU 48-002(b) is described in section 4.4.2.3 for SWMU 48-002(a).

4.4.4 SWMU 48-003, Septic System

4.4.4.1 Site Description and Operational History

SWMU 48-003 consists of a former septic system that served TA-48 from 1957 to 1986. This septic system consisted of a septic tank (former structure 48-5), a dosing chamber, a filter bed (former structure 48-6), and an outfall that discharged into Mortandad Canyon (Figure 4.4-4). The septic tank and dosing chamber were 21 ft 7 in. long and the filter bed measured 81 ft 2 in. long × 40 ft 7 in. wide. The septic system operated until 1986, at which time the septic tank and filter bed were decommissioned and removed (LANL 1990, 007513). A laboratory and diagnostics facility (building 48-45) was constructed over the site of the septic tank and filter bed. After the septic system was decommissioned, sanitary wastewater from TA-48 was sent to the sanitary lagoons at TA-35 and later to the consolidated treatment plant at TA-46. Although this septic system primarily received sanitary wastewater from TA-48 facilities, the system reportedly received hazardous and radioactive materials through accidental discharges (LANL 1992, 007666).

4.4.4.2 Previous Investigations

In 1993, 1997, and 2009, a total of 115 samples (21 soil or fill, 20 sediment, and 74 tuff) were collected from 34 locations at SWMU 48-003. Previously sampled locations are shown in Figure 4.4-4. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 1993, a Phase I RFI was conducted to determine the presence of surface and subsurface contamination at the former location of the septic system. A radiation survey conducted in this area determined that radiation levels were at background levels. Surface and subsurface samples were collected. All samples were field screened for radioactivity and organic vapors and submitted for analysis of inorganic chemicals, radionuclides, and organic chemicals using a combination of fixed and mobile laboratories. The RFI activities and results were presented in the RFI report (LANL 1995, 050289). Decision-level data from the 1993 RFI are included in the investigation report (LANL 2010, 109180.28).

Based on the responses to NMED's review of the Phase I RFI report (LANL 1996, 054448; LANL 1996, 055064), a sampling and analysis plan (SAP) was prepared to collect additional samples for analysis of metals, radionuclides, and SVOCs (LANL 1997, 055326). Ten samples were collected from five locations in 1997, as directed by the SAP, but these data have not been reported previously. Decision-level data from the 1997 RFI are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 48-003 consisted of the following activities in 2009:

- Soil and tuff samples were collected at 15 locations on the mesa top from five depth intervals: the surface interval, the soil-tuff-interface interval, the intervals beginning 5 ft, 10 ft, and 15 ft below the soil-tuff interface.
- Sediment and tuff samples on the slope (sediment pockets) were collected at four locations from two depth intervals: the surface-sediment interval and the sediment-tuff-interface interval.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, americium-241, isotopic plutonium, isotopic thorium, isotopic uranium, strontium-90, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 71), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 48-003, except for the vertical extent of strontium-90 at locations 48-02136 and 48-02140 (Figure 4.4-5).

4.4.4.3 Proposed Sampling at SWMU 48-003

Shallow subsurface samples will be collected at two previously sampled locations (48-02136 and 48-02140), extending the depths at these locations to define the vertical extent of strontium-90. Samples will be analyzed for strontium-90 only.

The proposed sampling and analyses at SWMU 48-003 are presented in Table 4.4-3, and the proposed sampling locations are shown in Figure 4.4-4.

4.4.5 SWMU 48-007(b), Cooling Tower Outfall from Building 48-1

4.4.5.1 Site Description and Operational History

SWMU 48-007(b) is an outfall that formerly discharged noncontact cooling water used to cool a magnet and laser housed in the main radiochemistry laboratory (building 48-1) (Figure 4.4-6). This outfall is located north of building 48-1 and formerly discharged up to 4300 gal./d of cooling water. Water discharged from the outfall flowed into Mortandad Canyon (LANL 1992, 007666). This outfall formerly operated as an NPDES-permitted outfall (016 EPA 04A) but was removed from the NPDES permit on September 19, 1997, because industrial wastewater discharges were discontinued. Presently, the outfall receives only stormwater (LANL 2007, 098955).

4.4.5.2 Previous Investigations

In 1997 and 2009, a total of 28 samples (4 soil, 8 sediment, and 16 tuff) were collected from 10 locations at SWMU 48-007(b). Previously sampled locations are shown in Figure 4.4-6. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 1993, a Phase I RFI was conducted at SWMU 48-007(b). The outfall location was surveyed for radiation and organic vapors. The results indicated radiation levels were at background levels, and organic vapors were not detected. Samples were collected and were field screened for radioactivity and organic vapors and submitted for analysis of inorganic chemicals and radionuclides using a combination of fixed and mobile laboratories. The sampling results are screening-level results based on current data quality standards but were reported in the RFI report (LANL 1995, 050289).

In 1997, four additional soil samples were collected from two locations at SWMU 48-007(b) and submitted for laboratory analysis of gamma-emitting radionuclides. The RFI activities and results were presented in the RFI report (LANL 1997, 056565). Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 48-007(b) consisted of the following activities in 2009:

- Soil and tuff samples were collected at four locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 2 ft below the soil-tuff interface at locations downgradient of the outfall.

- Soil and tuff samples were collected at four locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 2 ft below the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, gamma-emitting radionuclides, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 84), the vertical extent of aluminum (location MO-605111); chromium (locations MO-605110 and MO-605114); hexavalent chromium (location MO-605112); lead (location MO-605114); nickel (location MO-605111); perchlorate (locations MO-605111, MO-605116, and MO-605117); and vanadium (location MO-605111) is not defined (Figure 4.4-7). The investigation report stated that the vertical extent of iron is not defined. However, in reviewing the data all concentrations of iron (Figure 4.4-7) are less than the maximum Qbt 2, 3, and 4 background concentration (19,500 mg/kg). Therefore, the vertical extent of iron is defined. The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 48-007(b).

4.4.5.3 Proposed Sampling at SWMU 48-007(b)

Shallow subsurface samples will be collected at five previously sampled locations (MO-605111, MO-605112, MO-605114, MO-605116, and MO-605117), extending the depths to define the vertical extent of aluminum, chromium, hexavalent chromium, lead, nickel, perchlorate, and vanadium. The samples collected at location MO-605111 will also serve to define vertical extent at location MO-605110, which is 5 ft upgradient of location MO-605111. Samples from location MO-605111 will be analyzed for aluminum, chromium, nickel, perchlorate, and vanadium. Samples from location MO-605112 will be analyzed for hexavalent chromium only. Samples from location MO-605114 will be analyzed for chromium and lead only. Samples from location MO-605116 and MO-605117 will be analyzed for perchlorate only.

The proposed sampling and analyses at SWMU 48-007(b) are presented in Table 4.4-4, and the proposed sampling locations are shown in Figure 4.4-6.

4.4.6 SWMU 48-007(c), Floor Drain Outfall from Building 48-1

4.4.6.1 Site Description and Operational History

SWMU 48-007(c) is an outfall that previously received discharges from nine floor drains, a trench drain, and six roof drains at building 48-1 (Figure 4.4-8). This outfall is located north of building 48-1 and discharges into Mortandad Canyon (LANL 1992, 007666). Former sources of discharge to the floor drains included floor washings, backflow preventers, drainage and condensate from a vacuum pump, steam condensate, a boiler drain, a fire drain, and a water-heater pressure-relief valve. This outfall previously operated as an NPDES-permitted outfall (131 EPA 04A) but was removed from the NPDES permit on January 14, 1998, because industrial wastewater discharges were discontinued (LANL 1997, 056565). Currently, this outfall receives only stormwater.

4.4.6.2 Previous Investigations

In 1997 and 2009, a total of 27 samples (4 soil, 10 sediment, and 13 tuff) were collected from 10 locations at SWMU 48-007(c). Previously sampled locations are shown in Figure 4.4-8. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 1993, a Phase I RFI was conducted at SWMU 48-007(c) to determine the presence of contamination associated with former discharges to the outfall. The outfall location was surveyed for radiation and organic vapors. The survey determined radiation levels to be at background, and no organic vapors were detected. Samples were collected and were field screened for radioactivity and organic vapors and were submitted for analysis of inorganic chemicals and radionuclides using a combination of fixed and mobile laboratories. The RFI activities and results were presented in the RFI report (LANL 1995, 050289).

In 1997, additional soil samples were collected at SWMU 48-007(c) and submitted for laboratory analysis of radionuclides. The RFI activities and results were presented in the RFI report (LANL 1997, 056565). Decision-level data from the 1993 and 1997 investigations are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 48-007(c) consisted of the following activities in 2009:

- Soil and tuff samples were collected at four locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 2 ft below the soil-tuff interface at locations downgradient of the outfall.
- Soil and tuff samples were collected at two locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 2 ft below the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, gamma-emitting radionuclides, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 88), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 48-007(c), except for the vertical extent of chromium at locations MO-605163 and MO-605164 and the lateral and vertical extent of lead at location MO-605165 (Figure 4.4-9).

4.4.6.3 Proposed Sampling at SWMU 48-007(c)

Shallow subsurface samples will be collected at previously sampled locations MO-605163 and MO-605164, extending the depth at these locations to define the vertical extent of chromium. Samples from these locations will be analyzed for chromium.

Shallow subsurface samples will be collected at previously sampled location MO-605165, extending the depth at this location to define the vertical extent of lead. Samples from location MO-605165 will be analyzed for lead only.

Surface and shallow subsurface samples will be collected at a new sampling location (7c-1), downgradient of previously sampled location MO-605165, to define the lateral extent of lead to the toe of the slope. Samples from location 7c-1 will be analyzed for lead.

The proposed sampling and analyses at SWMU 48-007(c) are presented in Table 4.4-5, and the proposed sampling locations are shown in Figure 4.4-8.

4.4.7 SWMU 48-007(f), Outfall from Building 48-46

4.4.7.1 Site Description and Operational History

SWMU 48-007(f) is an inactive outfall that formerly received discharges from two sink drains in an office and laboratory building (48-46). This outfall is located northwest of building 48-1 (Figure 4.4-10) and discharged into Mortandad Canyon (LANL 1992, 007666). In approximately 1993, the outfall ceased to operate. This outfall formerly operated as an NPDES-permitted outfall (137 EPA 04A) but was removed from the NPDES permit on December 6, 1995.

4.4.7.2 Previous Investigations

In 1997 and 2009, a total of 28 samples (6 soil, 5 sediment, and 17 tuff) were collected from 10 locations at SWMU 48-007(f). Previously sampled locations are shown in Figure 4.4-10. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 1993, a Phase I RFI was conducted at SWMU 48-007(f) to determine the presence of contamination associated with discharges to the outfall. The outfall location was surveyed for radiation and organic vapors. The survey results indicated radiation was at background levels and organic vapors were not detected. Samples were collected and were field screened for radioactivity and organic vapors and submitted for analysis of inorganic chemicals and radionuclides using a combination of fixed and mobile laboratories. These results are screening-level data based on current data-quality validation standards, but the results were reported in the RFI report (LANL 1995, 050289).

In 1997, additional soil samples were collected at SWMU 48-007(f) and analyzed for radionuclides. The RFI activities and results were presented in the RFI report (LANL 1997, 056565). Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 48-007(f) consisted of the following activities in 2009:

- Soil and tuff samples were collected at four locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 2 ft below the soil-tuff interface at locations downgradient of the outfall.
- Soil and tuff samples were collected at four locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 2 ft below the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, gamma-emitting radionuclides, tritium, isotopic uranium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 90), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 48-007(f), except for the lateral and vertical extent of chromium (at locations MO-605097, MO-605099, MO-605100, MO-605101, and MO-605103) and the vertical extent of barium (at location MO-605097) (Figure 4.4-11).

4.4.7.3 Proposed Sampling at SWMU 48-007(f)

Shallow subsurface samples will be collected at five previously sampled locations (MO-605097, MO-605099, MO-605100, MO-605101, and MO-605103), extending the depth at these locations to define

the vertical extent of chromium. Samples from these locations will be analyzed for chromium. Samples from location MO-605097 will also be analyzed for barium.

Surface and shallow subsurface samples will be collected at a new sampling location (7f-1), downgradient of previously sampled location MO-605104, to define the lateral extent of chromium to the toe of the slope. Samples from location 7f-1 will be analyzed for chromium only.

The proposed sampling and analyses at SWMU 48-007(f) are presented in Table 4.4-6, and the proposed sampling locations are shown in Figure 4.4-10.

4.4.8 AOC 48-011, Radiation Detector Disposal Shaft

4.4.8.1 Site Description and Operational History

AOC 48-011 consists of a 3-ft-diameter x 65-ft-deep shaft drilled in 1976 or 1977 into the tuff on the east side of building 48-1 (Figure 4.4-12) for use in radiation-counting experiments. As part of these experiments, a 2-ft-diameter x 3-ft-long stainless-steel cylinder containing a sodium-iodide radiation detector was lowered into the shaft. This cylinder also contained approximately 3000 lb of lead shielding. As the cylinder was being lowered into the shaft, the cable broke and the cylinder fell to the bottom of the shaft. Because efforts to retrieve the cylinder were unsuccessful, it was left in place and covered (LANL 1992, 007666).

4.4.8.2 Previous Investigations

In 2009, a total of four tuff samples were collected from one location at AOC 48-011 (Figure 4.4-12). The sampling results are presented in the investigation report (LANL 2010, 109180.28).

Sampling at AOC 48-011 consisted of the following activities in 2009:

- Tuff samples were collected at one location from four depth intervals: the intervals beginning at 65 ft bgs, 75 ft bgs, 85 ft bgs and 100 ft bgs.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, gamma-emitting radionuclides, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 92), the vertical extent of all inorganic chemicals, organic chemicals, and radionuclides is defined at AOC 48-011. Lateral extent was not evaluated because only one location was sampled, as directed by the approved work plan (LANL 2008, 100750; NMED 2008, 101110).

4.4.8.3 Proposed Sampling at AOC 48-011

Subsurface samples will be collected at a new sampling location (11-1) to define the lateral extent of inorganic chemicals, organic chemicals, and radionuclides. The new location will be placed downgradient and to the east of the shaft and southeast of previously sampled location MO-605351. Samples from location 11-1 will be analyzed for TAL metals, nitrate, cyanide, perchlorate, SVOCs, VOCs, PCBs, dioxins and furans, gamma-emitting radionuclides, and tritium.

The proposed sampling and analyses at AOC 48-011 are presented in Table 4.4-7, and the proposed sampling location is shown in Figure 4.4-12.

4.5 TA-50

TA-50 is located immediately northeast of the intersection of Pajarito Road and Pecos Drive and occupies an area of approximately 21 acres: 11.8 acres are associated with MDA C and 8.7 acres are associated with the RLWTF. MDA C was used from 1948 until it was decommissioned in 1974 and consists of pits and shafts that received radioactive and hazardous wastes. Treatment facilities include the RLWTF and associated waste transfer and storage systems, equipment-decontamination areas, and solid waste volume-reduction facilities.

4.5.1 Consolidated Unit 50-004(a)-00, Historical Waste Lines and Underground Vault

4.5.1.1 Site Description and Operational History

Consolidated Unit 50-004(a)-00 (Figure 4.5-1) consists of SWMUs 50-004(a,b,c), which are former components and one existing component (waste line 56) of the TA-50 RLWTF.

SWMU 50-004(a) consists of the locations of former underground RLW and industrial waste lines. These waste lines routed wastes to the TA-50 RLWTF from TAs located along Pajarito Road. Most of these waste lines were decommissioned and removed in 1975, when excavated soil was characterized for radioactive constituents and remediated to meet regulatory levels (LANL 1992, 007672).

SWMU 50-004(b) is the location of a decommissioned underground vault (former structure 50-3) that housed three stainless-steel-lined concrete storage tanks. The tanks, ranging in volume from 1000 to 4500 gal., were used to collect and store wastewater from the former Omega Reactor at TA-02. Waste lines to this tank vault included waste line 49 from TA-35 and waste line 50 from building 50-1. Waste line 49, the vault, and the tanks were removed in 1989. Soil sampled during decommissioning was screened for radionuclides and chemical constituents. No elevated concentrations were detected (LANL 1992, 007672).

SWMU 50-004(c) consists of 13 industrial waste lines (lines 44, 45, 45a, 46, 47, 48, 48a, 49, 54, 55, 56, 65, and 67) and 3 associated manholes (structures 50-6, 50-55, and 50-56) that discharged to the decommissioned underground tank vault (former structure 50-3). With the exception of waste line 56, all waste lines and manholes associated with the underground vault [SWMU 50-004(b)] were removed between 1981 and 1989 (Elder et al. 1986, 006666; LANL 1992, 007672). Waste line 56 remains in service. Radionuclide contamination encountered during decommissioning of the waste lines and manholes was remediated to regulatory levels through removal of the pipe and soil to approximately 19 ft bgs. Field screening for radionuclides confirmed regulatory levels were met (LANL 1992, 007672).

4.5.1.2 Previous Investigations

In 1994 and 2009, a total of 156 samples (57 soil or fill, 1 sediment, and 98 tuff) were collected from 58 locations at Consolidated Unit 50-004(a)-00. Previously sampled locations are shown in Figure 4.5-1. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 1994, an RFI was conducted at SWMUs 50-004(a) and 50-004(c) with the objective of determining the presence of radionuclides and hazardous constituents from historical operational releases. During the RFI at SWMU 50-004(a), a 520-ft length of the original 6-in. vitrified clay pipe waste line trench and the manholes were investigated. Five vertical boreholes located approximately 100 ft apart were advanced along the waste line trench. Eleven samples collected from the five boreholes at SWMU 50-004(a) were field screened for radionuclides and organic vapors. Radionuclide-screening results were all at or near

background levels. The samples were submitted to an off-site laboratory for analysis of inorganic chemicals, organic chemicals, and radionuclides.

In 1994, 67 samples were collected from depths up to approximately 14 ft at 29 locations at SWMU 50-004(c). Samples were field screened for radionuclides and organic vapors and submitted for off-site laboratory analysis of organic chemicals, inorganic chemicals, and radionuclides. The RFI activities and results were presented in the RFI report (LANL 1996, 054836).

In 2003, additional samples were collected at SWMUs 50-004(a) and 50-004(c) and analyzed for metals, radionuclides, PCBs, pesticides, SVOCs, TPH-DRO, and VOCs (LANL 2005, 087834). Decision-level data from the 1994 and 2003 investigation activities are included in the investigation report (LANL 2010, 109180.28).

Sampling at Consolidated Unit 50-004(a)-00 consisted of the following activities in 2009:

- Eighty-two fill and tuff samples were collected from 27 locations at depth intervals ranging from 0–29 ft bgs. Samples were collected from two to five depth intervals at each location. Depth intervals were varied by location but were no more than 5 ft apart vertically.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 108), the vertical extent of chromium, the lateral and vertical extent of barium, cobalt, and copper, and the lateral extent of nickel are not defined at multiple locations (Plate 9). The vertical extent of plutonium-239/240 and tritium is also not defined at multiple locations (Plate 10). The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at Consolidated Unit 50-004(a)-00.

4.5.1.3 Proposed Sampling at Consolidated Unit 50-004(a)-00

Shallow subsurface samples will be collected at 18 previously sampled locations (50-03022, 50-03026, 50-03027, 50-03030, 50-03031, 50-03032, 50-03038, MO-605108, MO-605458, MO-605460, MO-605462, MO-605463, MO-605464, MO-605473, MO-605478, MO-605626, MO-605627, and MO-605628), extending the depths at these locations to define the vertical extent of barium, chromium, cobalt, copper, plutonium-239/240, and tritium. Samples from each location will be analyzed as specified in Table 4.5-1.

Samples from location MO-605463 will be used to define the vertical extent of barium at nearby location 50-03025 (approximately 10 ft away). Samples from location MO-605627 will be used to define the vertical extent of plutonium-239/240 at location 50-03005. Samples from location MO-605626 will be used to define the vertical extent of barium and plutonium-239/240 at location 50-03021. Samples from location MO-605464 will be used to define the vertical extent of barium at nearby location 50-03018 (10 ft away). Samples from location MO-605628 will be used to define the vertical extent of tritium at location 50-03001 and the vertical extent of chromium at nearby location MO-605106 (approximately 10 ft away). Samples from location MO-605458 will be used to define the vertical extent of tritium at nearby location 50-03002 (approximately 10 ft away).

Shallow subsurface samples will be collected at three new sampling locations (4a-1, 4a-2, and 4a-3) to define the lateral extent of barium, cobalt, copper, and nickel. Location 4a-1 will be sited to the east of previously sampled location 50-03009, and samples will be analyzed for copper and nickel only.

Location 4a-2 will be sited downgradient of location MO-605464, and samples will be analyzed for barium, copper, and nickel. Location 4a-3 will be sited east of location MO-605473, and samples will be analyzed for barium, cobalt, and copper.

The proposed sampling and analyses at Consolidated Unit 50-004(a)-00 are presented in Table 4.5-1, and the proposed sampling locations are shown in Figure 4.5-1.

4.5.2 SWMU 50-006(a), Operational Releases from Sump

4.5.2.1 Site Description and Operational History

SWMU 50-006(a) is the outfall area at the head of Ten Site Canyon impacted by two accidental operational releases when a sump in a pumping station (building 50-2) overflowed, causing untreated wastewater to be discharged to waste lines 55 and 67 (the waste lines for treated effluent) (Figure 4.5-2). The releases occurred in July and September 1974 (LANL 1995, 049925). In February 1975, waste line 67 was plugged at its outfall. A soil sample collected from the outfall area when waste line 67 was plugged showed elevated levels of gross-alpha radioactivity. Analysis of additional soil samples collected below the waste line 67 outfall in September 1976 showed elevated levels of gross-alpha radioactivity extending 984 ft downgradient of the outfall. In 1981, both waste lines 55 and 67 were completely removed (Elder et al. 1986, 006666). During waste line removal, elevated levels of radionuclides, including plutonium-239, ruthenium-106, cesium-137, strontium-89, and yttrium-90, were detected. As a result, the outfall area was partially remediated by the removal of 70 m^3 of contaminated soil from the outfall location (LANL 1992, 007672).

4.5.2.2 Previous Investigations

In 1993 and 2009, a total of 132 samples (22 soil, 104 sediment, and 6 tuff) were collected from 65 locations at SWMU 50-006(a). Previously sampled locations are shown in Figure 4.5-2. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

A Phase I RFI was conducted in 1993 at SWMU 50-006(a) to determine the nature and extent of radionuclide and hazardous chemical contamination in and around the area of the Ten Site Canyon outfall. Samples were collected below the former waste line outfall, on both banks of the drainage channel, and in the canyon drainage channel at regular intervals over a distance of approximately 1300 ft downstream from the TA-50 boundary. Samples were field screened for organic vapors and radioactivity. Elevated gross-alpha radiation was detected at one screening sample location, resulting in the selection of additional sampling locations upstream and downstream from the area with elevated gross-alpha radiation. A total of 134 samples were collected from 53 locations and analyzed for inorganic chemicals, VOCs, SVOCs, PCBs, and radionuclides. The RFI activities and results were presented in the RFI report (LANL 1995, 049925).

In 1996, an interim action (IA) was implemented to remove the contaminated sediment. Approximately 0.72 yd^3 of radioactively contaminated soil was excavated and removed. Ten confirmation samples were collected from the excavated area and analyzed for gross-alpha and gross-beta radioactivity. The results were reported in the IA report (LANL 1997, 055834). Decision-level data from the 1993 RFI and the 1996 IA are included in the investigation report (LANL 2010, 109830).

Sampling at SWMU 50-006(a) consisted of the following activities in 2009:

- Soil and tuff samples were collected at three locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 5 ft below the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, anions, perchlorate, total phosphorous, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, strontium-90, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 110), the vertical extent of chromium is not defined at locations MO-605076, MO-605077, and MO-605078. The investigation report stated that the lateral extent of cadmium and fluoride is not defined. However, cadmium was not detected above BV at any of the locations sampled in 2009 (Figure 4.5-3). Cadmium was detected above BV at multiple locations in canyon reaches TS-1W and TS-1C in Ten Site Canyon, below SWMU 50-006(a), but decreased downgradient (LANL 2006, 094161). In the case of fluoride, concentrations were 1.2 mg/kg or less. Because fluoride is naturally occurring, the concentrations likely reflect natural levels. Therefore, the lateral extent of cadmium and fluoride is defined. The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 50-006(a).

4.5.2.3 Proposed Sampling at SWMU 50-006(a)

Shallow subsurface samples will be collected at three previously sampled locations MO-605076, MO-605077, and MO-605078, extending the depth at these locations to define the vertical extent of chromium. Samples will be analyzed for chromium only.

The proposed sampling and analyses at SWMU 50-006(a) are presented in Table 4.5-2, and the proposed sampling locations are shown in Figure 4.5-2.

4.5.3 SWMU 50-006(d), Drainline and Associated NPDES-Permitted Outfall

4.5.3.1 Site Description and Operational History

SWMU 50-006(d) consists of a drainline (structure 50-64) and associated NPDES-permitted outfall 051 in Mortandad Canyon for treated wastewater from the RLWTF (building 50-1) (Figure 4.5-4). Structure 50-64 is a 6-in.-diameter iron discharge pipe that was rerouted in 1983 to accommodate construction of the TA-35 target fabrication facility (building 35-213). In 1985, EPA Region 6 issued an administrative order to DOE requiring modification of the outfall to mitigate ongoing stream-bank erosion caused by the discharge pipe ending 25 ft short of the stream channel. DOE extended the pipe into the stream channel, and subsequently EPA Region 6 closed the order in 1986 (LANL 1992, 007672).

4.5.3.2 Previous Investigations

In 1993 and 2009, a total of 92 samples (28 soil or fill, 33 sediment, and 31 tuff) were collected from 44 locations at SWMU 50-006(d). Previously sampled locations are shown in Figure 4.5-4. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In a 1993 RFI, 52 samples were collected from 27 locations in the canyon downgradient from SWMU 50-006(d), from depths ranging between 0 and 4 ft bgs. Samples were analyzed for gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, strontium-90, tritium, PCBs, and SVOCs. Results of the 1993 RFI were not reported previously, but decision-level data from the 1993 RFI are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 50-006(d) consisted of the following activities in 2009:

- Soil and tuff samples were collected at four locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 5 ft below the soil-tuff interface. The samples were collected from below the outfall.
- Soil and tuff samples were collected at one location from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 5 ft below the soil-tuff interface. The samples were collected from the drainage.
- Tuff samples were collected at 12 locations from two depth intervals: the base of the pipe and the interval beginning 5 ft below the base of the pipe.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, strontium-90, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, pp. 115–116), the lateral and vertical extent of chromium, copper, mercury, nitrate, and perchlorate are not defined. The vertical extent of chromium is not defined at locations MO-605085 and MO-605506. The vertical extent of copper is not defined at locations MO-605085 and MO-605088. The vertical extent of mercury and nitrate is not defined at location MO-605085. The vertical extent of perchlorate is not defined at locations MO-605085, MO-605087, MO-605088, and MO-605506 (Plate 11).

The vertical extent of PCBs is not defined at locations MO-605083, MO-605085, MO-605088, and MO-605504. The investigation report stated the lateral extent of PAHs and PCBs is not defined. However, PAHs and PCBs were not detected in samples at locations downgradient of location MO-605085 (Plate 12). Therefore, the lateral extent of PAHs and PCBs is defined at SWMU 50-006(d).

The vertical extent of americium-241 (location MO-605088); cesium-137 (locations MO-605085 and MO-605088); plutonium-238 (locations MO-605085 and MO-605088); strontium-90 (location MO-605088); thorium-232 (locations 50-06002, 50-06019, and 50-06026); tritium (locations MO-605084, MO-605085, MO-605088, and MO-605506); and uranium-235/236 (location MO-605511) is not defined (Plate 13). The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 50-006(d).

The 1993 RFI samples were collected in Effluent Canyon and Mortandad Canyon. The area encompassing these locations is included in reaches E-1E of Effluent Canyon and M-2W of Mortandad Canyon (Figure 4.5-4), which have been investigated separately (LANL 2006, 094161). The Mortandad Canyon investigation report stated, on the basis of multiple years of sediment and water sampling data, that Effluent Canyon reach E-1E has been a primary source of radionuclide contamination in Mortandad Canyon, but that the concentrations of radionuclides have generally declined substantially with time. The Mortandad Canyon investigation report also found the risk from contamination to be below the target level. Therefore, no additional samples will be collected at the 1993 RFI locations.

4.5.3.3 Proposed Sampling at SWMU 50-006(d)

Shallow subsurface samples will be collected at eight previously sampled locations (MO-605083, MO-605084, MO-605085, MO-605087, MO-605088, MO-605504, MO-605506, and MO-605511), extending the depth at these locations to define the vertical extent of chromium, copper, mercury, nitrate, perchlorate, PCBs, americium-241, cesium-137, plutonium-238, strontium-90, tritium, and uranium-235/236. Samples from each location will be analyzed as specified in Table 4.5-3.

New sampling location (6d-1) will be placed downgradient of existing location MO-605085 to define the lateral (downgradient) extent of nitrate and perchlorate because nitrate and perchlorate were not included in the Mortandad Canyon investigation. Samples from location 6d-1 will be analyzed for nitrate and perchlorate. Lateral extent of chromium, copper, and mercury is defined by the results of the Mortandad Canyon investigation.

Additional samples will be collected at two new locations (6d-2 and 6d-3) below the former outfall location and in the vicinity of existing location MO-605088 (above the drainage channel) to define the lateral and vertical extent of radionuclides. Samples from these locations will be analyzed for americium-241, cesium-137, isotopic plutonium, strontium-90, tritium, and isotopic uranium.

The proposed sampling and analyses at SWMU 50-006(d) are presented in Table 4.5-3, and the proposed sampling locations are shown in Figure 4.5-4.

5.0 INVESTIGATION METHODS

A summary of investigation methods to be implemented is presented in Table 5.0-1. The standard operating procedures (SOPs) used to implement these methods are available at http://www.lanl.gov/environment/all/qa/adep.shtml.

Descriptions of the field investigation methods are provided below. Additional procedures may be added as necessary to describe and document quality-affecting activities.

Chemical analyses will be performed in accordance with the current analytical statement of work (LANL 2008, 109962). Accredited non-Laboratory contract analytical laboratories will use the most recent EPA- and industry-accepted extraction and analytical methods for the requested analyses.

5.1 Sampling Locations

Proposed sampling locations are identified for each site based on engineering drawings, surveyed locations of existing structures (from the geographic information system database), previous sampling locations, and topography or other features identified in the field (e.g., drainage channels, sediment accumulation areas). The coordinates of proposed new sampling locations will be obtained by georeferencing the points from the proposed sampling maps. Coordinates will be located and flagged or otherwise marked in the field using a differential global positioning system (GPS) unit. If any proposed sampling locations are moved because of field conditions, utilities, or other unexpected reasons, the new locations will be surveyed immediately following sample collection as described in section 5.2. Surveying and establishing sampling locations will be conducted in accordance with the latest version of standard operating procedure SOP-5028, Coordinating and Evaluating Geodetic Surveys.

5.2 Geodetic Surveys

Geodetic surveys will be conducted in accordance with the latest version of SOP-5028, Coordinating and Evaluating Geodetic Surveys, to locate historical structures and previous sampling locations and to document field activities such as sample collection. The surveyors will use a Trimble GeoXT hand-held GPS or equivalent for the surveys. The coordinate values will be expressed in the New Mexico State Plane Coordinate System (transverse Mercator), Central Zone, North American Datum 1983. Elevations will be reported per the National Geodetic Vertical Datum of 1929. All GPS equipment used will meet the accuracy requirements specified in the SOP.

5.3 Surface and Shallow Subsurface Sampling

Soil and rock samples will be collected by the most efficient, least invasive method practicable. The methods will be determined by the field team based on site conditions such as topography, the nature of the material to be sampled, the depth intervals sampled, accessibility, and the level of disruption to Laboratory activities. Typically, samples will be collected using spade-and-scoop, hand-auger, or hollow-stem auger drilling methods.

5.3.1 Spade-and-Scoop Method

Surface and shallow subsurface samples will be collected in accordance with SOP-06.09, Spade and Scoop Method for the Collection of Soil Samples. Stainless-steel shovels, spades, scoops, and bowls will be used for ease of decontamination. If the surface location is at bedrock, an axe or hammer and chisel may be used to collect samples. Samples collected for analyses will be placed in the appropriate sample containers, depending upon the analytical method requirement.

5.3.2 Sediment Samples

Sediment samples will be collected from areas of sediment accumulation that include sediment judged to be representative of the historical period of Laboratory operations (i.e., post-1943). Sediment samples will be collected using either spade-and-scoop and/or hand-auger methods. Proposed sediment sampling locations have been identified and are shown in the figures in the preceeding sections. The actual sediment sampling locations will be selected in the field based on geomorphic relationships in areas likely to have been affected by discharges from Laboratory operations. Because sediment is dynamic and subject to redistribution by runoff events, some locations may need to be adjusted when this work plan is implemented. In the course of collecting sediment samples, it may be determined, based on field conditions, that the selected location is not appropriate (e.g., the sediment is much shallower than anticipated, the sediment is predominantly coarse grained, or the sediment shows evidence of being older than the target age). Sediment sampling locations will be adjusted as appropriate, any revised locations will be surveyed, and the updated coordinates will be submitted for inclusion in the appropriate database.

5.4 Subsurface Sampling

Subsurface sampling is proposed to include surface soil and fill, sediment, and tuff. Any adjustments will be noted on sample collection logs and recorded in the Phase II investigation report as deviations from this investigation work plan. Subsurface samples will be collected following the current version of SOP-06.24, Sample Collection from Split-Spoon Samplers and Shelby-Tube Samplers, and SOP-06.26, Core-Barrel Sampling for Subsurface Earth Materials.

5.4.1 Hollow-Stem Auger

A hollow-stem auger may be used to drill holes deeper than approximately 15 ft or to shallower depths where hand-auger refusal is encountered. The hollow-stem auger consists of a hollow steel shaft with a continuous spiraled steel flight welded onto the exterior of the stem. The stem is connected to an auger bit; when it is rotated, it transports cuttings to the surface. The hollow stem of the auger allows insertion of drill rods, split-spoon core barrels, Shelby tubes, and other samplers through the center of the auger so samples may be retrieved during drilling operations. The hollow stem also acts to case the borehole core temporarily so a well casing (riser) may be inserted down through the center of the auger once the desired depth is reached, thus minimizing the risk of possible collapse of the borehole. A bottom plug or pilot bit can be fastened onto the bottom of the auger to keep out most of the soil and/or water that tends

to clog the bottom of augers during drilling. Drilling without a center plug is acceptable if the soil plug, formed in the bottom of the auger, is removed before sampling or installing a well casing. The soil plug can be removed by washing out the plug using a side-discharge rotary bit or auguring out the plug with a solid-stem auger bit sized to fit inside the hollow-stem auger.

During sampling, the auger will be advanced to just above the desired sampling interval. The sample will be collected by driving a split-spoon sampler into undisturbed soil-tuff to the desired depth. Samples will be collected in accordance with SOP-06.26, Core-Barrel Sampling for Subsurface Earth Materials.

5.4.2 Hand Auger

Hand augers may be used to drill shallow holes. The hand auger is advanced by turning the auger into the soil or tuff until the barrel is filled. The auger is removed and the sample is placed in a stainless-steel bowl. Hand-auger samples will be collected in accordance with SOP-06.10, Hand Auger and Thin-Wall Tube Sampler.

Because the chromium and nickel concentrations at some previously hand-augered sampling locations are suspected of being influenced by the use of stainless-steel auger buckets, carbon-steel auger buckets will be used to collect the proposed samples at locations not accessible to a drill rig and must be sampled by the hand-auger method.

5.4.3 Borehole Abandonment

All boreholes will be properly abandoned according to the current version of SOP-5.03, Monitoring Well and RFI Borehole Abandonment.

Shallow boreholes (less than approximately 20 ft deep or advanced by methods other than a drill rig) will be abandoned by filling the borehole with bentonite chips, which are subsequently hydrated, in 1- to 2-ft lifts. The borehole will be visually inspected while the bentonite chips are added to ensure bridging does not occur.

Deeper boreholes will be pressure-grouted from the bottom of the borehole to the surface using the tremie pipe method. Acceptable grout materials include cement or bentonite grout, neat cement, or concrete.

The use of backfill materials, such as bentonite and grout, will be documented in a field logbook with regard to volume (calculated and actual), intervals of placement, and additives used to enhance backfilling. All borehole abandonment information will be provided in the Phase II investigation report.

5.5 Chain of Custody and Sample Collection Logs

The collection, screening, and transport of samples will be documented on standard forms generated by the Sample Management Office (SMO). These include sample container labels and combined sample collection log (SCL)/chain-of-custody (COC) forms. Sample collection portions of the combined forms will be completed at the time of sample collection and signed by the sampler and a reviewer who will verify the logs for completeness and accuracy. Chain-of-custody portions of the combined forms will be completed and signed to verify the samples are not left unattended. Corresponding labels will be initialed and applied to each sample container, and custody seals will be placed around container lids or openings. Documentation and handling of all samples will be conducted in accordance with WES-EDA-QP-219, Sample Control and Field Documentation, and with SOP-5057, Handling, Packaging, and Transporting Field Samples.

5.6 Field-Screening Methods

The primary field-screening methods to be used on samples include radiological screening and organic vapor screening using a photoionization detector (PID). Field screening will be used primarily for health and safety purposes and for determining transportability of samples from the field sites to the SMO and from the SMO to the analytical laboratories. Field-screening results may be used at the discretion of the field personnel to collect additional samples beyond those planned or to extend the depth of sampling as required. Field changes to sampling plans will be approved by the subcontractor technical representative and will be documented on field paperwork and in the Phase II investigation report.

5.6.1 Radiological Screening

Based on the results of past sampling, field screening for radioactivity will be conducted primarily to ensure worker health and safety rather than to direct sampling. Radiological screening will target gross-alpha, -beta, and -gamma radiation. Field screening for alpha, beta, and gamma radiation will be conducted within 6 in. from soil and core material using appropriate field instruments as determined by the Laboratory's Health Physics Operations Group. Instruments will be calibrated in accordance with the Health Physics Operations Group procedures or equivalent procedures. All instrument calibration activities will be documented daily in the field logbooks in accordance with SOP-5181, Notebook Documentation for Waste and Environmental Services Technical Field Activities.

5.6.2 Organic Vapor Field Screening

Because VOCs are not known to have been used at the sites being investigated, VOC screening will be conducted primarily to ensure worker health and safety rather than to direct sampling. Screening will be conducted using a PID capable of measuring quantities as low as 1 ppm. Vapor screening of soil, sediment, and subsurface core for VOCs will be conducted using a PID equipped with an 11.7 electron volt lamp. All samples will be screened for VOCs in headspace gas in accordance with SOP-06.33, Headspace Vapor Screening with a Photo Ionization Detector.

The PID will be calibrated daily to the manufacturer's standard for instrument operation, and the daily calibration results will be documented in the field logbooks. All instrument background checks, background ranges, and calibration procedures will be documented daily in the field logbooks in accordance with SOP-5181, Notebook Documentation for Waste and Environmental Services Technical Field Activities.

5.7 Quality Assurance/Quality Control Samples

Quality assurance/quality control samples will include field duplicate, equipment rinsate, and field trip blank samples. Field duplicate samples and field rinsate blanks will be collected at an overall frequency of at least 1 for every 10 regular samples or as directed by the current version of SOP-5059, Field Quality Control Samples. Field trip blanks will be collected at a rate of at least one per day on days when VOC samples are being collected.

5.8 Laboratory Analytical Methods

The analytical suites for laboratory analyses and the specific analytical methods to be used are summarized in Table 5.8-1. All analytical methods are presented in the statement of work for analytical laboratories (LANL 2008, 109962). Sample collection and analysis will be coordinated with the SMO.

5.9 Health and Safety

The field investigations described in this Phase II investigation work plan will comply with all applicable requirements pertaining to worker health and safety. An integrated work document and a site-specific health and safety plan will be in place before conducting fieldwork.

5.10 Equipment Decontamination

Equipment for drilling and sampling will be decontaminated before and after sampling activities to minimize the potential for cross-contamination. All equipment will be decontaminated using dry decontamination methods whenever possible to minimize generating liquid waste. All sampling equipment will be decontaminated using dry decontamination methods if possible, as described in SOP-5061, Field Decontamination of Equipment. If dry decontamination methods are not effective as determined by field screening of the equipment after dry decontamination, drilling/exploration equipment that may come in contact with the borehole will be decontaminated by steam-cleaning, hot-water pressure-washing, or another method before each new borehole is drilled. If wet decontamination is necessary, the equipment will be decontaminated on a high-density polyethylene liner on a temporary decontamination pad. Cleaning solutions and wash water will be collected and contained for proper disposal. Decontamination solutions will be sampled and analyzed to determine the final disposition of the wastewater and the effectiveness of the decontamination procedures.

5.11 Investigation-Derived Waste

IDW generated during field-investigation activities may include, but is not limited to, drill cuttings; contaminated soil; contaminated personal protective equipment (PPE), sampling supplies, and plastic; fluids from the decontamination of PPE and sampling equipment; and all other waste that has potentially come into contact with contamination.

All IDW generated during field-investigation activities will be managed in accordance with applicable EPA and NMED regulations, DOE orders, and Laboratory requirements. Appendix B presents the IDW management plan.

6.0 MONITORING PROGRAMS

SWMUs 03-045(h), 03-049(a), 03-049(e), 03-054(e), 42-001(a,b,c), 42-002(b), 48-003, 48-007(b), 48-007(c), 50-006(a), and 50-006(d), and AOCs 35-016(g), 35-016(h), 42-002(a), and 48-001 are subject to the stormwater monitoring requirements of the Laboratory's NPDES individual permit for stormwater discharges from SWMUs and AOCs.

7.0 SCHEDULE

Preparation of investigation activities is scheduled to start by October 3, 2011. Fieldwork is expected to start April 24, 2012, and will take approximately two months to complete. Fieldwork is scheduled to be completed by June 26, 2012. A submittal date of no later than January 31, 2013, is proposed for the Phase II investigation report.

8.0 REFERENCES AND MAP DATA SOURCES

8.1 References

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

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

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8.2 Map Data Sources

Data sources used in original figures and/or plates created for this report are described below and identified by legend title.

Legend Item	Data Source
LANL Technical Areas	Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; September 2007; as published 04 December 2008.
Paved roads	Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Paved parking	Paved Parking; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Dirt roads	Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
LANL structures	Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
LANL fence lines	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.
LANL communications lines	Communication Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 08 August 2002; as published 28 May 2009.
LANL electric lines	Primary Electric Grid; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
LANL gas lines	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.
LANL sewer lines	Sewer Line System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Legend Item	Data Source
LANL steam lines	Steam Line Distribution System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 January 2009.
LANL water lines	Water Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
LANL industrial waste lines	Primary Industrial Waste Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 October 2008.
LANL historical sampling locations	Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, Waste and Environmental Services Division, 5 June 2010.
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Contours	Hypsography, 2, 10, 20, and 100 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

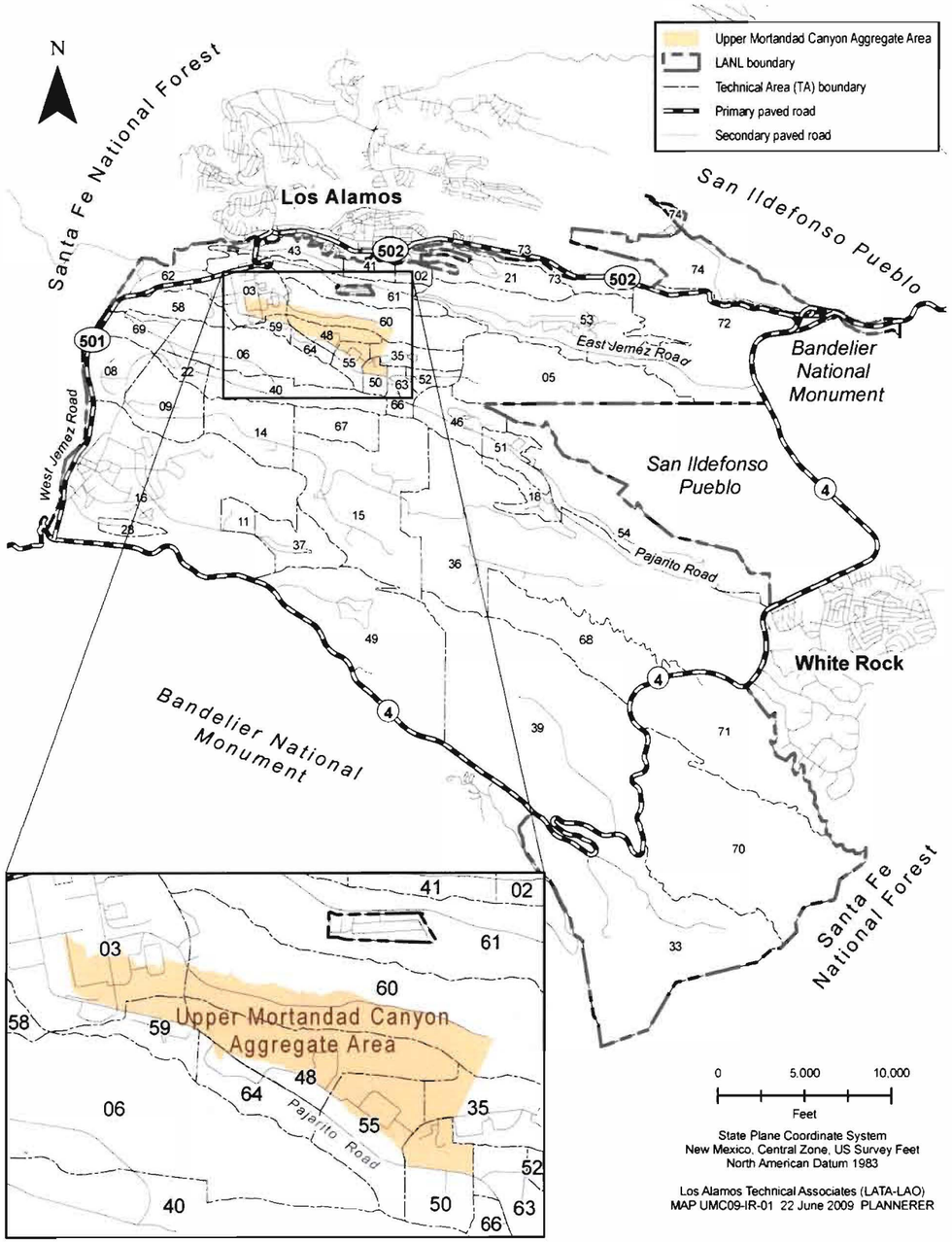


Figure 1.1-1 Location of Upper Mortandad Canyon Aggregate Area with respect to Laboratory technical areas

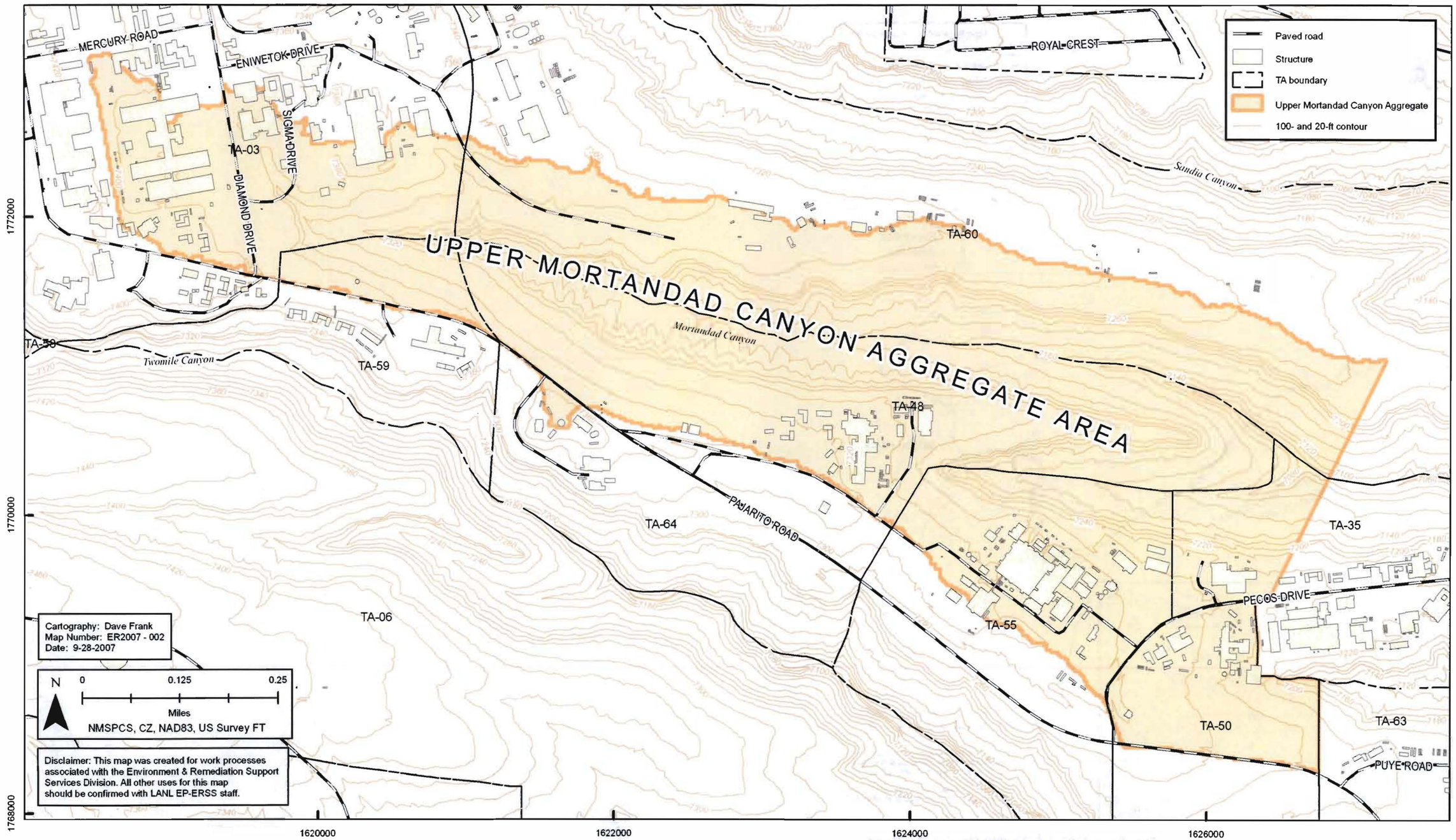


Figure 1.1-2 Location of Upper Mortandad Canyon Aggregate Area and its surrounding land holdings

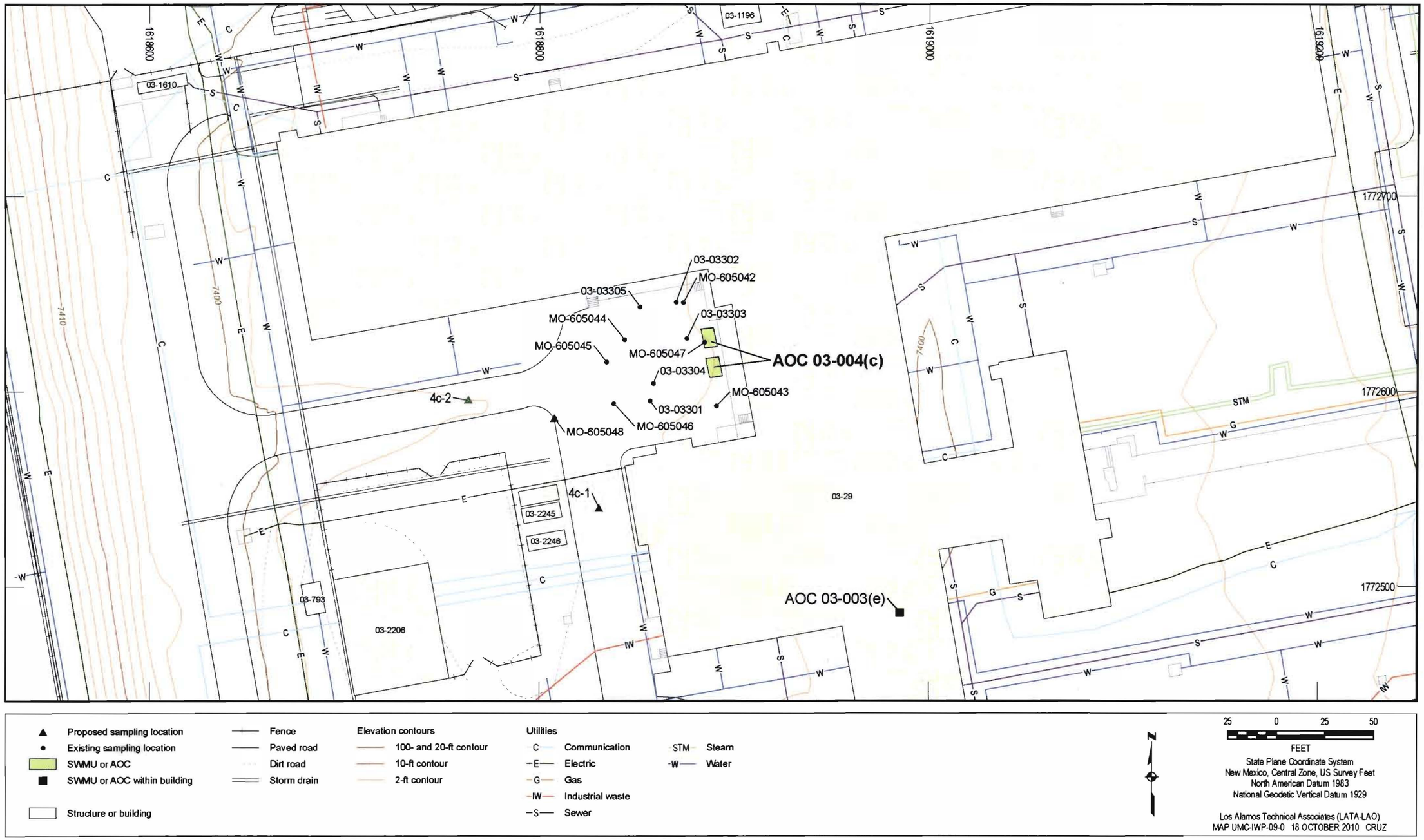


Figure 4.1-1 Site map and proposed sampling locations at AOC 03-004(c)

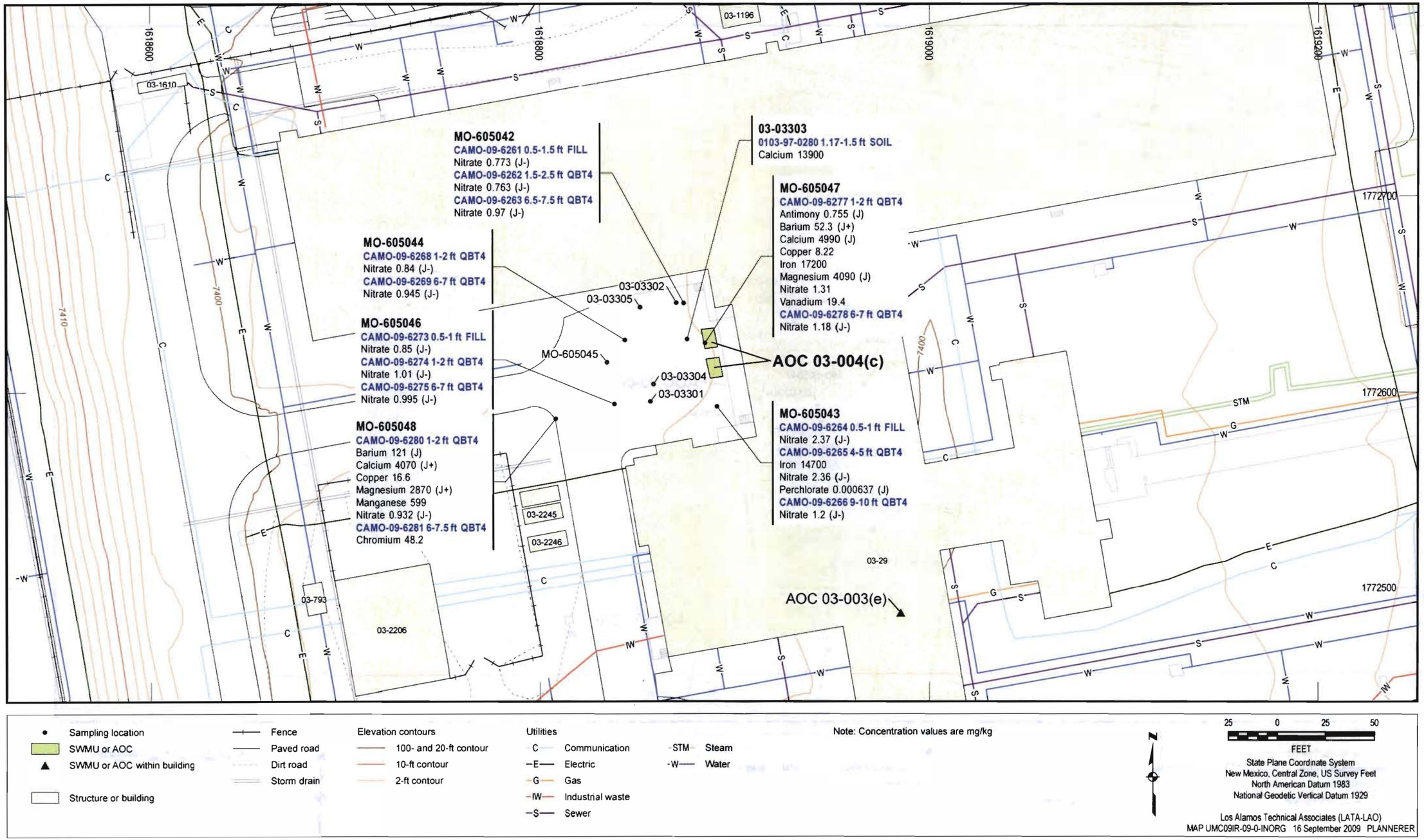


Figure 4.1-2 Inorganic chemicals detected or detected above BVs at AOC 03-004(c)

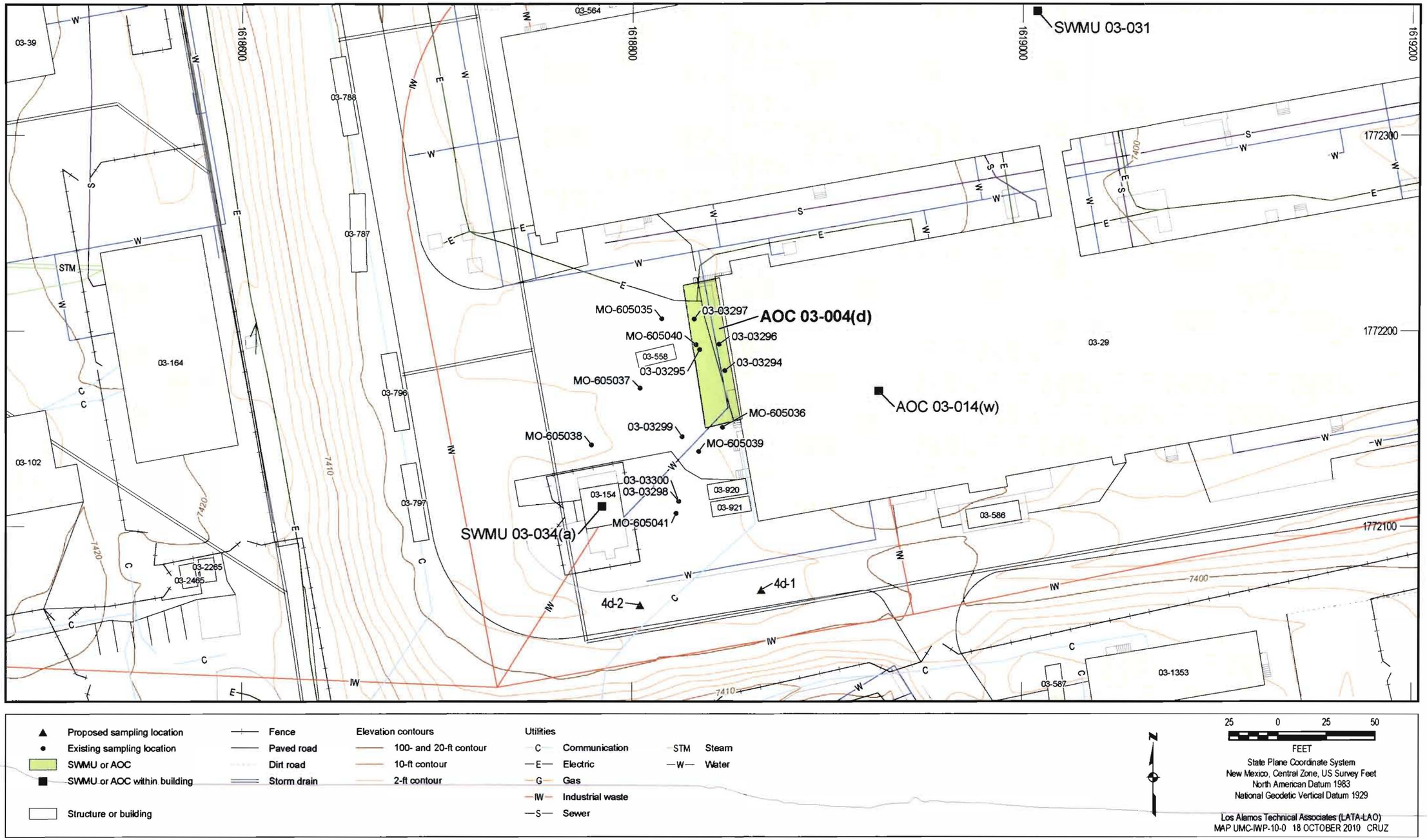


Figure 4.1-3 Site map and proposed sampling locations at AOC 03-004(d)

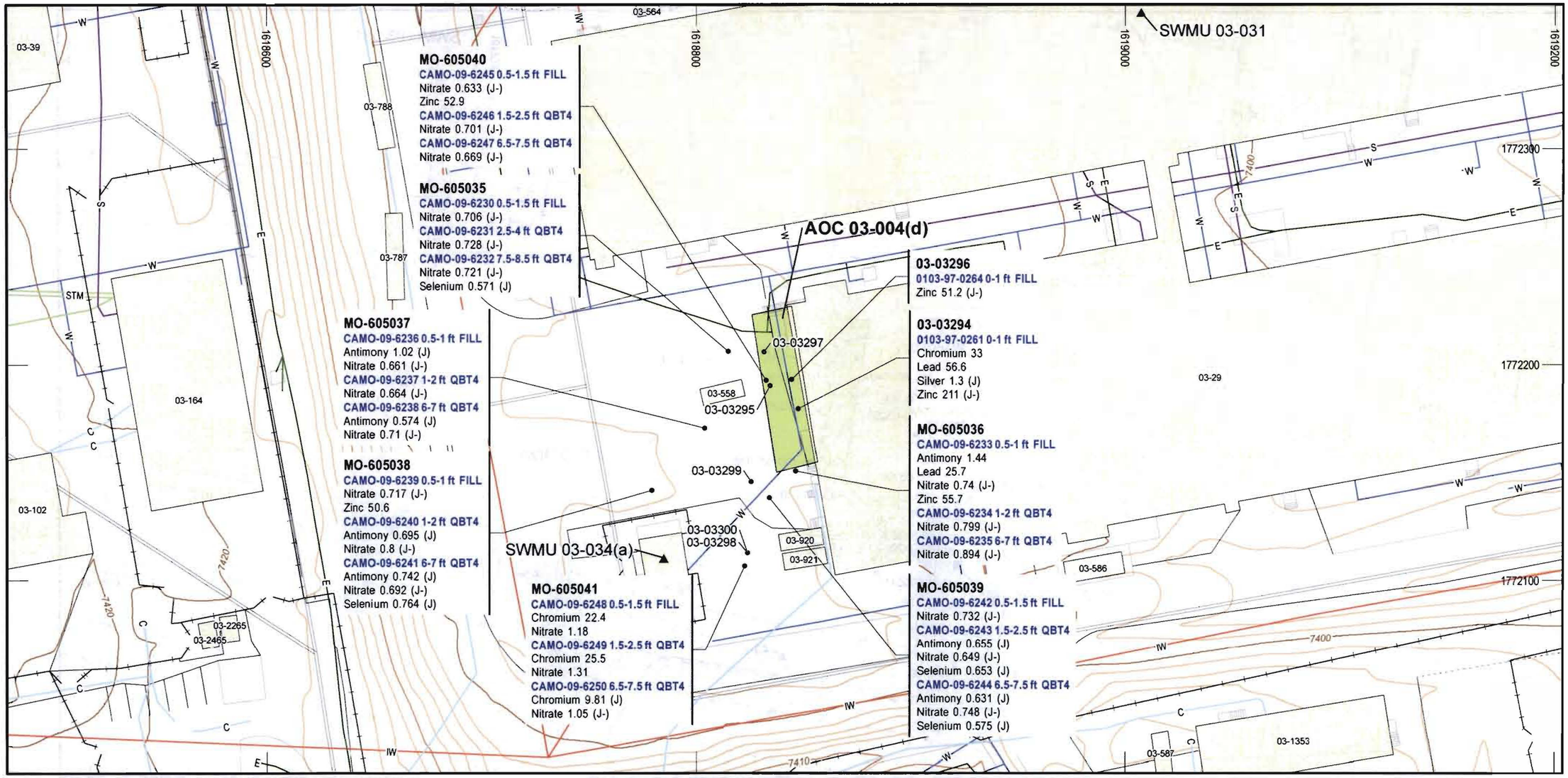


Figure 4.1-4 Inorganic chemicals detected or detected above BVs at AOC 03-004(d)

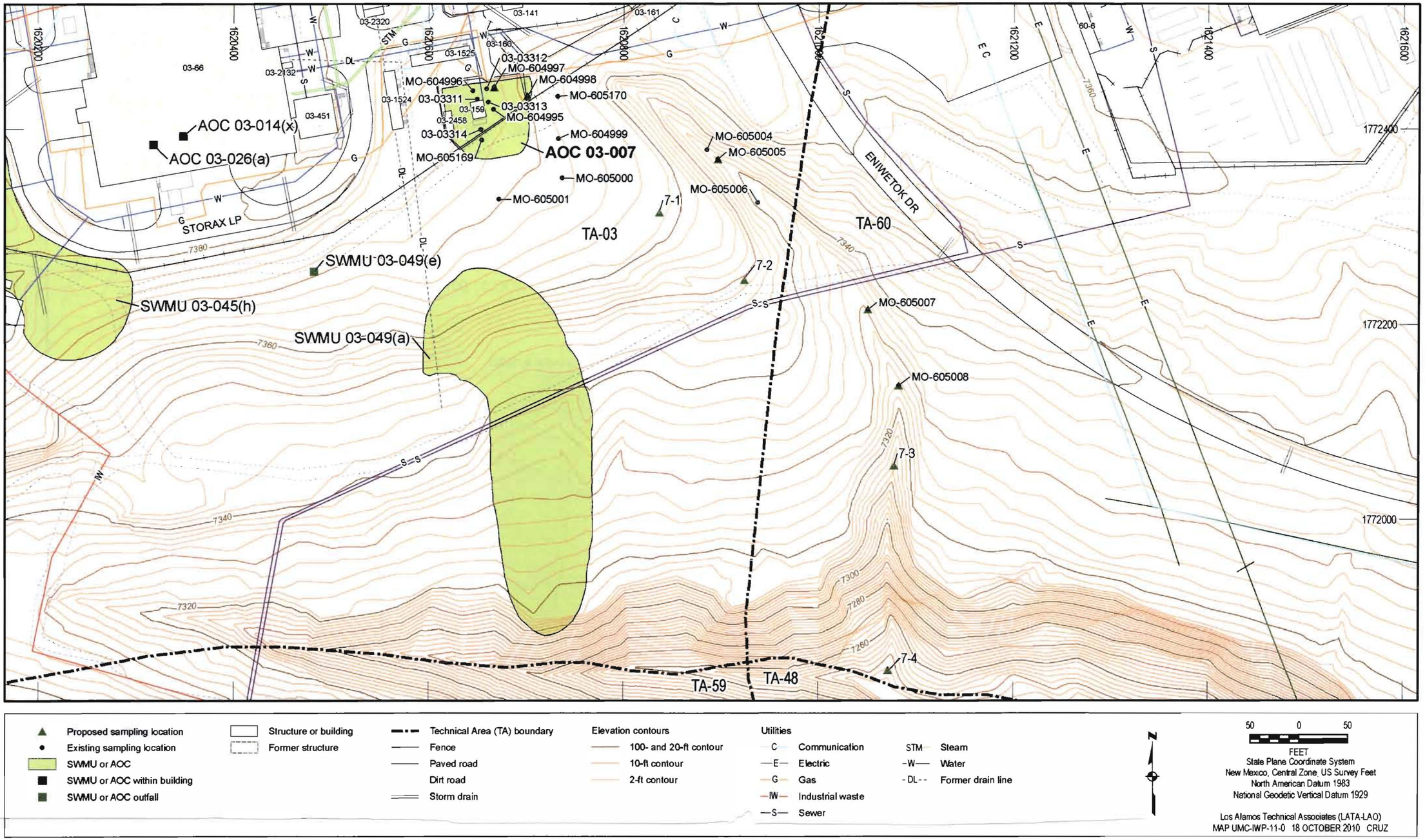


Figure 4.1-5 Site map and proposed sampling locations at AOC 03-007

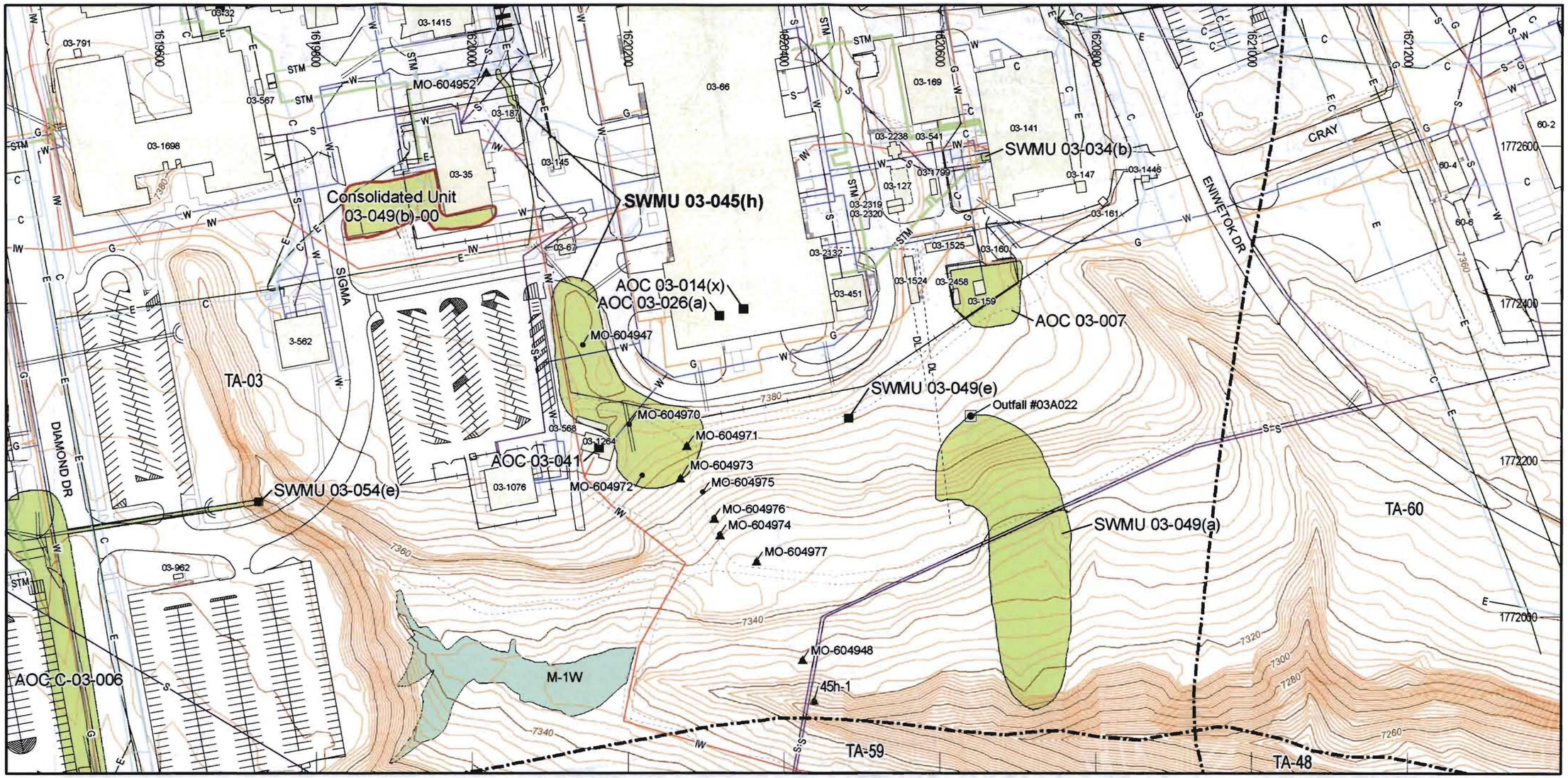


Figure 4.1-6 Site map and proposed sampling locations at SWMU 03-045(h)

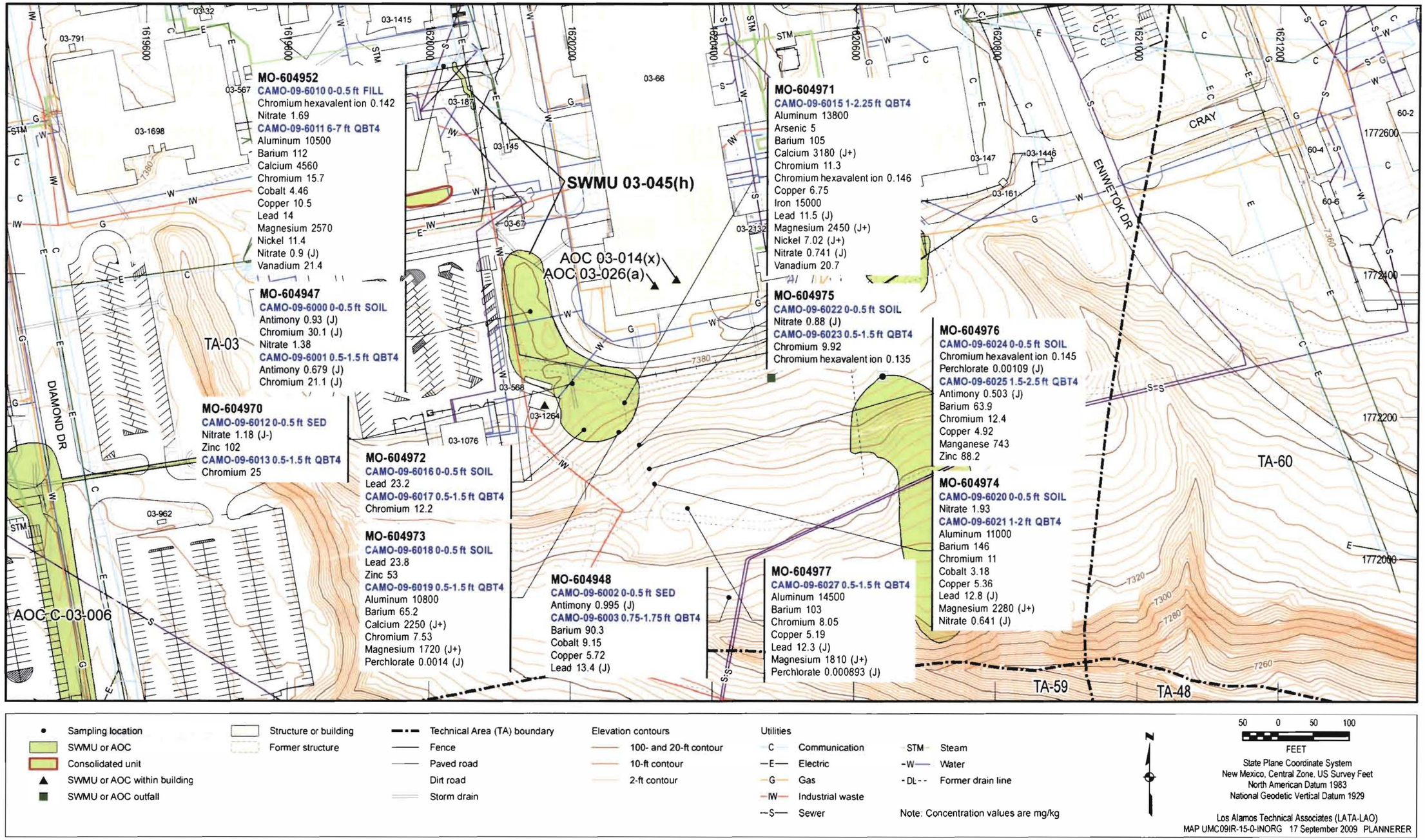


Figure 4.1-7 Inorganic chemicals detected or detected above BVs at SWMU 03-045(h)

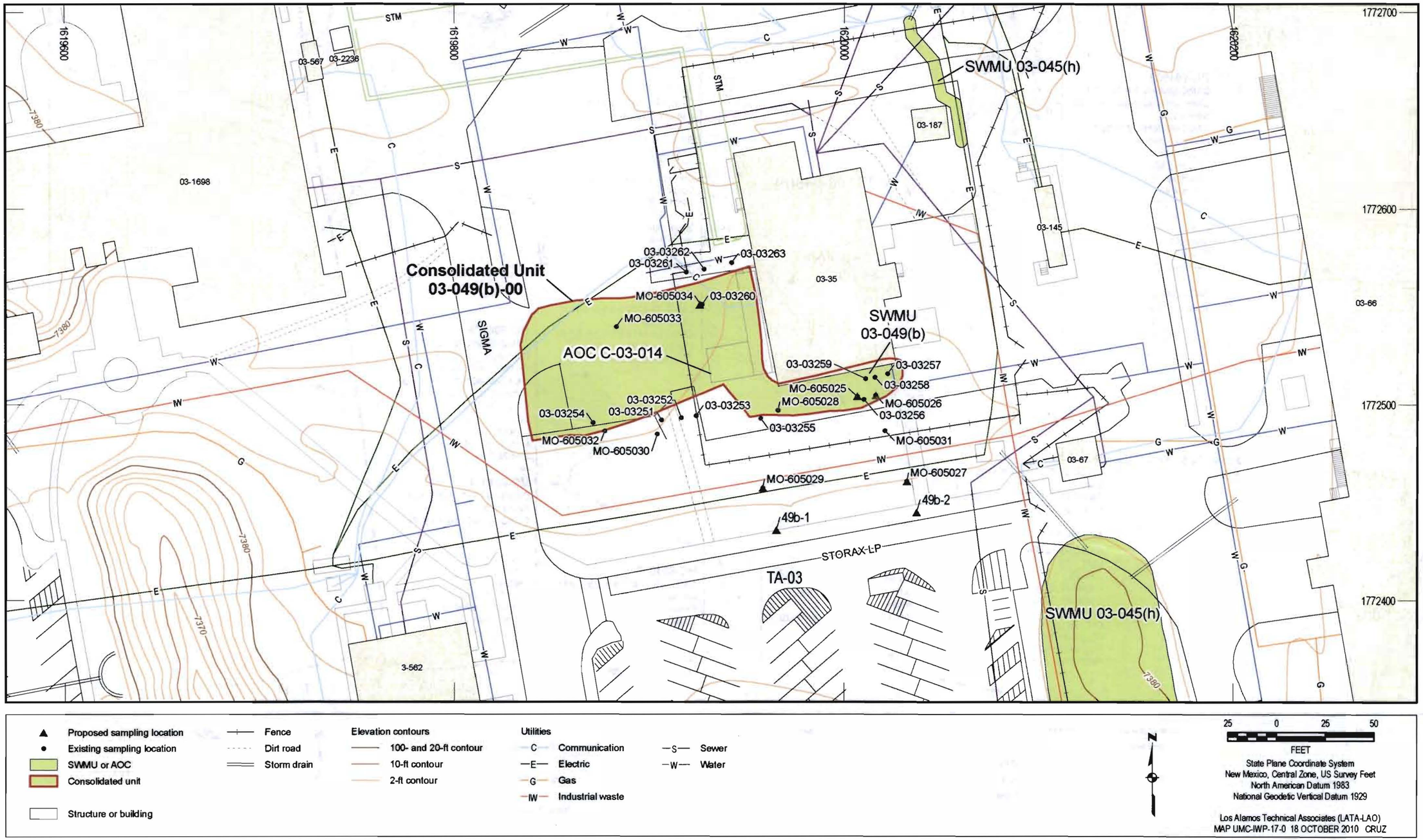


Figure 4.1-8 Site map and proposed sampling locations at Consolidated Unit 03-049(b)-00

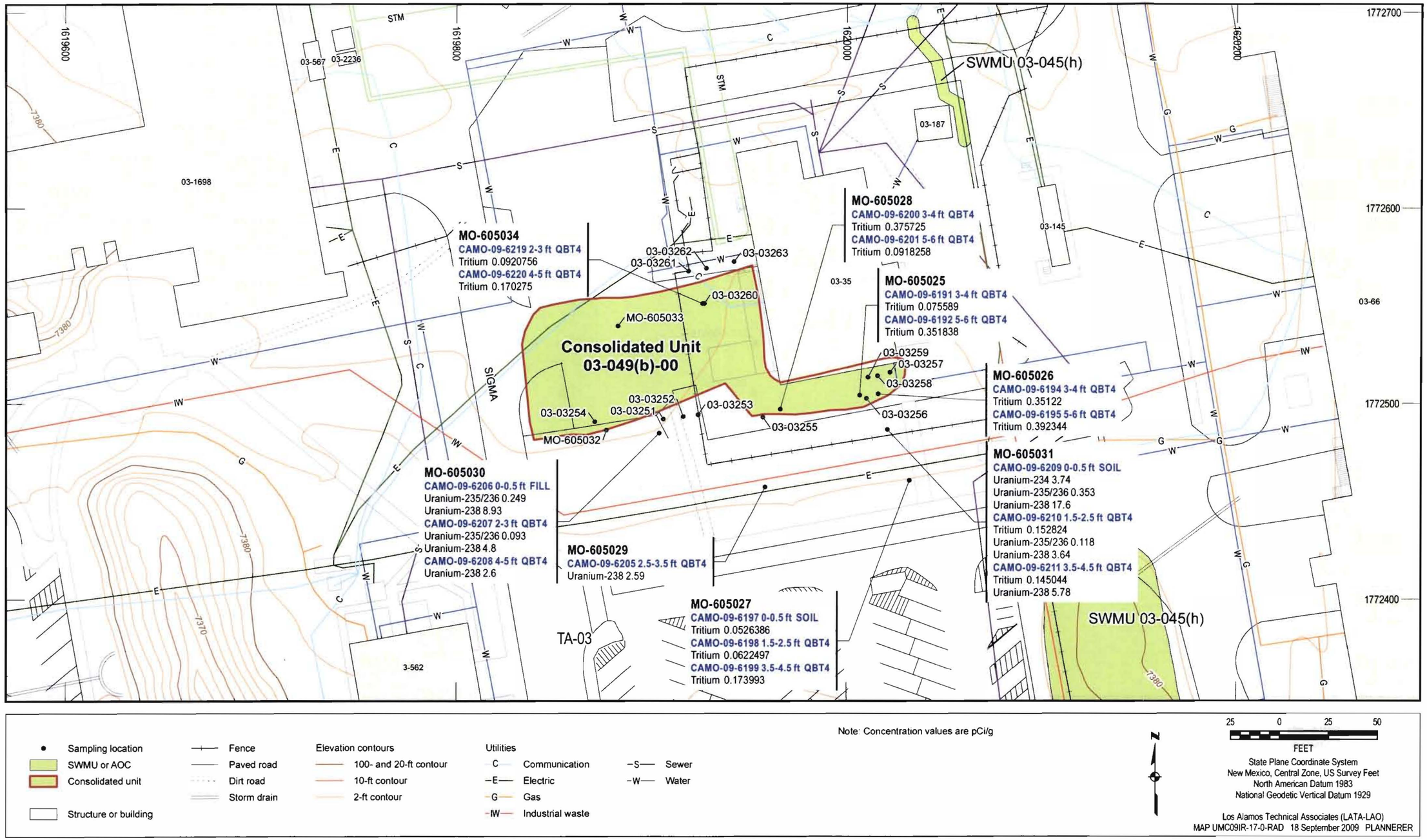


Figure 4.1-9 Radionuclides detected or detected above BVs/FVs at Consolidated Unit 03-049(b)-00

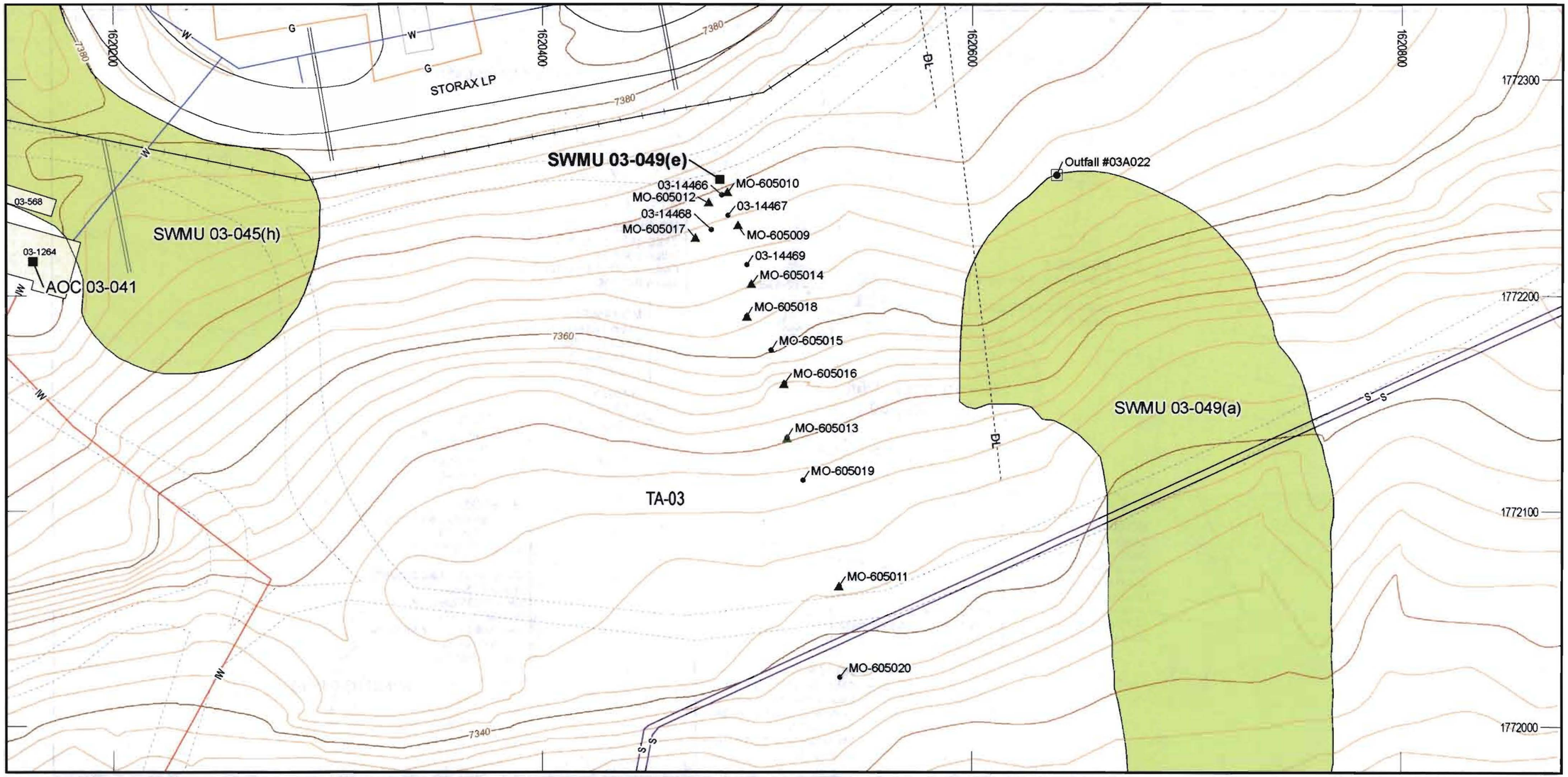


Figure 4.1-10 Site map and proposed sampling locations at SWMU 03-049(e)

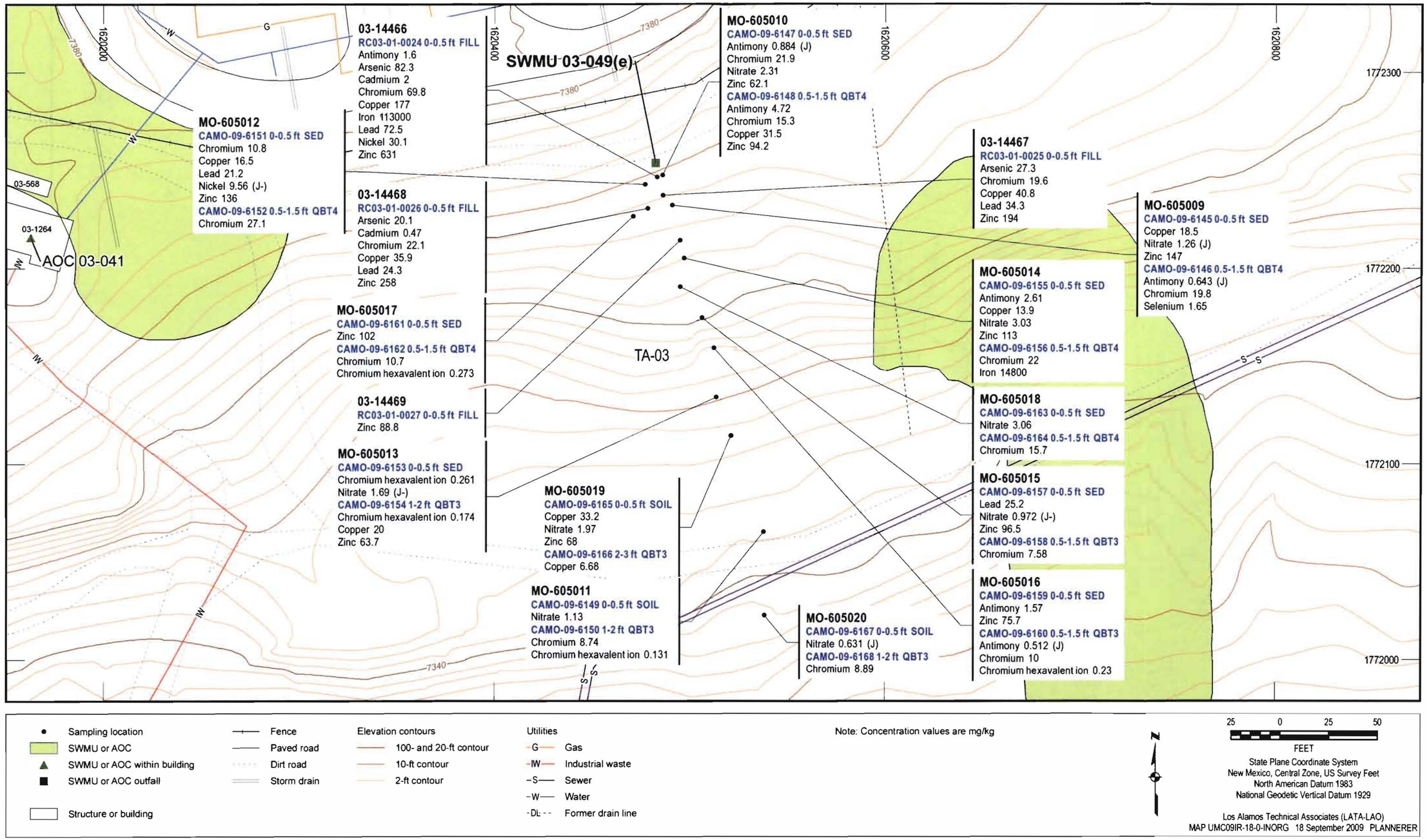
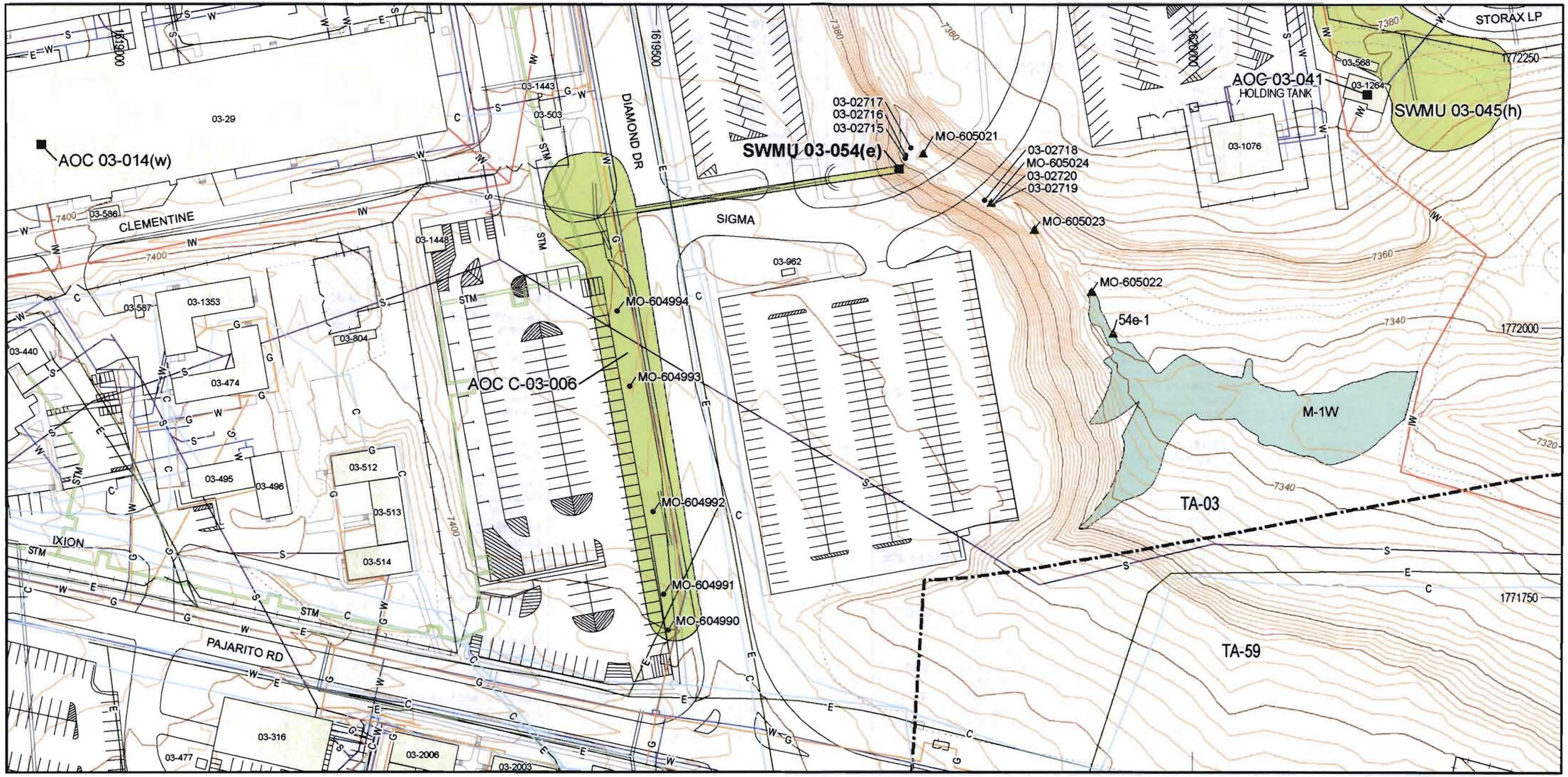


Figure 4.1-11 Inorganic chemicals detected or detected above BVs at SWMU 03-049(e)



Proposed sampling location
Existing sampling location
SWMU or AOC
SWMU or AOC within building
SWMU or AOC outfall

Fence
Paved road
Dirt road
Storm drain
Structure or building
Canyon reach

Elevation contours
100- and 20-ft contour
10-ft contour
2-ft contour

Utilities
C Communication
E Electric
G Gas
IW Industrial waste
S Sewer
STM Steam
W Water

50 0 50 100
FEET

Figure 4.1-12 Site map and proposed sampling locations at SWMU 03-054(e)

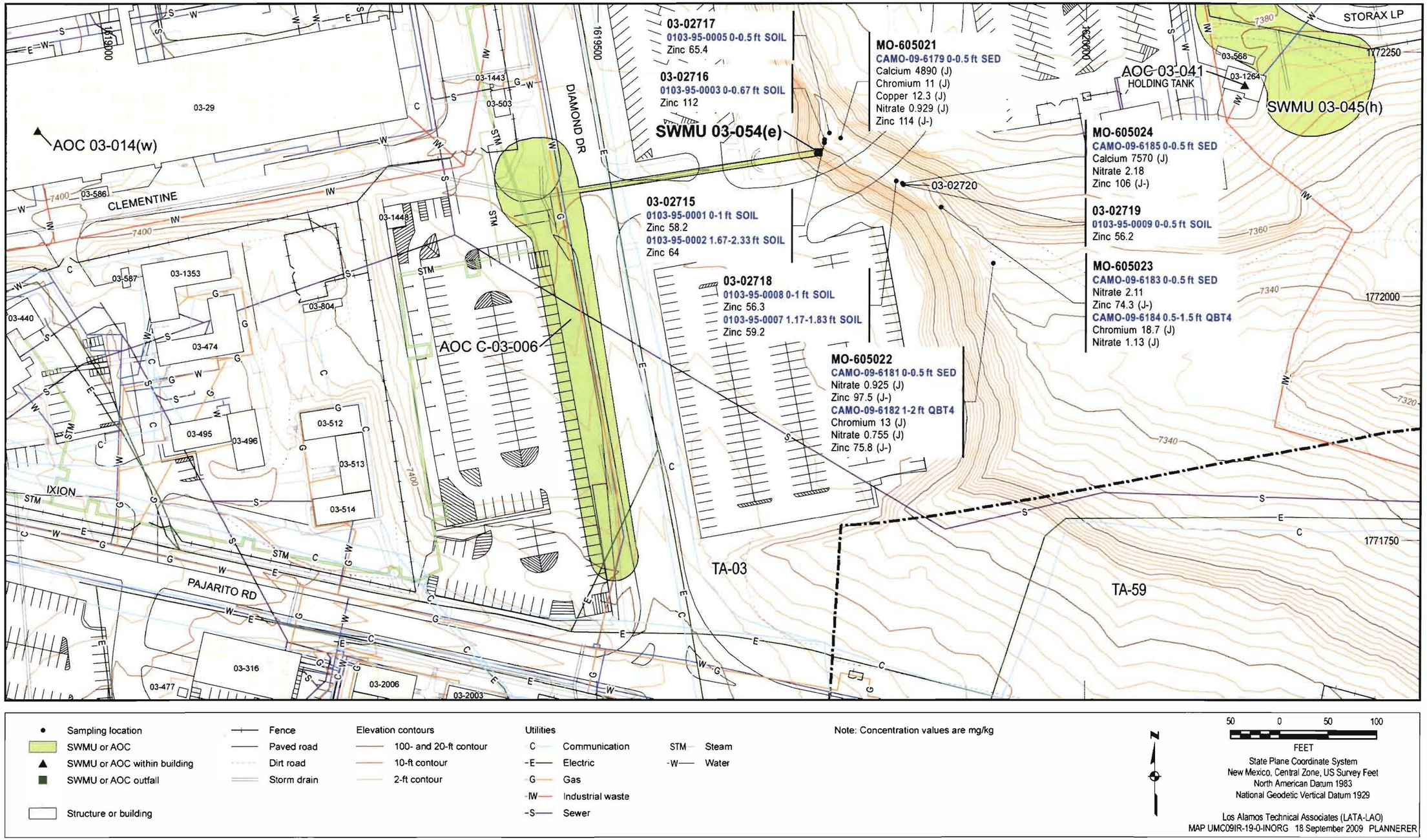


Figure 4.1-13 Inorganic chemicals detected or detected above BVs at SWMU 03-054(e)

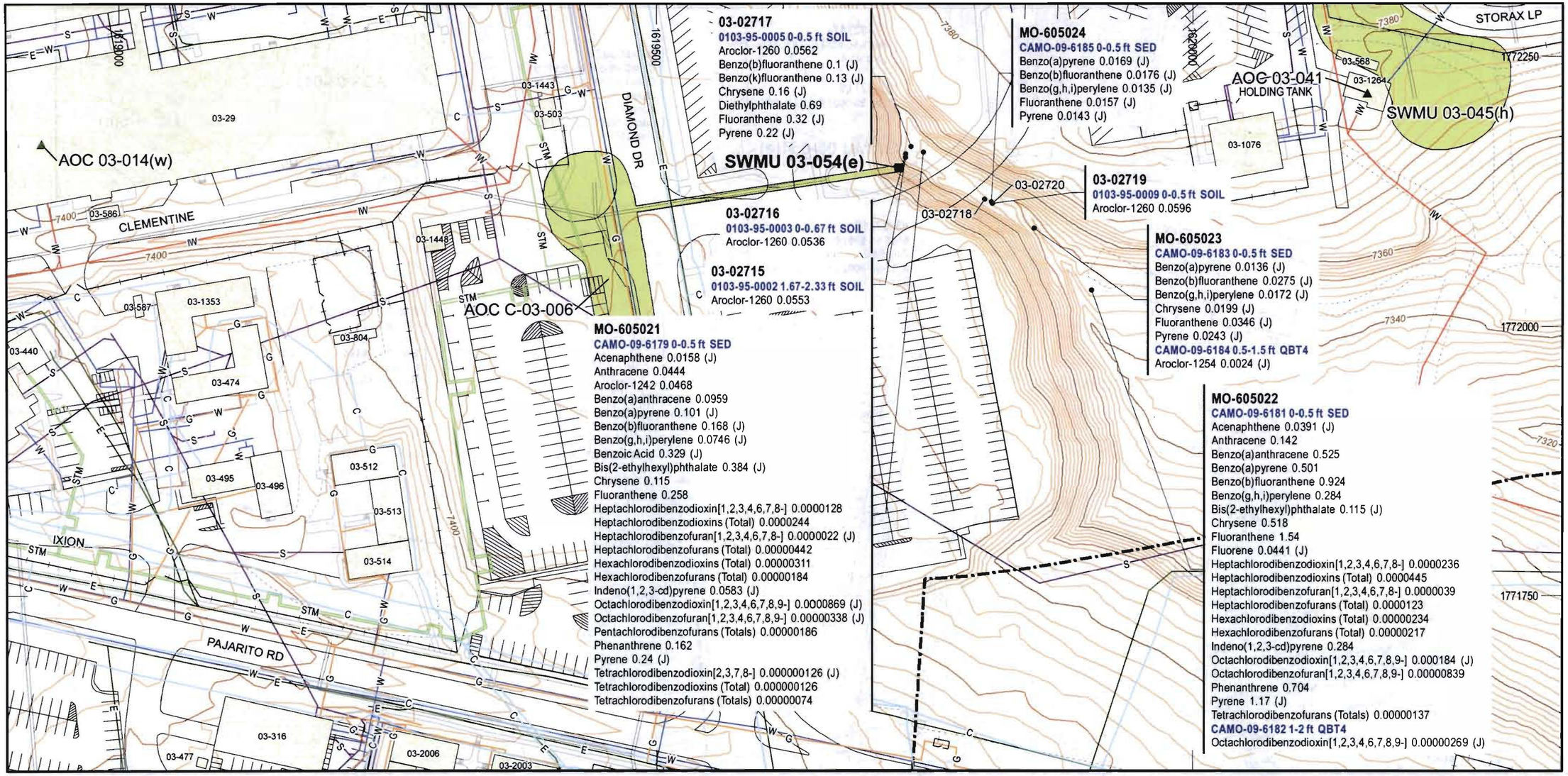


Figure 4.1-14 Organic chemicals detected at SWMU 03-054(e)

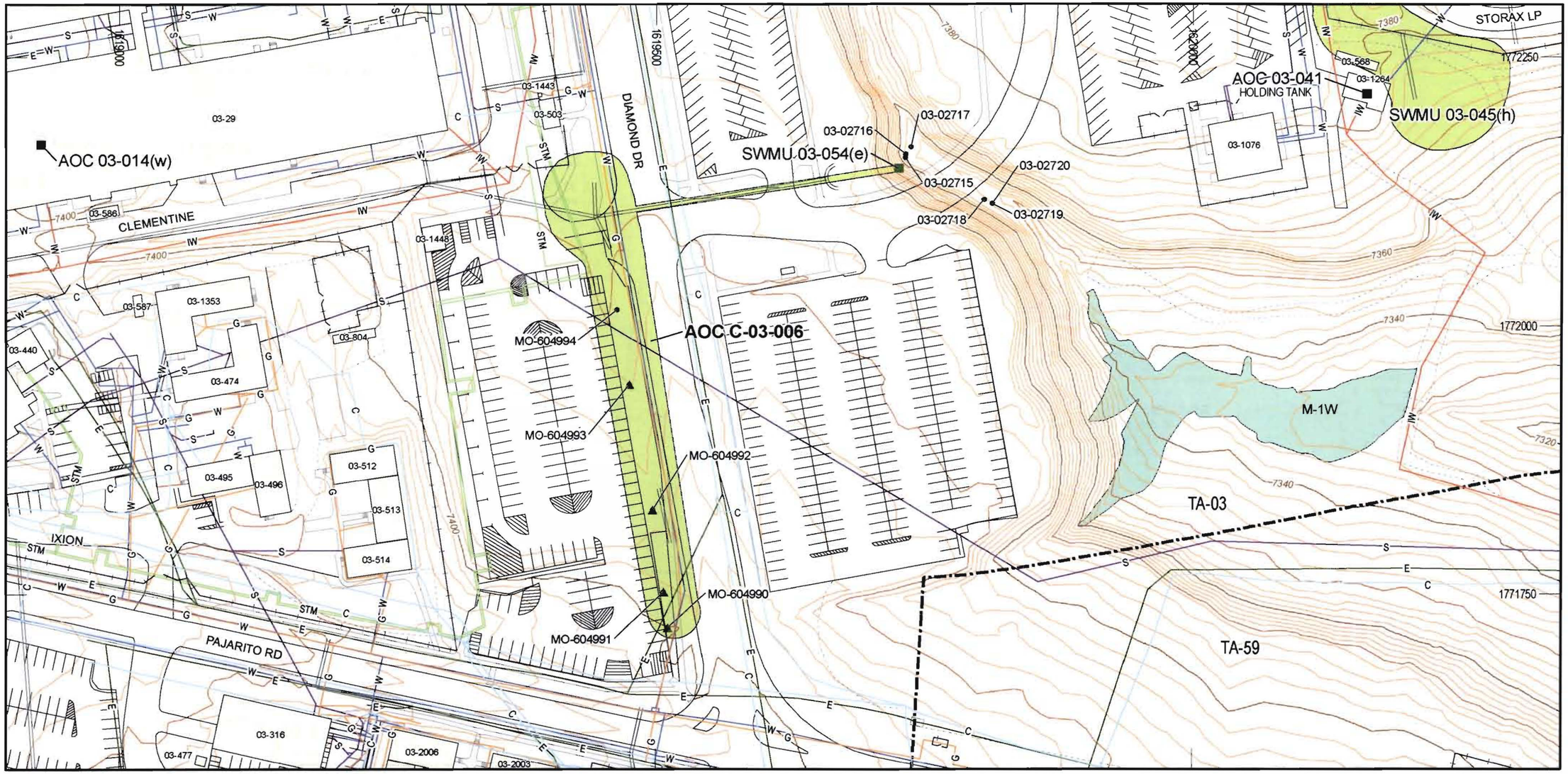


Figure 4.1-15 Site map and proposed sampling locations at AOC C-03-006

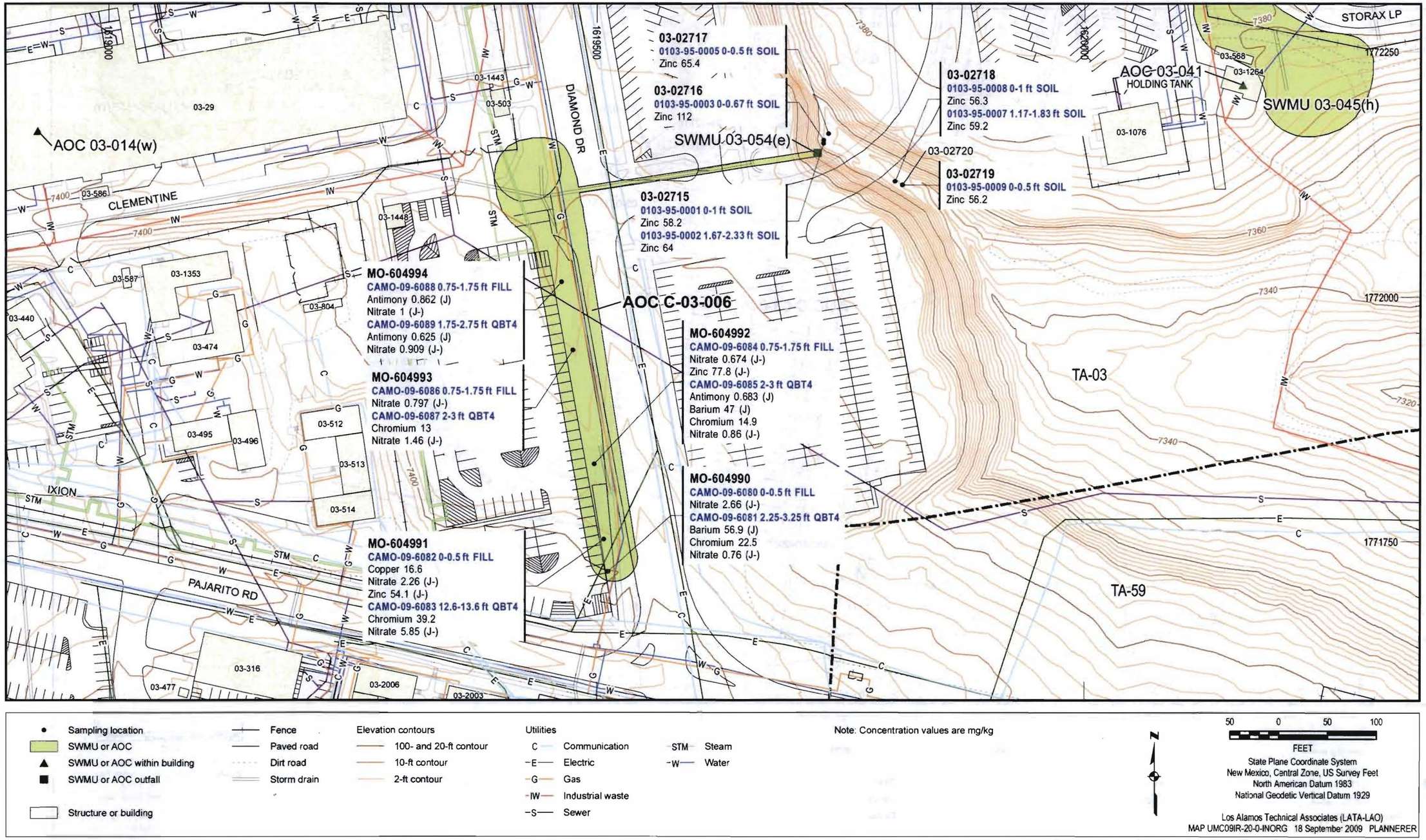


Figure 4.1-16 Inorganic chemicals detected or detected above BVs at AOC C-03-006

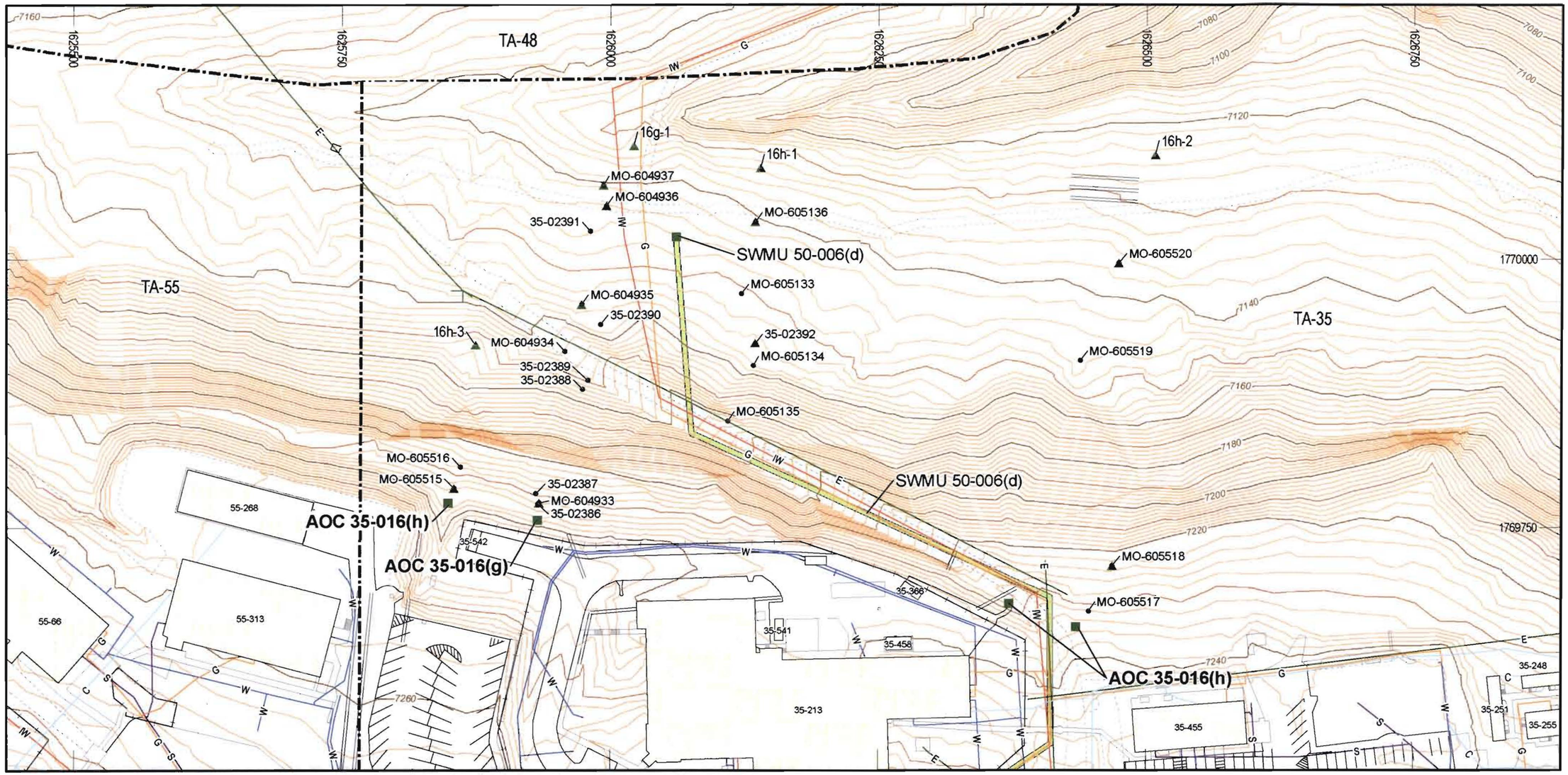


Figure 4.2-1 Site map and proposed sampling locations at AOCs 35-016(g) and 35-016(h)

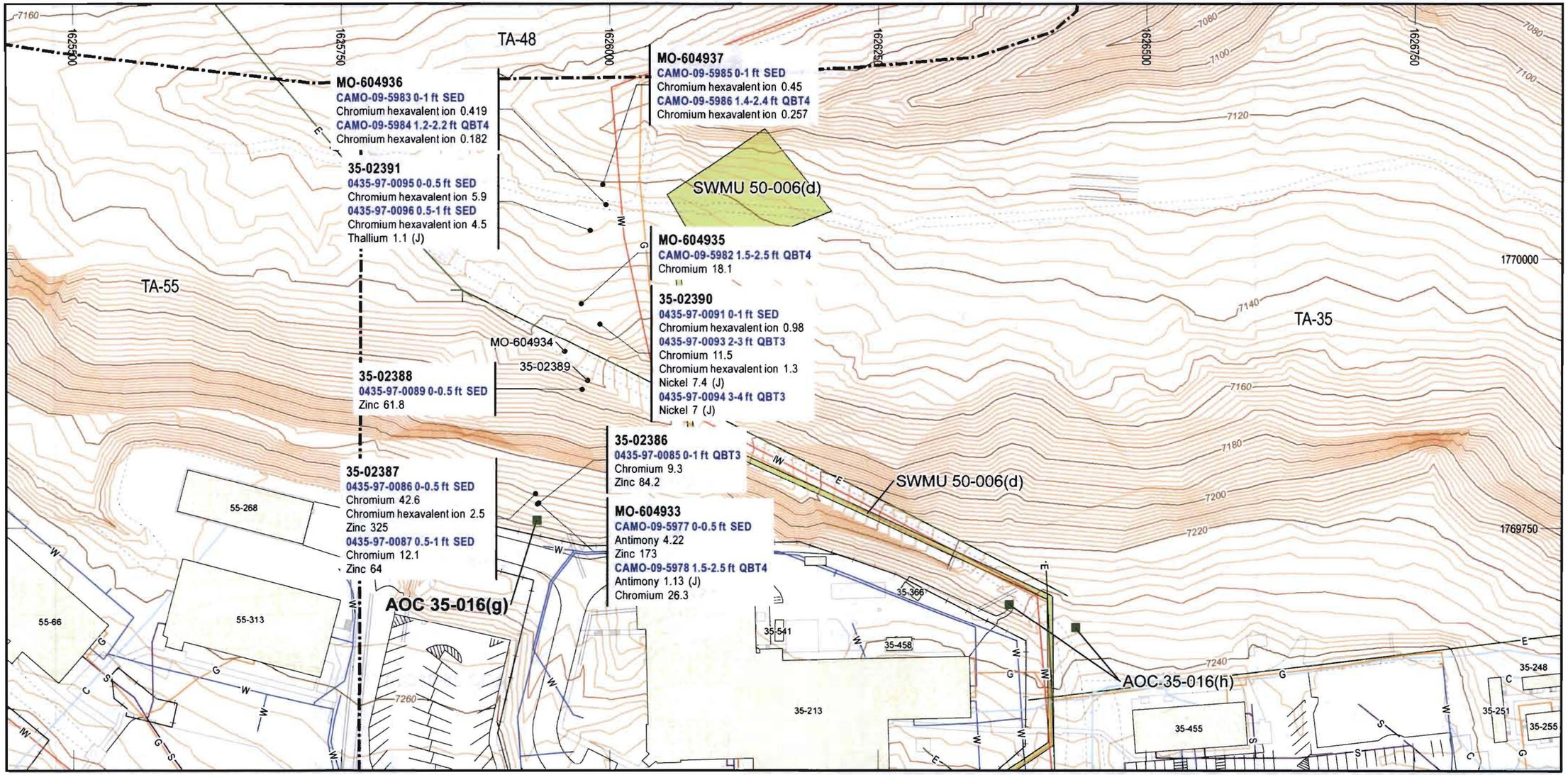


Figure 4.2-2 Inorganic chemicals detected or detected above BVs at AOC 35-016(g)

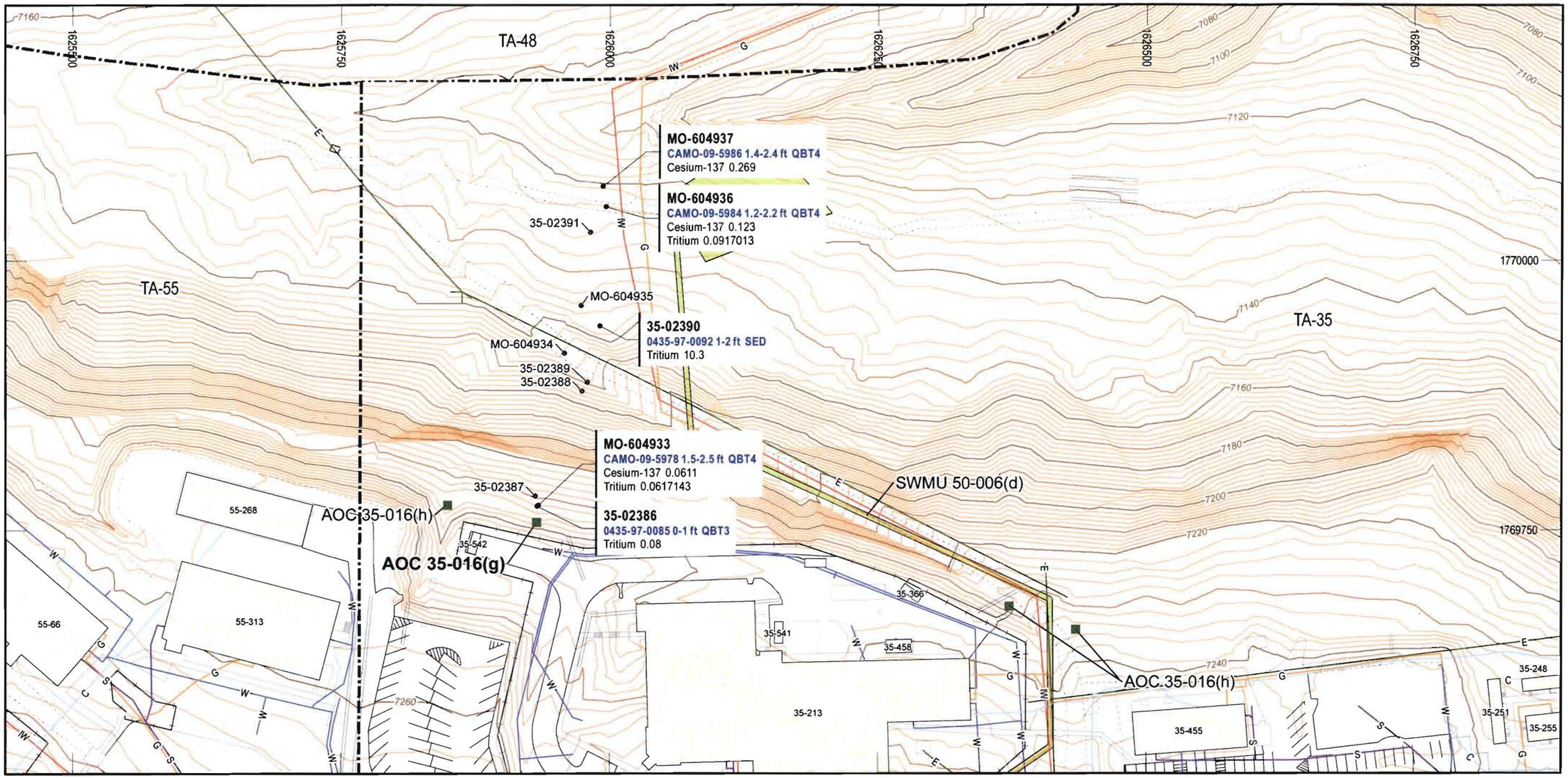


Figure 4.2-3 Radionuclides detected or detected above BVs/FVs at AOC 35-016(g)

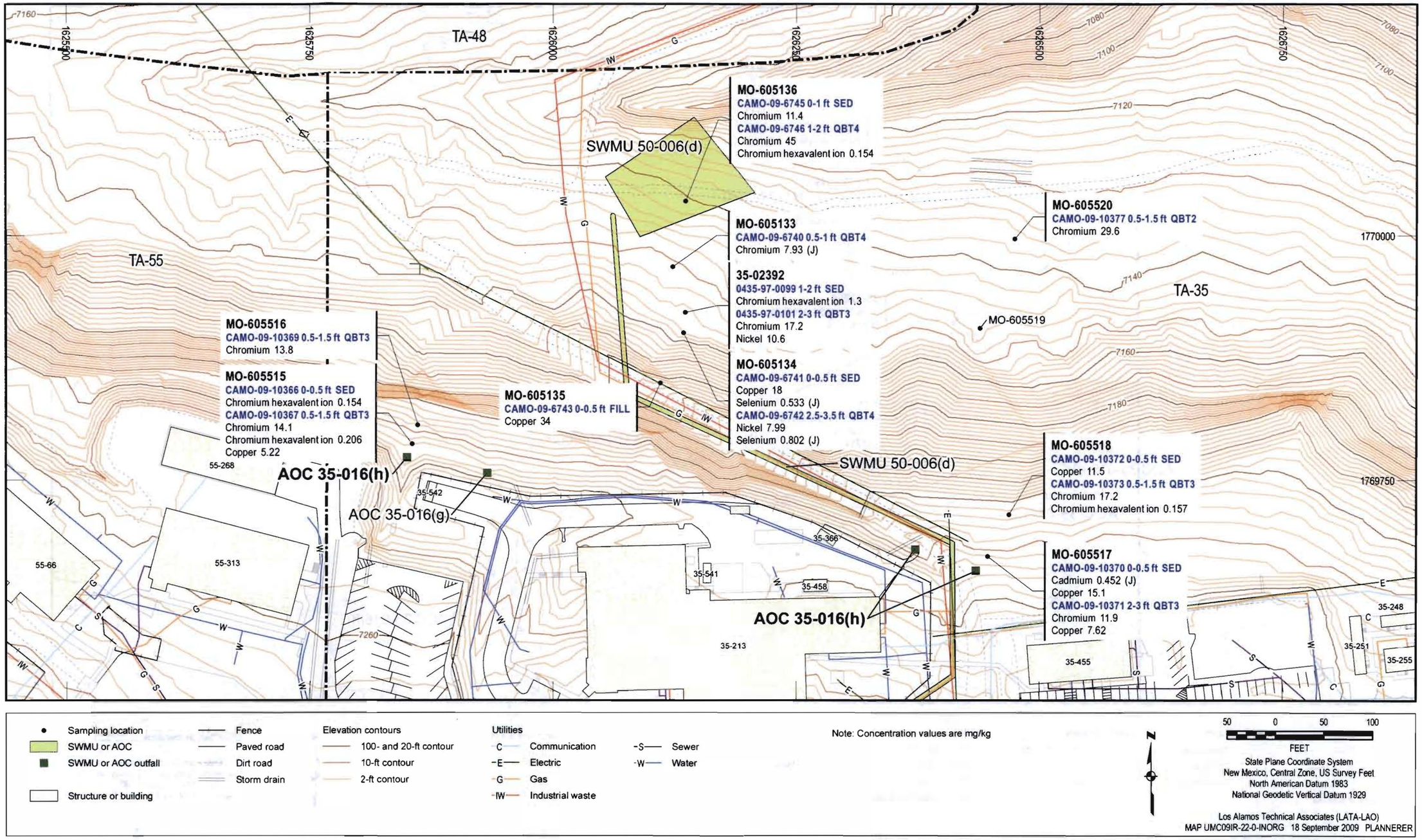


Figure 4.2-4 Inorganic chemicals detected or detected above BVs at AOC 35-016(h)

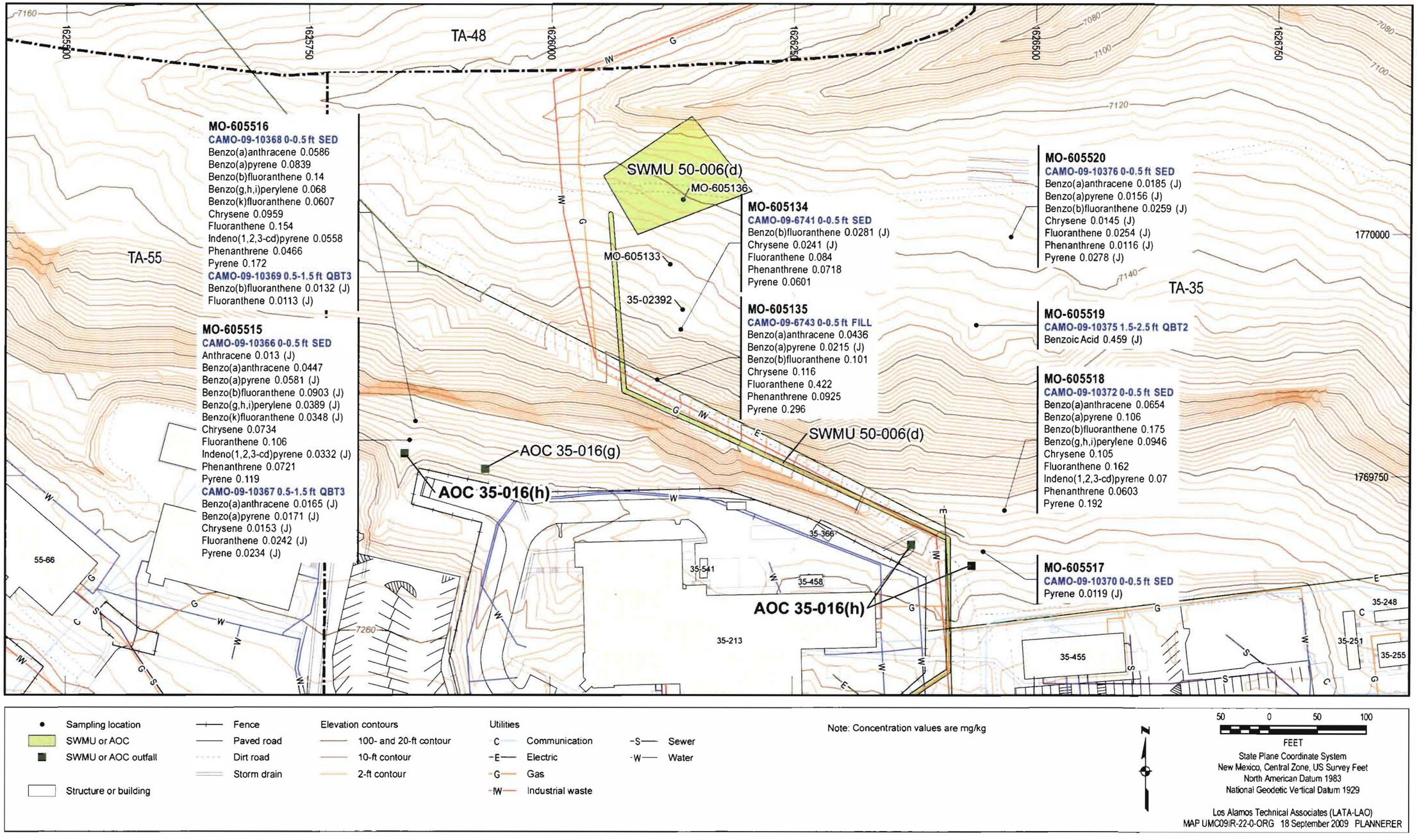
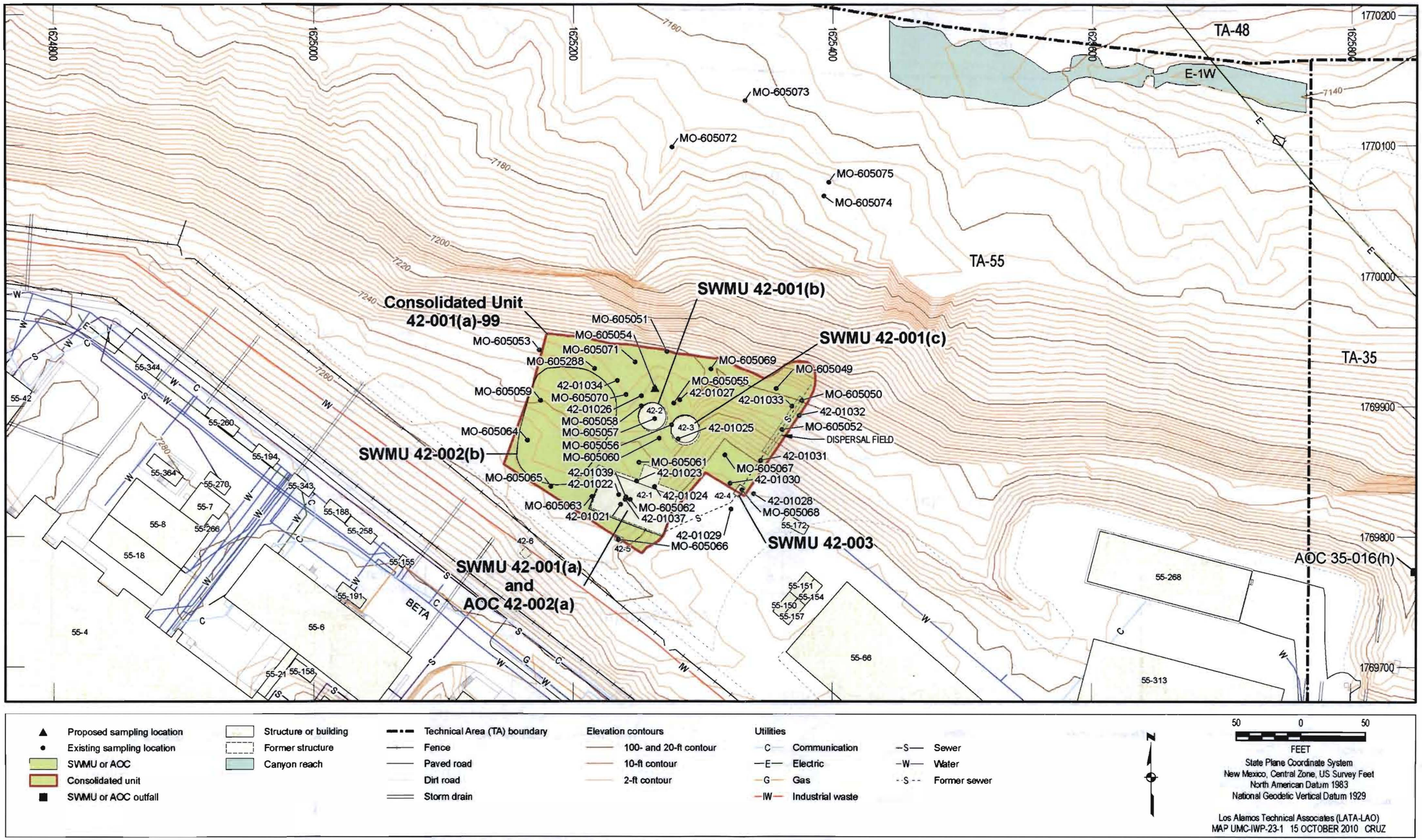


Figure 4.2-5 Organic chemicals detected at AOCs 35-016(h)



▲ Proposed sampling location
• Existing sampling location
SWMU or AOC
Consolidated unit
■ SWMU or AOC outfall

Structure or building
Former structure
Canyon reach

Technical Area (TA) boundary
Fence
Paved road
Dirt road
Storm drain

Elevation contours
100- and 20-ft contour
10-ft contour
2-ft contour

Utilities
C Communication
E Electric
G Gas
IW Industrial waste
S Sewer
W Water
S Former sewer

N

50 0 50
FEET
State Plane Coordinate System
New Mexico, Central Zone, US Survey Feet
North American Datum 1983
National Geodetic Vertical Datum 1929

Los Alamos Technical Associates (LATA-LAO)
MAP UMC-IWP-23-1 15 OCTOBER 2010 CRUZ

Figure 4.3-1 Site map and proposed sampling locations at Consolidated Unit 42-001(a)-99

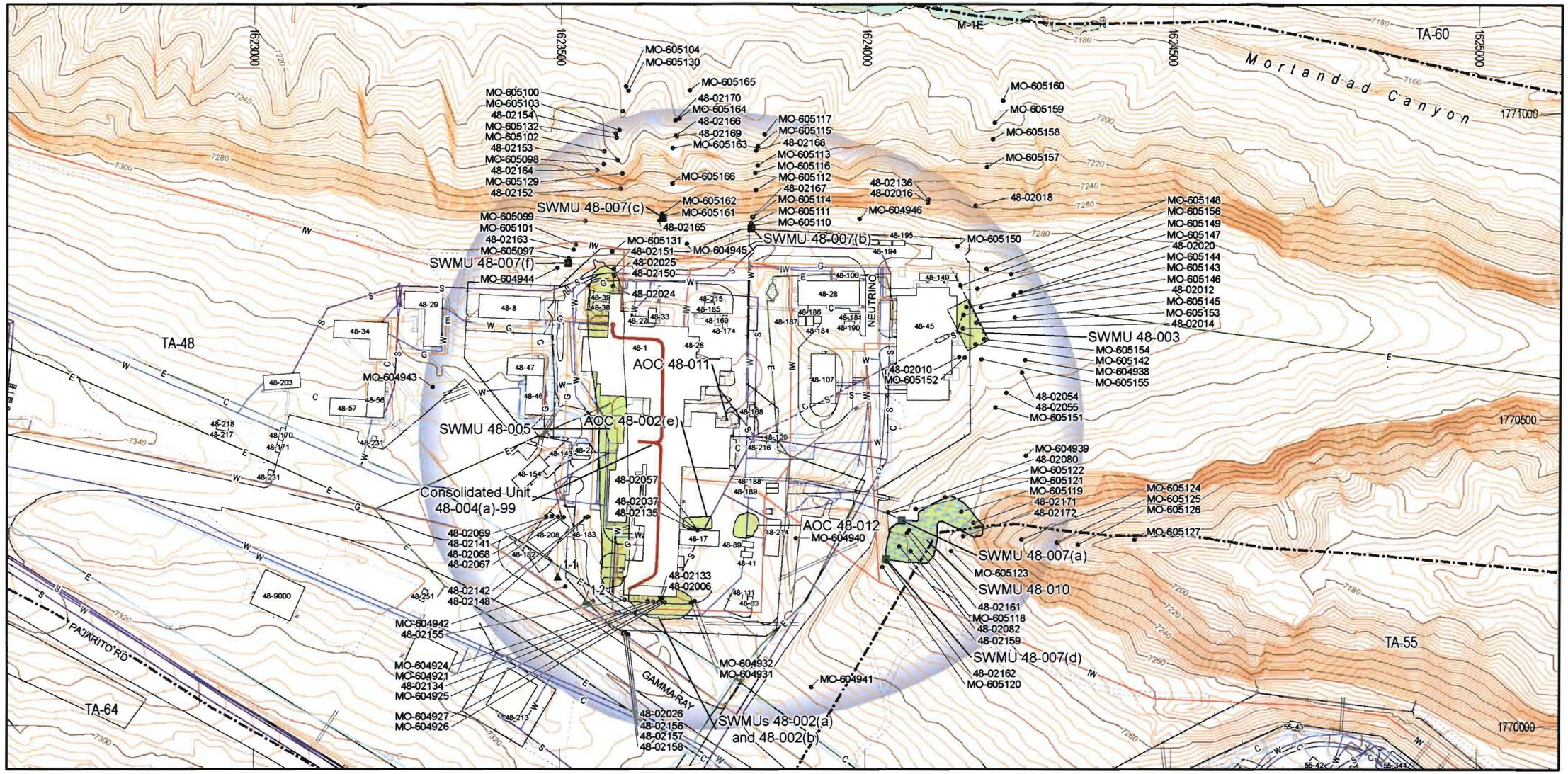


Figure 4.4-1 Site map and proposed sampling locations at AOC 48-001

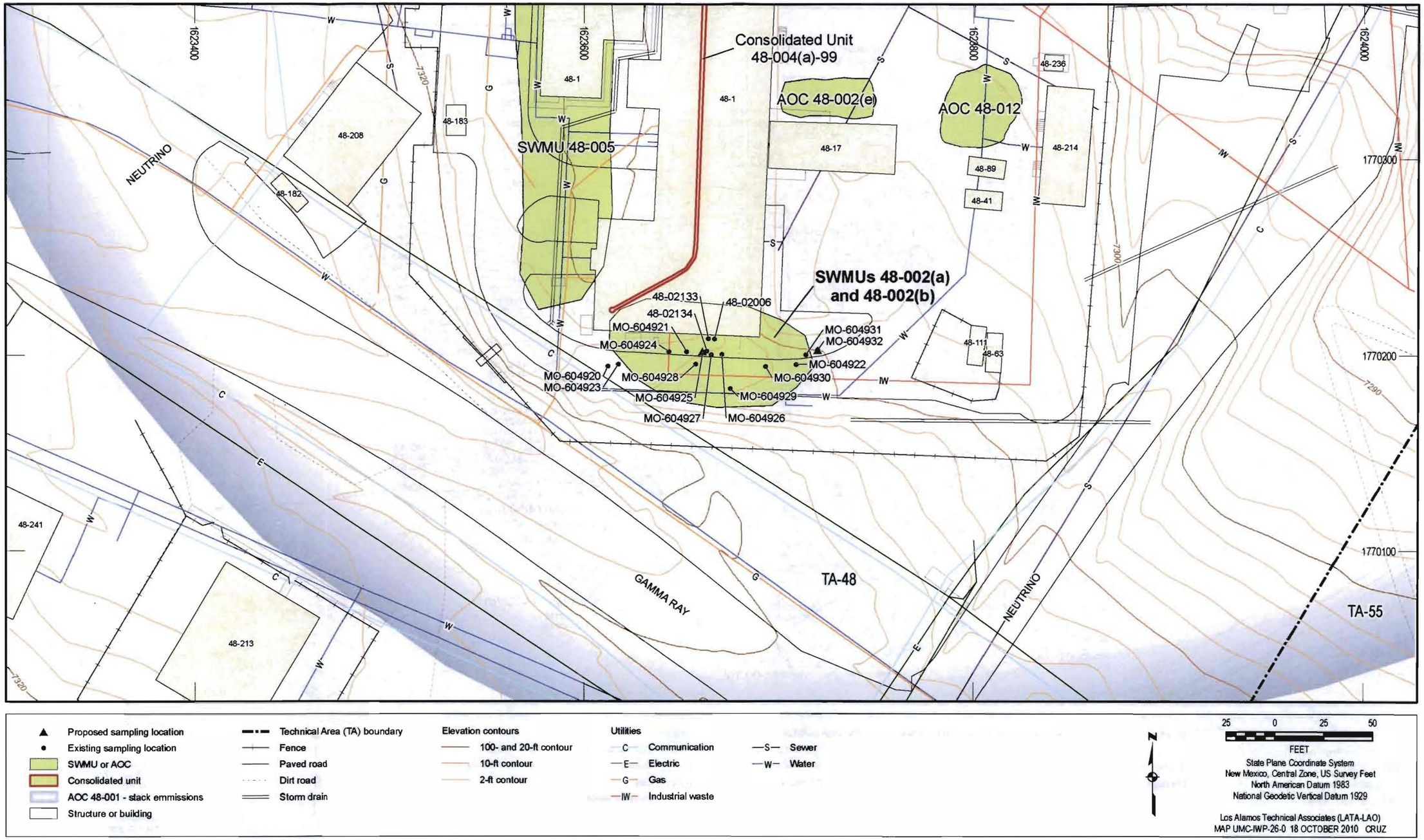


Figure 4.4-2 Site map and proposed sampling locations at SWMUs 48-002(a) and 48-002(b)

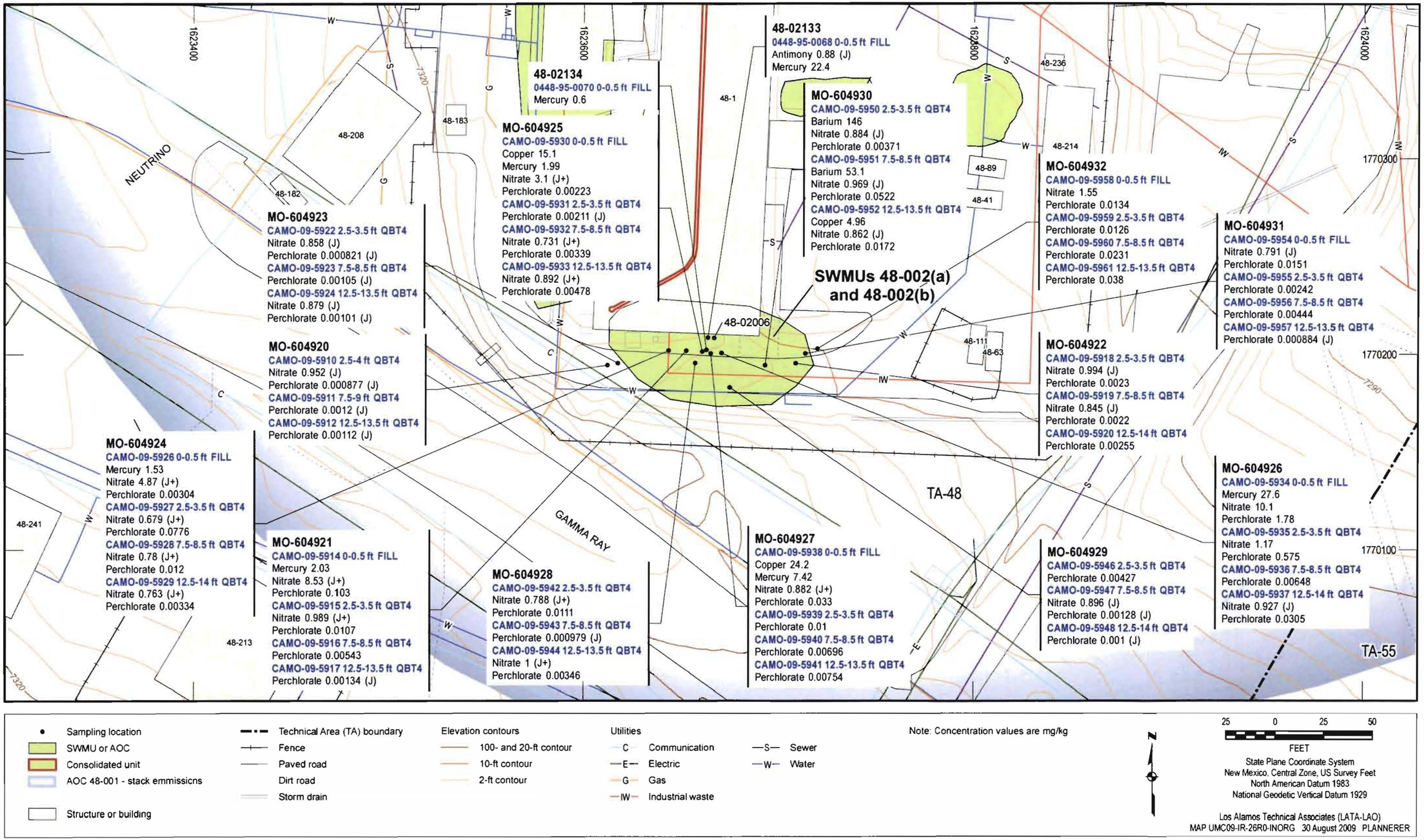


Figure 4.4-3 Inorganic chemicals detected or detected above BVs at SWMUs 48-002(a) and 48-002(b)

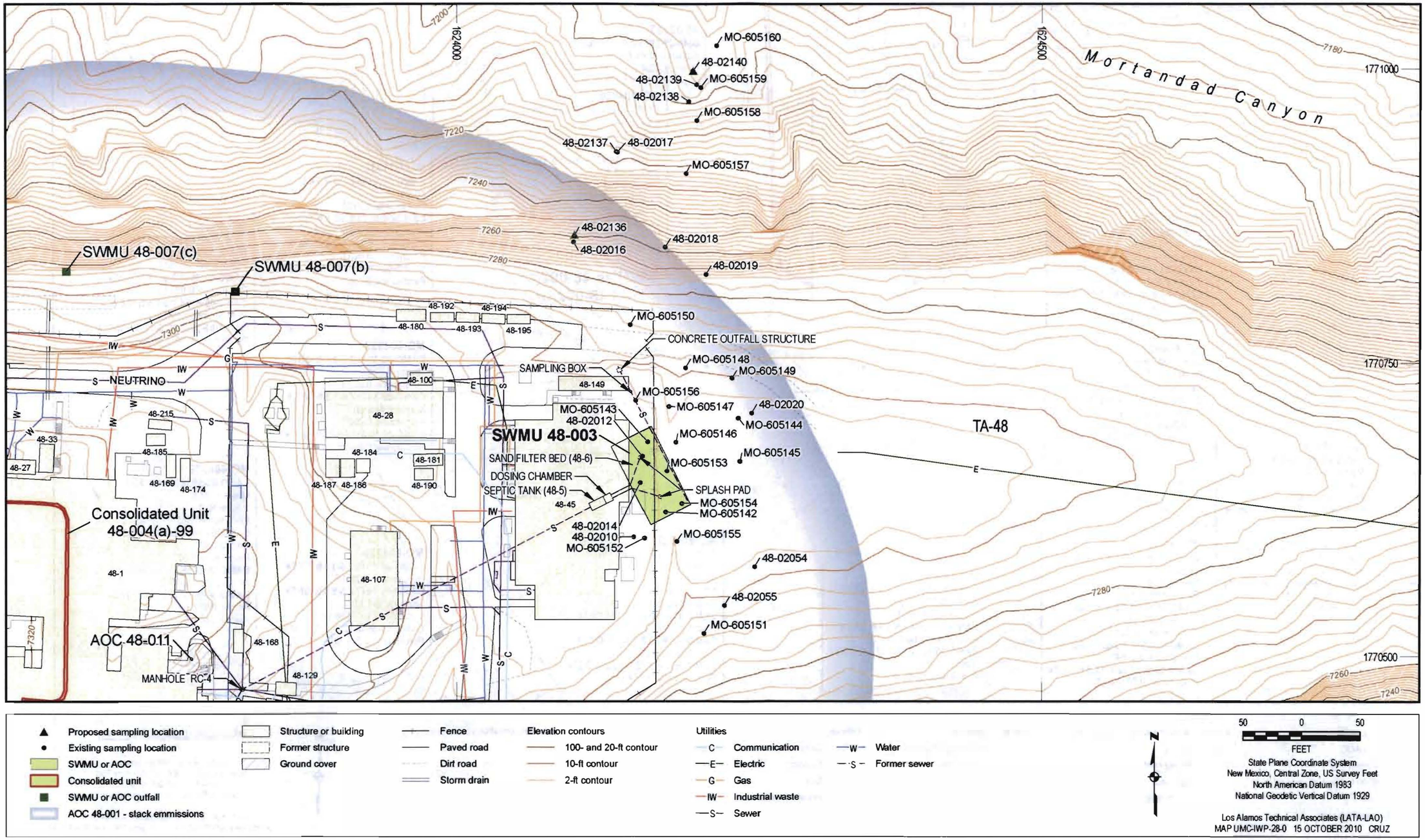


Figure 4.4-4 Site map and proposed sampling locations at SWMU 48-003

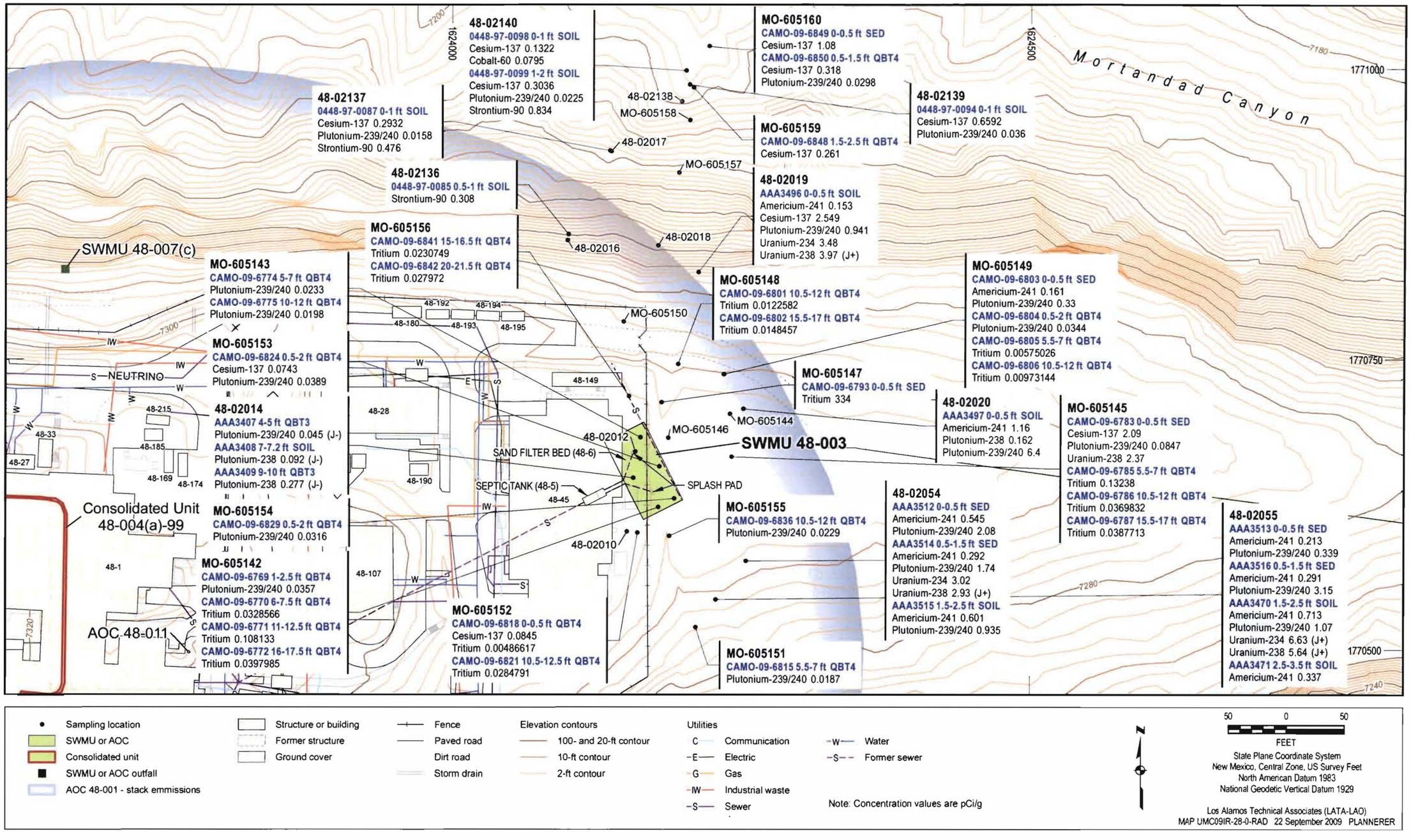


Figure 4.4-5 Radionuclides detected or detected above BVs/FVs at SWMU 48-003

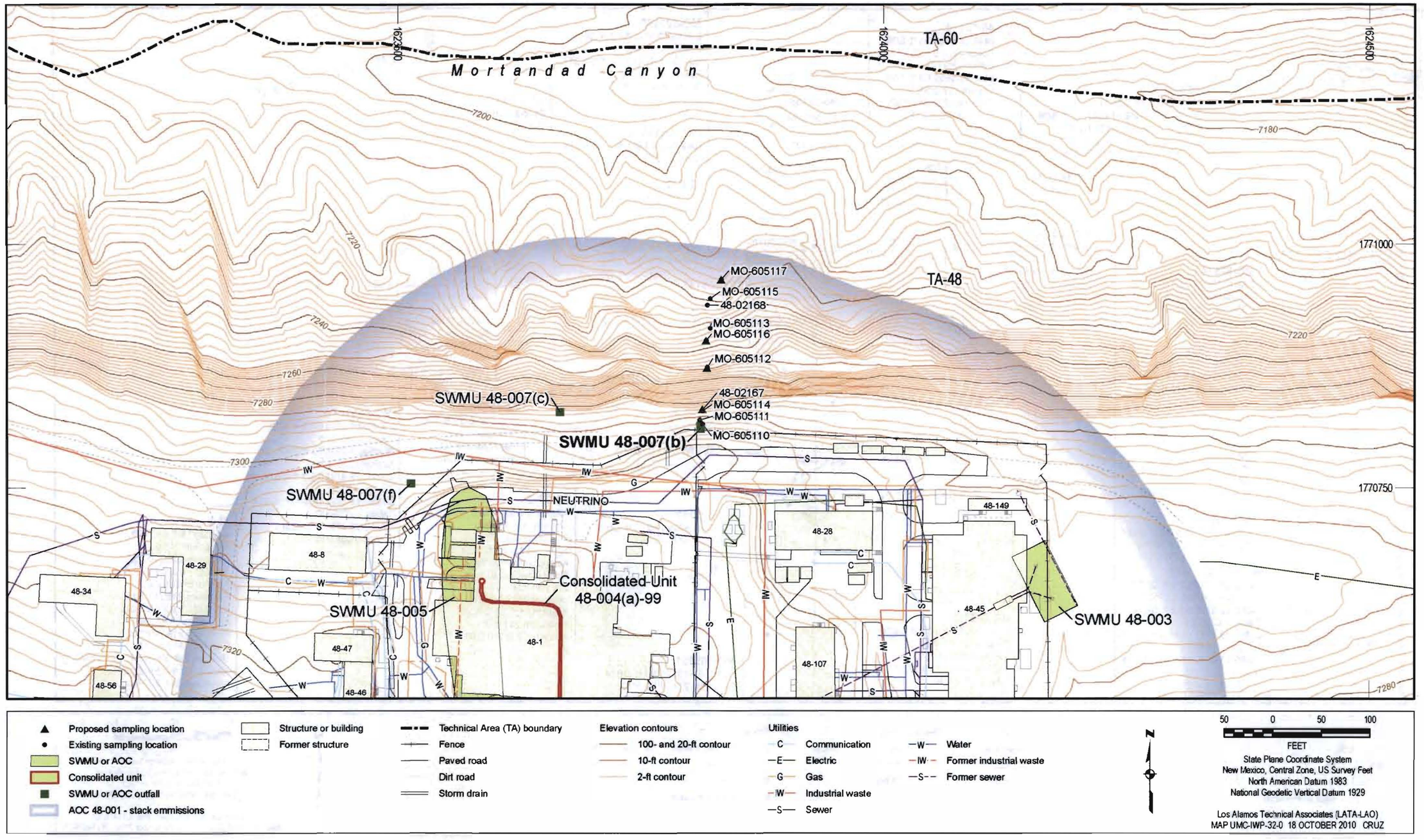


Figure 4.4-6 Site map and proposed sampling locations at SWMU 48-007(b)

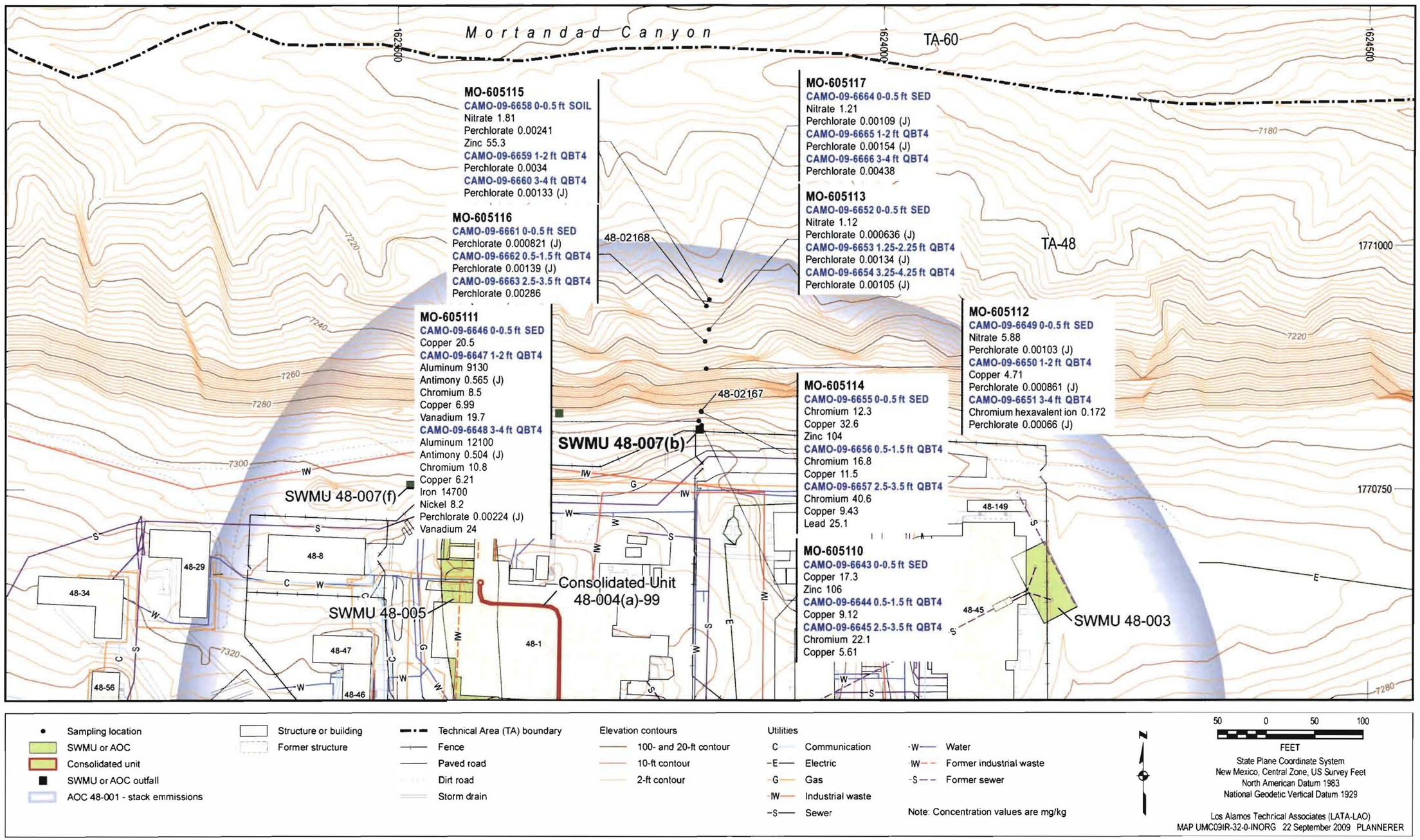


Figure 4.4-7 Inorganic chemicals detected or detected above BVs at SWMU 48-007(b)

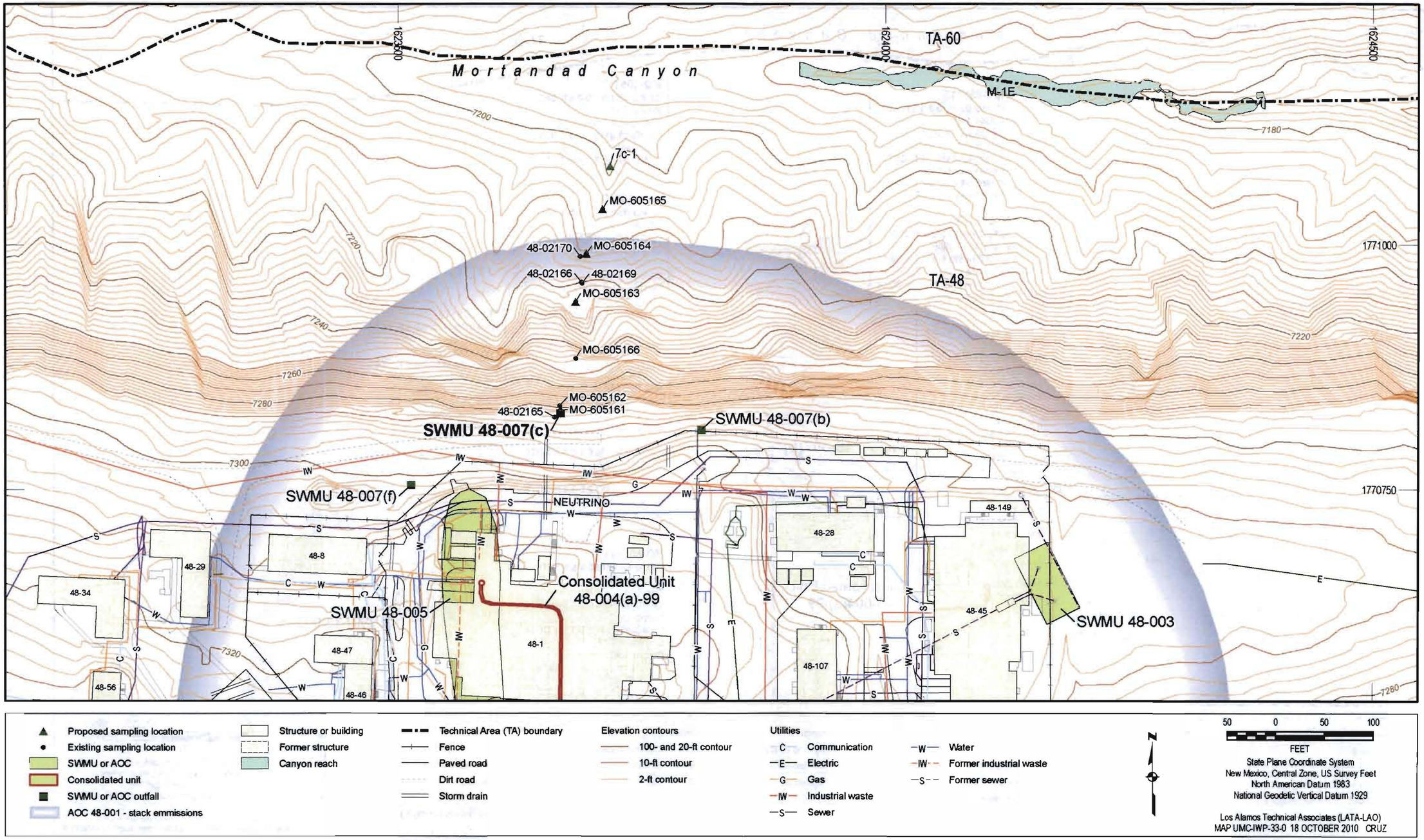


Figure 4.4-8 Site map and proposed sampling locations at SWMU 48-007(c)

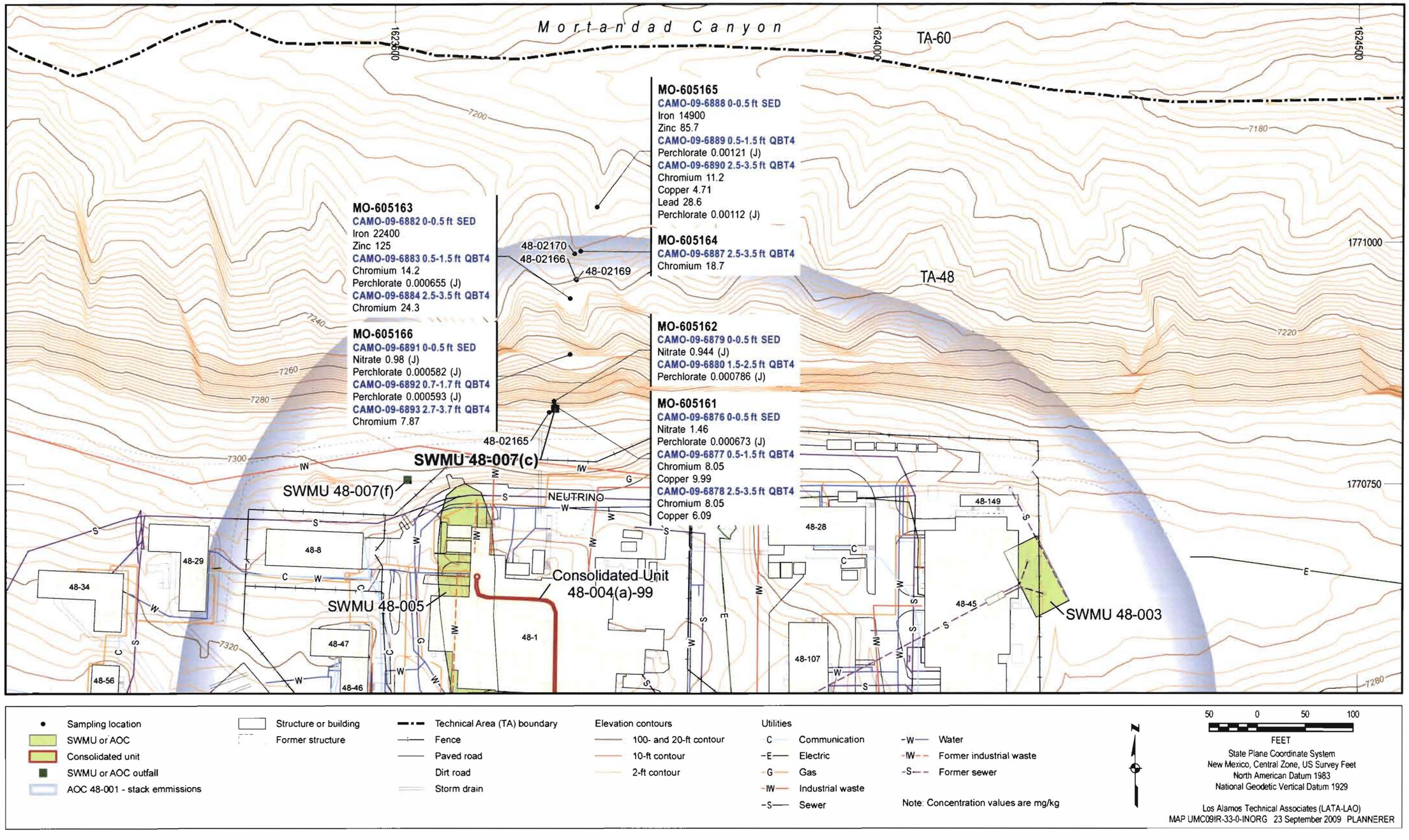


Figure 4.4-9 Inorganic chemicals detected or detected above BVs at SWMU 48-007(c)

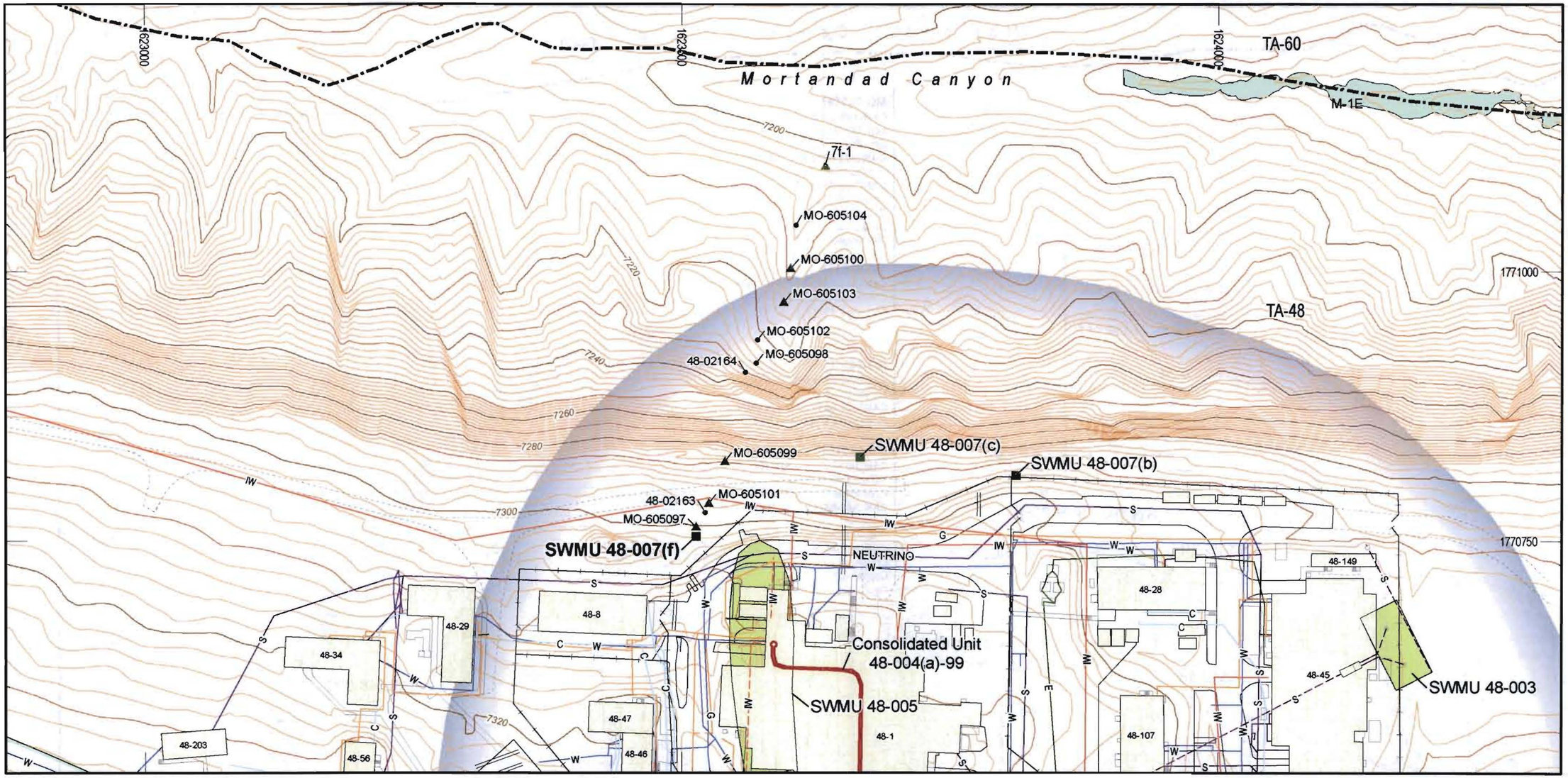


Figure 4.4-10 Site map and proposed sampling locations at SWMU 48-007(f)

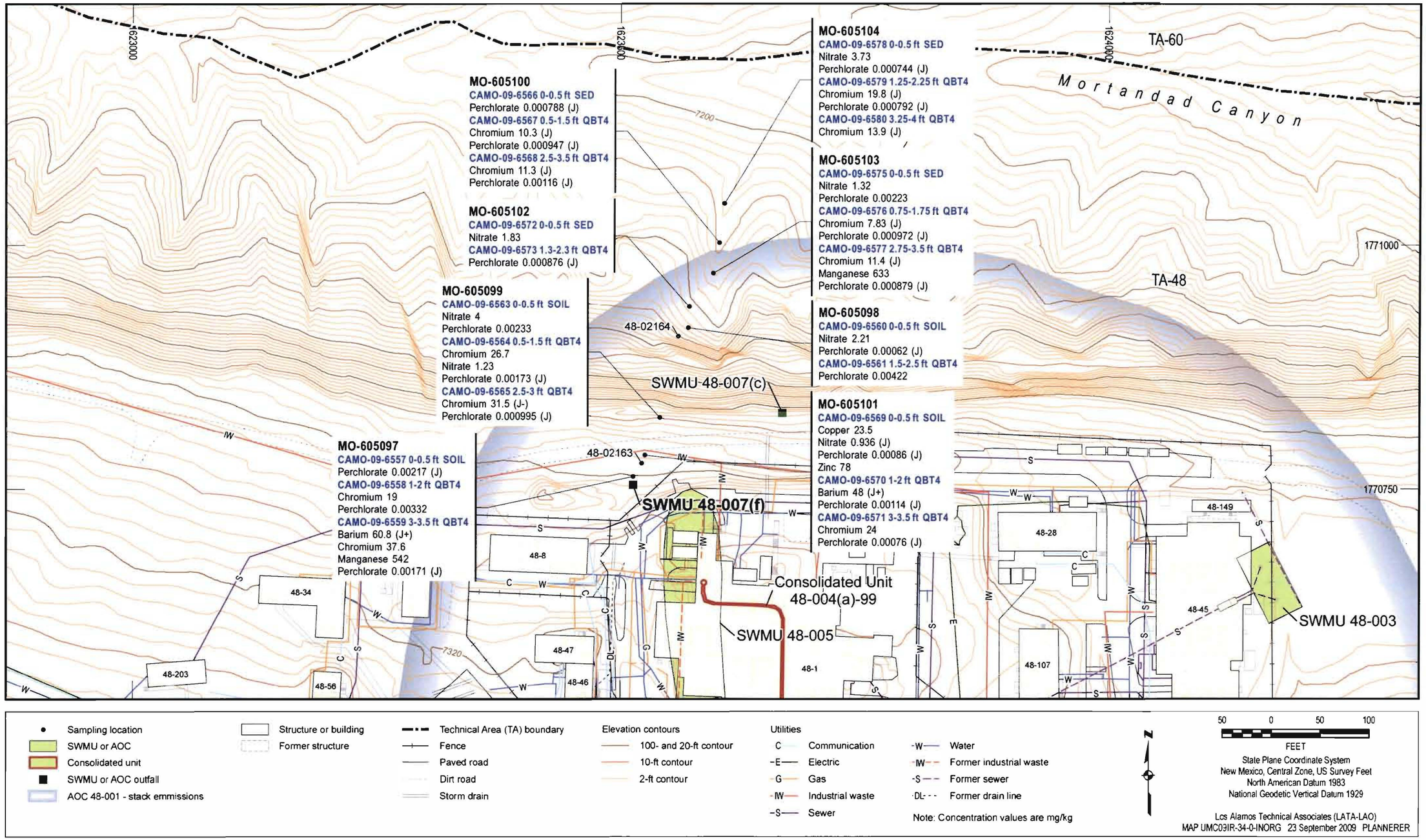


Figure 4.4-11 Inorganic chemicals detected or detected above BVs at SWMU 48-007(f)

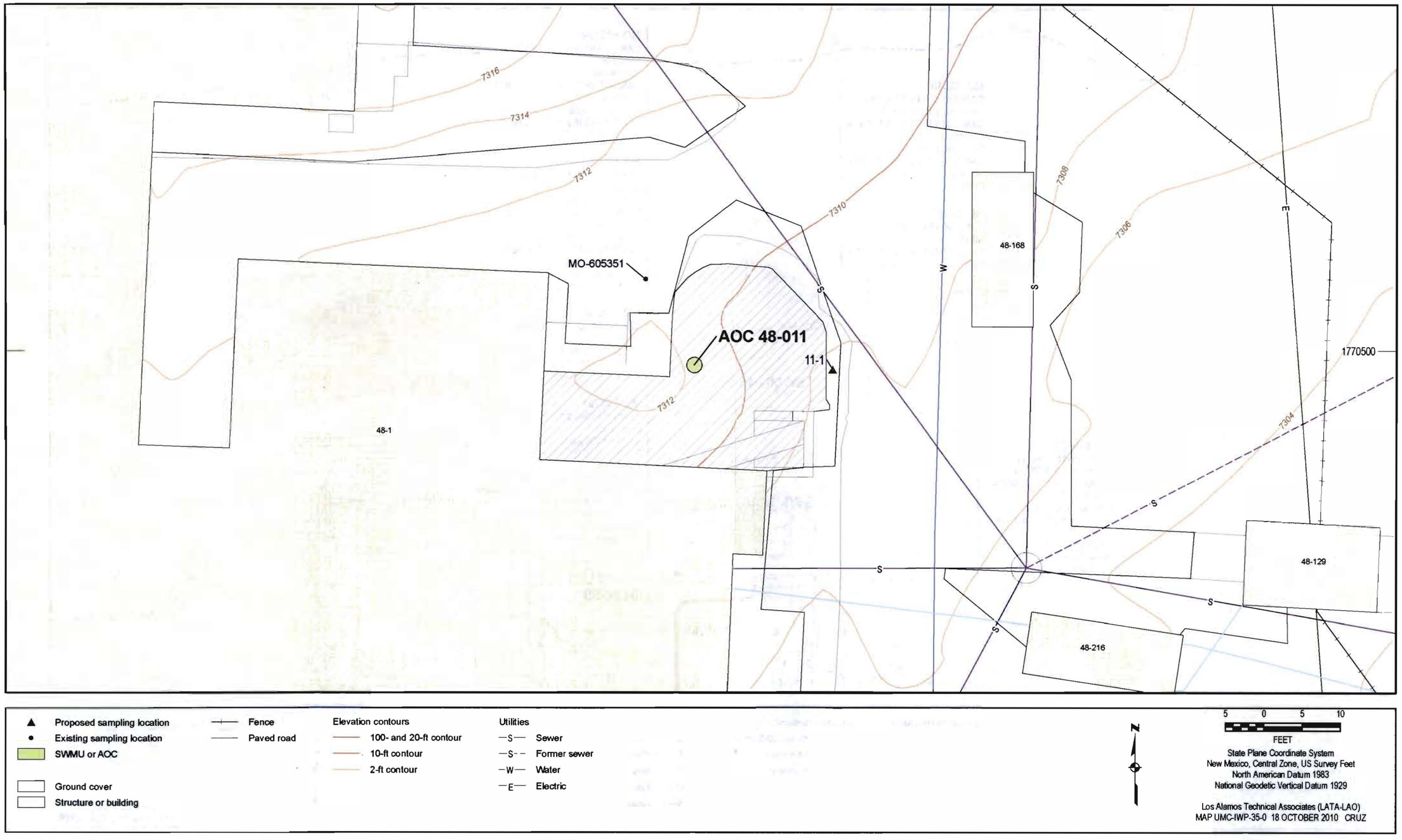


Figure 4.4-12 Site map and proposed sampling locations at AOC 48-011

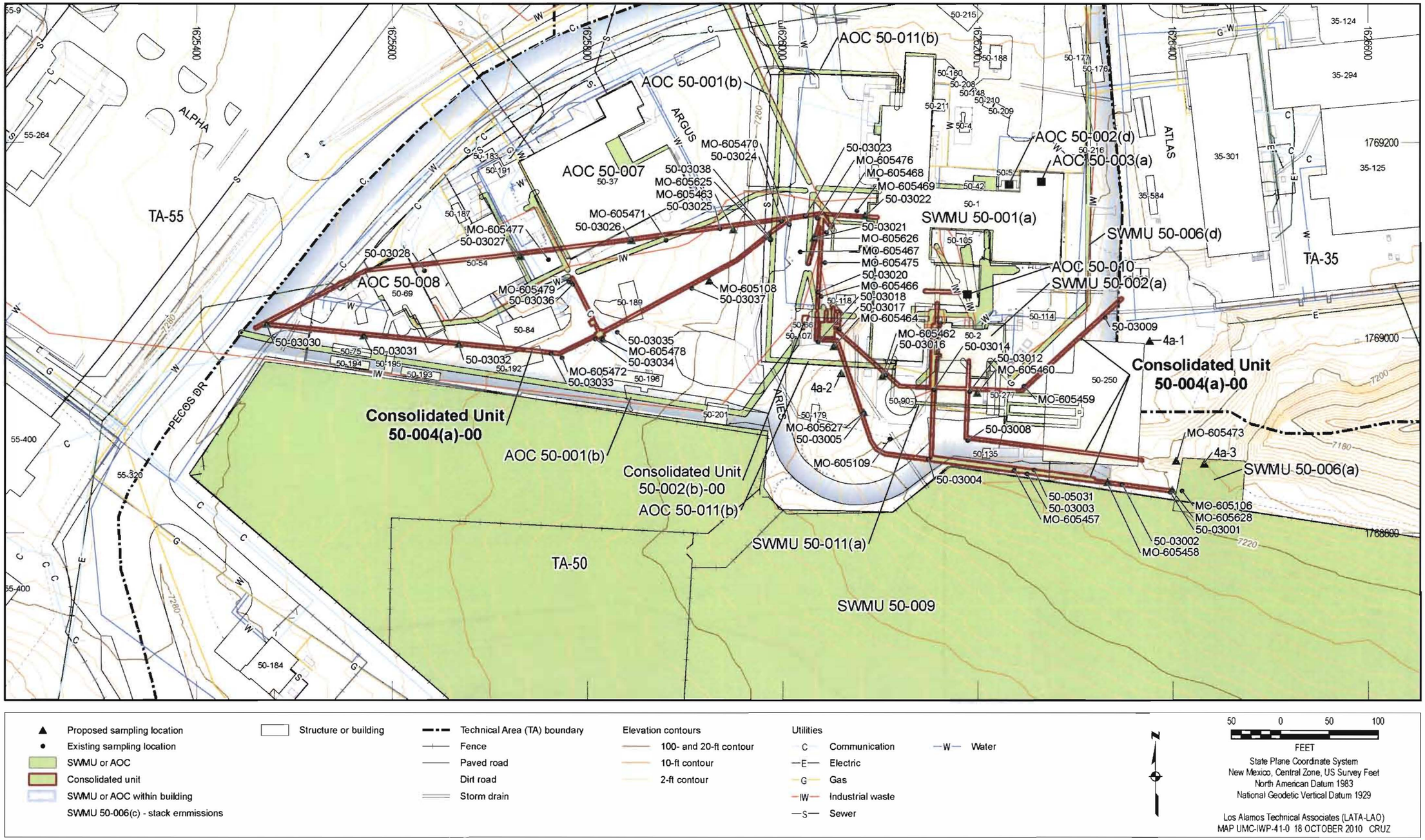


Figure 4.5-1 Site map and proposed sampling locations at Consolidated Unit 50-004(a)-00

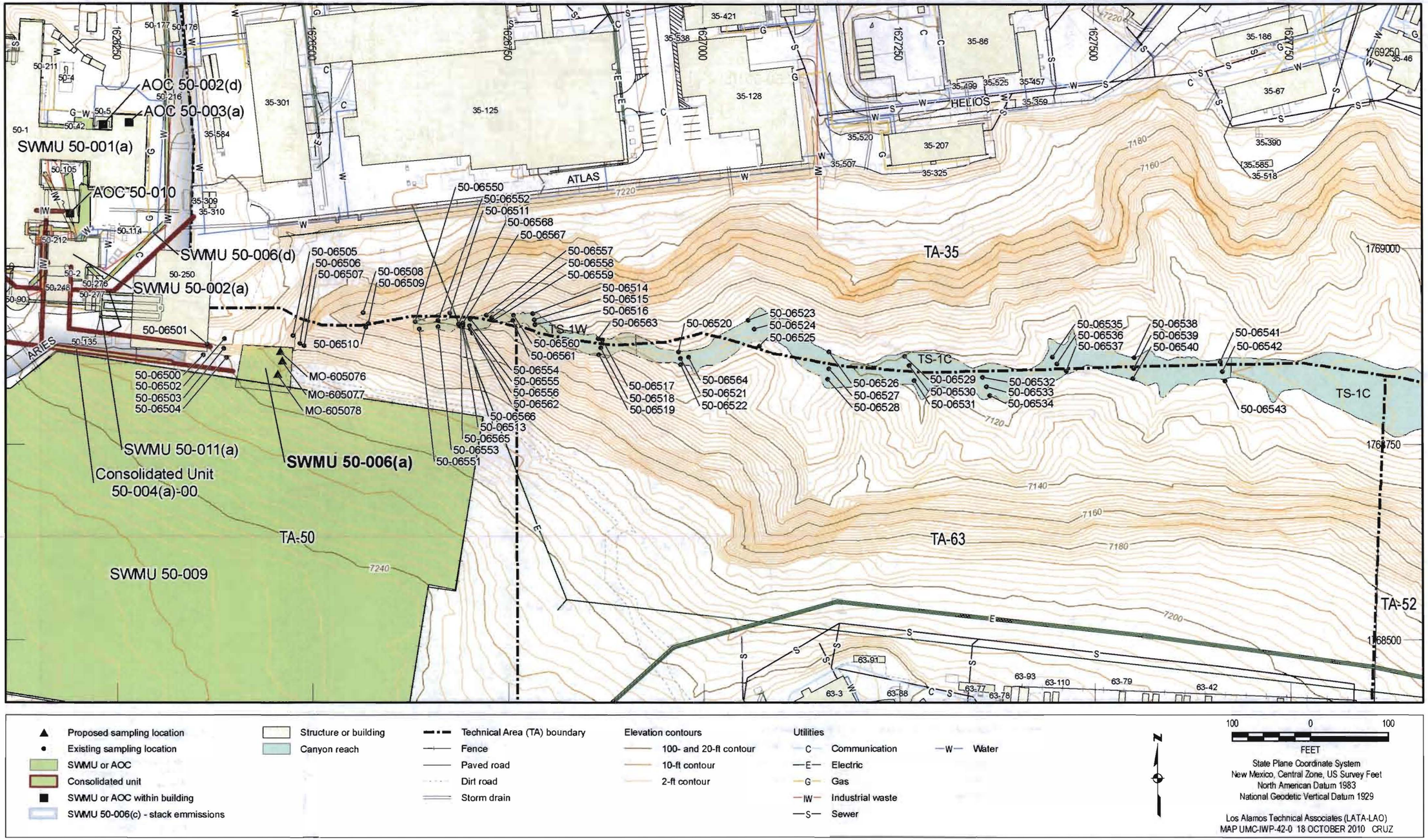


Figure 4.5-2 Site map and proposed sampling locations at SWMU 50-006(a)

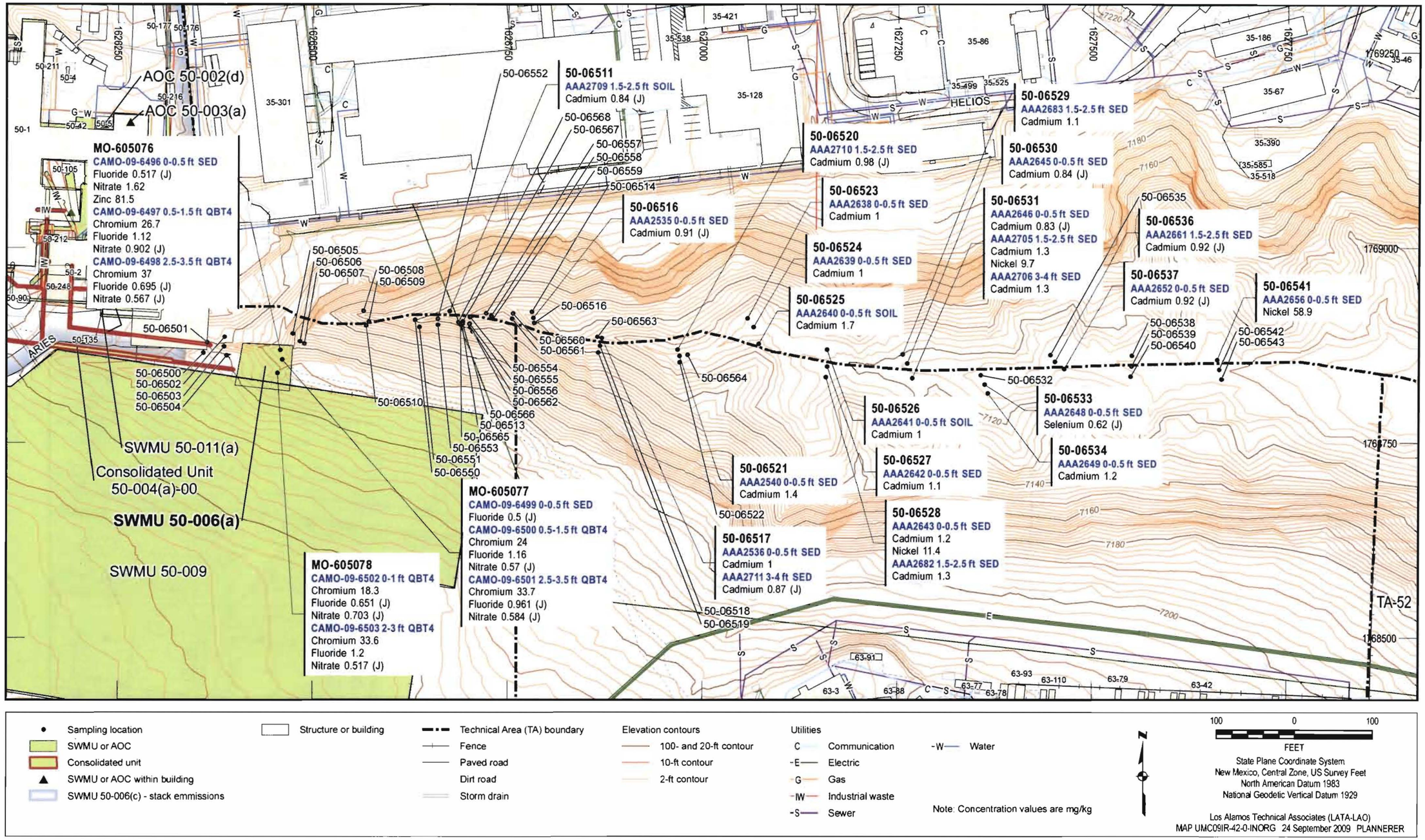


Figure 4.5-3 Inorganic chemicals detected or detected above BVs at SWMU 50-006(a)

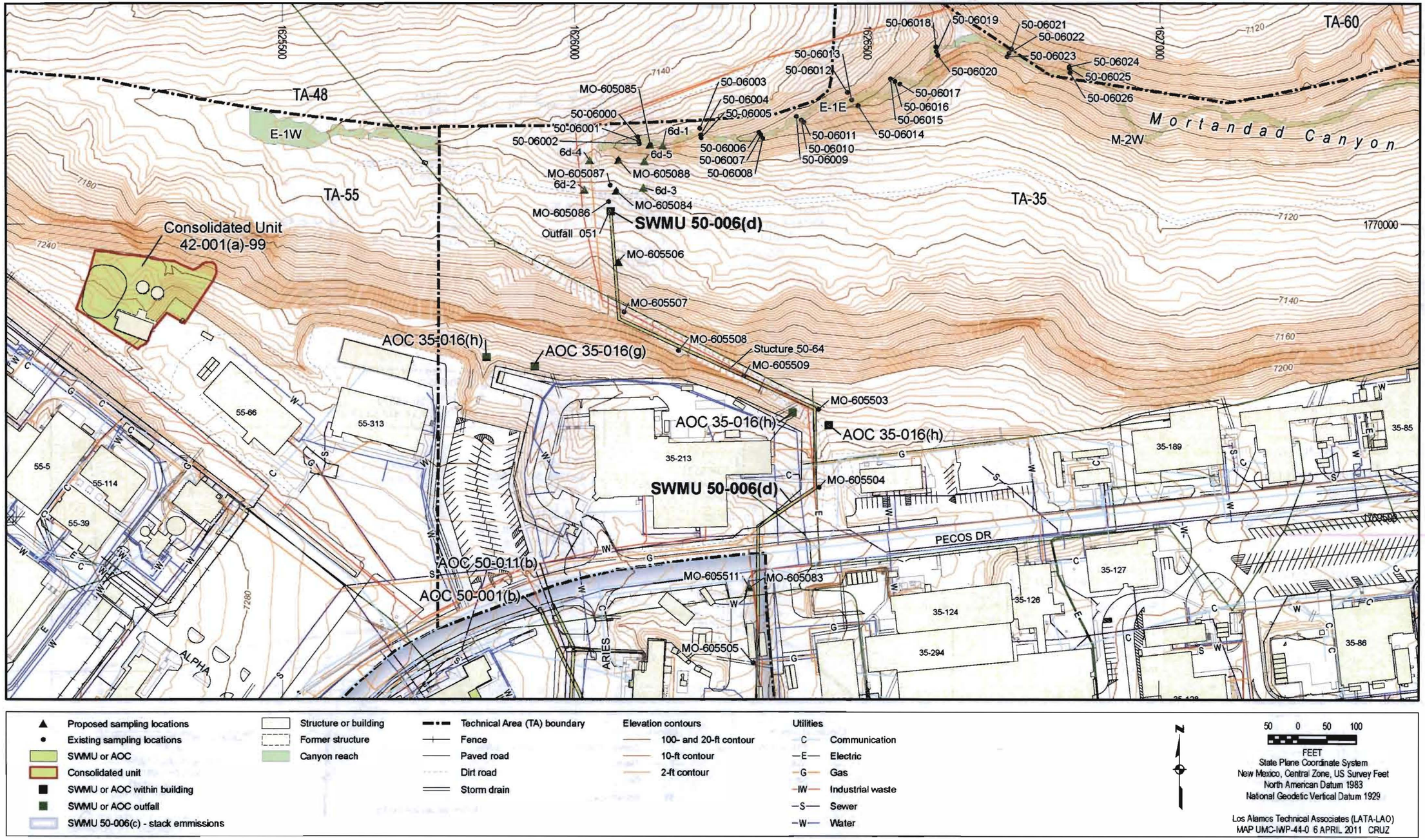


Figure 4.5-4 Site map and proposed sampling locations at SWMU 50-006(d)

Table 1.1-1
Sites under Phase II Investigation in the Upper Mortandad Canyon Aggregate Area

Consolidated Unit	SWMU/AOC	Brief Description	Phase I Investigation Results	Proposed Activities
TA-03				
	AOC 03-004(c)	Storage area at the main loading dock of the CMR Building (03-29)	Extent not defined (lateral extent of barium, chromium, copper, and manganese; vertical extent of chromium)	Additional sampling for extent
	AOC 03-004(d)	Former dumpster storage area located at the west end of Wing 9 of the CMR Building (03-29)	Extent not defined (lateral extent of chromium)	Additional sampling for extent
	AOC 03-007	Decommissioned firing site located southwest of the Beryllium Technology Facility (03-141)	Extent not defined (lateral/vertical extent of chromium)	Additional sampling for extent
Consolidated Unit 03-045(h)-00	SWMU 03-045(h)	Former NPDES-permitted outfall at the north perimeter of the Sigma Complex security fence, approximately 50 ft north of a cooling tower (03-187)	Extent not defined (lateral/vertical extent of barium and cobalt; lateral extent of antimony)	Additional sampling for extent
	SWMU 03-049(a)	NPDES-permitted outfall south of the Sigma Building (03-66) that discharges treated cooling water from a cooling tower (03-127) and roof-drain runoff to Mortandad Canyon	Extent not defined (vertical extent of chromium; lateral extent of dioxins/furans)	Additional sampling for extent
Consolidated Unit 03-049(b)-00	SWMU 03-049(b)	Discharge area from a former vacuum pump at the south wall of the Press Building (03-35)	Extent not defined (lateral extent of aluminum, chromium, total cyanide, lead, and perchlorate; vertical extent of PCBs; lateral/vertical extent of tritium)	Additional sampling for extent
	AOC C-03-014	Equipment storage area located southwest of the Press Building (03-35)		
	SWMU 03-049(e)	Outfall from a pipe that connects three roof drains, located south of the Sigma Building (03-66)	Extent not defined (vertical extent of antimony, chromium, hexavalent chromium, selenium, and zinc)	Additional sampling for extent
	SWMU 03-054(e)	Outfall located in upper Mortandad Canyon, receives roof drains and stormwater runoff at the CMR Building (03-29); received an unintentional one-time release from an industrial waste manhole (AOC C-03-006) in 1974	Extent not defined (vertical extent of chromium and zinc; lateral/vertical extent of phthalates and dioxins/furans; lateral extent of PAHs)	Additional sampling for extent

Table 1.1-1 (continued)

Consolidated Unit	SWMU/AOC	Brief Description	Phase I Investigation Results	Proposed Activities
	AOC C-03-006	Unintentional release at an industrial waste line manhole in 1974 that discharged to the outfall [SWMU 03-054(e)]	Extent not defined (vertical extent of chromium)	Additional sampling for extent
TA-35				
	AOC 35-016(g)	Drain and outfall from building 35-213	Extent not defined (vertical extent of chromium; lateral/vertical extent of cesium-137)	Additional sampling for extent
	AOC 35-016(h)	Stormdrains and outfalls associated with building 35-213	Extent not defined (lateral/vertical extent chromium; vertical extent of hexavalent chromium; lateral extent of PAHs)	Additional sampling for extent
Former TA-42				
Consolidated Unit 42-001(a)-00	SWMU 42-001(a)	Former location for building 42-1 that housed the incinerator	Extent not defined (vertical extent of tritium)	Additional sampling for extent
	SWMU 42-001(b)	Former location of one of the two ash storage tanks associated with the incinerator		
	SWMU 42-001(c)	Former location of the other ash storage tank		
	AOC 42-002(a)	Former location of an indoor storage and decontamination area (building 42-1)		
	SWMU 42-002(b)	Former location of the outdoor decontamination area		
	SWMU 42-003	Former septic system that served building 42-1		
TA-48				
	AOC 48-001	Air exhaust system at building 48-1	Extent not defined (lateral extent of total cyanide)	Additional sampling for extent
	SWMU 48-002(a)	Former container storage area located at the southwest corner of building 48-1	Extent not defined (vertical extent of perchlorate)	Additional sampling for extent
	SWMU 48-002(b)	Former container storage area located at a loading dock on the south side of building 48-1	Extent not defined (vertical extent of perchlorate)	Additional sampling for extent
	SWMU 48-003	Former septic system that served TA-48 from 1957 to 1986	Extent not defined (vertical extent of strontium-90)	Additional sampling for extent

Table 1.1-1 (continued)

Consolidated Unit	SWMU/AOC	Brief Description	Phase I Investigation Results	Proposed Activities
	SWMU 48-007(b)	Former NPDES-permitted outfall located north of building 48-1; currently discharges stormwater into Mortandad Canyon	Extent not defined (vertical extent of aluminum, chromium, hexavalent chromium, lead, nickel, perchlorate, and vanadium)	Additional sampling for extent
	SWMU 48-007(c)	Former NPDES-permitted outfall located north of building 48-1; currently discharges stormwater into Mortandad Canyon	Extent not defined (vertical extent of chromium; lateral/vertical extent of lead)	Additional sampling for extent
	SWMU 48-007(f)	Former NPDES-permitted outfall located north of building 48-1 that received discharges from two sink drains in building 48-46	Extent not defined (lateral/vertical extent chromium; vertical extent of barium)	Additional sampling for extent
	AOC 48-011	A 3-ft diameter by 65-ft deep shaft that was drilled into tuff on the east side of building 48-1	Extent not defined (lateral extent of inorganic chemicals, organic chemicals, and radionuclides)	Additional sampling for extent
TA-50				
Consolidated Unit 50-004(a)-00	SWMU 50-004(a)	Location of former underground radioactive liquid waste and industrial waste lines	Extent not defined (vertical extent of chromium; lateral/vertical extent of barium, cobalt, and copper; lateral extent of nickel; vertical extent plutonium-239/240 and tritium)	Additional sampling for extent
	SWMU 50-004(b)	Location of a former underground vault that housed three stainless-steel-lined concrete storage tanks		
	SWMU 50-004(c)	Thirteen industrial waste lines and three associated manholes that discharged to the underground tank vault [SWMU 50-004(b)]		
	SWMU 50-006(a)	Outfall area impacted by two accidental operational releases	Extent not defined (vertical extent of chromium)	Additional sampling for extent
	SWMU 50-006(d)	A drainline and associated NPDES-permitted outfall (051) in Mortandad Canyon for treated wastewater from the RLWTF	Extent not defined (lateral/vertical extent chromium, copper, mercury, nitrate, and perchlorate; vertical extent of PCBs; vertical extent of americium-241, cesium-137, plutonium-238, strontium-90, tritium, and uranium-235/236)	Additional sampling for extent

Note: Shading denotes consolidated unit.

Table 4.1-1
Proposed Sampling at AOC 03-004(c)

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define vertical extent of chromium	MO-605048	9–10, 14–15	X[a,b]
Define lateral extent of barium, chromium, copper, and manganese south and west of location MO-605048	4c-1 4c-2	1–2[c], 6–7, 9–10, 14–15 1–2[c], 6–7, 9–10, 14–15	X[d] X[d]

[a] X = Analysis will be performed.

[b] Chromium only.

[c] Depth to be adjusted below ground surface to ensure sample is below asphalt.

[d] Barium, chromium, copper, and manganese only.

Table 4.1-2
Proposed Sampling at AOC 03-004(d)

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define lateral extent of chromium downgradient of location MO-605041	4d-1 4d-2	1–2[a], 2–3, 6–7 1–2[a], 2–3, 6–7	X[b,c] X[c]

[a] Depth to be adjusted below ground surface to ensure sample is below asphalt.

[b] X = Analysis will be performed.

[c] Chromium only.

Table 4.1-3
Proposed Sampling at AOC 03-007

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define vertical extent of chromium	MO-604997 MO-604998 MO-605005 MO-605007 MO-605008	12–13, 16–17 10–11, 14–15 2–3, 4–5 3–4, 6–7 3–4, 6–7	X[a,b] X[b] X[b] X[b] X[b]
Define lateral extent of chromium	7-1 7-2 7-3 7-4	0–1, 3–4, 8–9 0–1, 3–4, 8–9 0–1, 3–4, 5–6 0–1, 3–4, 5–6	X[b] X[b] X[b] X[b]

[a] X = Analysis will be performed.

[b] Chromium only.

Table 4.1-4
Proposed Sampling at SWMU 03-045(h)

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define vertical extent of barium and cobalt	MO-604948	2–3, 5–6	X[a,b]
	MO-604952	8–9, 11–12	X[b]
	MO-604971	3–4, 6–7	X[c]
	MO-604973	3–4, 6–7	X[c]
	MO-604974	3–4, 6–7	X[b]
	MO-604976	3–4, 6–7	X[c]
	MO-604977	3–4, 6–7	X[c]
Define lateral extent of antimony, barium, and cobalt downgradient of location MO-604948	45h-1	0–1, 2–3, 6–7	X[d]

[a] X = Analysis will be performed.
[b] Barium and cobalt only.
[c] Barium only.
[d] Antimony, barium, and cobalt only.

Table 4.1-5
Proposed Sampling at SWMU 03-049(a)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Dioxins/Furans
Define vertical extent of chromium	MO-604985	2–3, 6–7	X[a,b]	—[c]
Define lateral extent of dioxins/furans	MO-604981	0–1, 2–3	—	X

[a] X = Analysis will be performed.
[b] Chromium only.
[c] — = Analysis will not be performed.

Table 4.1-6
Proposed Sampling at Consolidated Unit 03-049(b)-00

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Total Cyanide	Perchlorate	PCBs	Tritium
Define vertical extent of PCBs and tritium	MO-605025	9–10, 11–12	—[a]	—	—	X[b]	X
	MO-605026	7–8, 9–10	—	—	—	—	X
	MO-605027	6–7, 9–10	—	—	—	—	X
	MO-605029	8–9, 11–12	—	—	—	X	—
	MO-605034	6–7, 9–10	—	—	—	—	X
Define lateral extent of aluminum, chromium, total cyanide, lead, perchlorate, PCBs, and tritium	49b-1	1–2, 4–5, 8–9, 11–12	X[c]	X	X	X	—
	49b-2	1–2, 4–5, 8–9, 11–12	X[c]	X	X	X	X

[a] — = Analysis will not be performed.

[b] X = Analysis will be performed.

[c] Aluminum, chromium, and lead only.

Table 4.1-7
Proposed Sampling at SWMU 03-049(e)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Hexavalent Chromium
Define the vertical extent of antimony, chromium, hexavalent chromium, selenium, and zinc	MO-605009	3–4, 6–7	X[a,b]	—[c]
	MO-605010	3–4, 6–7	X[d]	—
	MO-605011	3–4, 6–7	—	X
	MO-605012	3–4, 6–7	X[e]	—
	MO-605013	3–4, 6–7	X[f]	—
	MO-605014	3–4, 6–7	X[e]	—
	MO-605016	3–4, 6–7	—	X
	MO-605017	3–4, 6–7	—	X
	MO-605018	3–4, 6–7	X[e]	—

[a] X = Analysis will be performed.

[b] Antimony, chromium, and selenium only.

[c] — = Analysis will not be performed.

[d] Antimony and zinc only.

[e] Chromium only.

[f] Zinc only.

Table 4.1-8
Proposed Sampling at SWMU 03-054(e)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	SVOCs	Dioxins/Furans
Define vertical extent of chromium, zinc, bis(2-ethylhexyl)phthalate, diethylphthalate, and dioxins/furans	MO-605021 MO-605022 MO-605023 MO-605024	2–3, 4–5 2–3, 4–5 3-4, 5–6 2–3, 4–5	X[a,b] X[d] X[d] X[b]	X[c] X[c] X[c] X[c]	X —[e] — —
Define lateral extent of bis(2-ethylhexyl)phthalate, diethylphthalate, dioxins/furans, and PAHs	54e-1	0–1, 2–3, 6–7	—	X[f]	X

[a] X = Analysis will be performed.

[b] Zinc only.

[c] Bis(2-ethylhexyl)phthalate and diethylphthalate only.

[d] Chromium only.

[e] — = Analysis will not be performed.

[f] Bis(2-ethylhexyl)phthalate and diethylphthalate, and PAHs only.

Table 4.1-9
Proposed Sampling at AOC C-03-006

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define vertical extent of chromium	MO-604990 MO-604991 MO-604992 MO-604993	6–7, 12–13 15–16, 19–20 6–7, 12–13 6–7, 12–13	X[a,b] X[b] X[b] X[b]

[a] X = Analysis will be performed.

[b] Chromium only.

Table 4.2-1
Proposed Sampling at AOC 35-016(g)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Gamma-Emitting Radionuclides
Define the vertical extent of chromium and cesium-137	MO-604933	4–5, 6–7	X[a,b]	X[c]
	MO-604935	4–5, 6–7	X[b]	—[d]
	MO-604936	4–5, 6–7	—	X[c]
	MO-604937	4–5, 6–7	—	X[c]
Define the lateral extent of cesium-137	16g-1	0–1, 4–5, 6–7	—	X[c]

[a] X = Analysis will be performed.

[b] Chromium only.

[c] Cesium-137 only.

[d] — = Analysis will not be performed.

Table 4.2-2
Proposed Sampling at AOC 35-016(h)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Chromium Hexavalent Ion	SVOCs
Define the vertical extent of chromium and hexavalent chromium	35-02392	4–5, 6–7	X[a,b]	—[c]	—
	MO-605136	3–4, 6–7	X[b]	X	—
	MO-605515	3–4, 6–7	X[b]	X	—
	MO-605518	3–4, 6–7	X[b]	X	—
	MO-605520	3–4, 6–7	X[b]	—	—
Define the lateral extent of chromium and PAHs	16h-1	0–1, 3–4, 6–7	X[b]	—	—
	16h-2	0–1, 3–4, 6–7	X[b]	—	—
	16h-3	0–1, 3–4, 6–7	X[b]	—	X[d]

[a] X = Analysis will be performed.

[b] Chromium only.

[c] — = Analysis will not be performed.

[d] PAHs only.

Table 4.3-1
Proposed Sampling at Consolidated Unit 42-001(a)-99

Sampling Objective	Location Number	Depth (ft)	Tritium
Define the vertical extent of tritium	MO-605054	50–52.5, 60–62.5	X*

* X = Analysis will be performed.

Table 4.4-1
Proposed Sampling at AOC 48-001

Sampling Objective	Location Number	Depth (ft)	Total Cyanide
Define the lateral extent of total cyanide upgradient and downgradient of location MO-604942	1-1 1-2	0–0.5 0–0.5	X* X

* X = Analysis will be performed.

Table 4.4-2
Proposed Sampling at SWMUs 48-002(a) and 48-002(b)

Sampling Objective	Location Number	Depth (ft)	Perchlorate
Define the vertical extent of perchlorate	MO-604925 MO-604932	15–16, 19–20 15–16, 19–20	X* X

* X = Analysis will be performed.

Table 4.4-3
Proposed Sampling at SWMU 48-003

Sampling Objective	Location Number	Depth (ft)	Strontium-90
Define the vertical extent of strontium-90	48-02136 48-02140	2–3, 4–5 3–4, 5–6	X* X

* X = Analysis will be performed.

Table 4.4-4
Proposed Sampling at SWMU 48-007(b)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Chromium Hexavalent Ion	Perchlorate
Define the vertical extent of aluminum, chromium, hexavalent chromium, lead, nickel, perchlorate, and vanadium	MO-605111	5–6, 7–8	X[a,b]	—[c]	X
	MO-605112	5–6, 7–8	—	X	—
	MO-605114	5–6, 7–8	X[d]	—	—
	MO-605116	5–6, 7–8	—	—	X
	MO-605117	5–6, 7–8	—	—	X

[a] X = Analysis will be performed.

[b] Aluminum, chromium, nickel, and vanadium only.

[c] — = Analysis will not be performed.

[d] Chromium and lead only.

Table 4.4-5
Proposed Sampling at SWMU 48-007(c)

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define the vertical extent of chromium and lead	MO-605163 MO-605164 MO-605165	4–5, 6–7 4–5, 6–7 4–5, 6–7	X[a,b] X[b] X[c]
Define the lateral extent of lead downgradient of location MO-605165	7c-1	0–1, 3–4, 6–7	X[c]

[a] X = Analysis will be performed.

[b] Chromium only.

[c] Lead only.

Table 4.4-6
Proposed Sampling at SWMU 48-007(f)

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define the vertical extent of barium and chromium	MO-605097 MO-605099 MO-605100 MO-605101 MO-605103	5–6, 7–8 5–6, 7–8 5–6, 7–8 5–6, 7–8 5–6, 7–8	X[a,b] X[c] X[c] X[c] X[c]
Define the lateral extent of chromium downgradient of location MO-605104	7f-1	0–1, 3–4, 5–6	X[c]

[a] X = Analysis will be performed.

[b] Barium and chromium only.

[c] Chromium only.

Table 4.4-7
Proposed Sampling at AOC 48-011

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Nitrate	Cyanide	Perchlorate	SVOCs	VOCs	PCBs	Dioxins/Furans	Gamma-Emitting Radionuclides	Tritium
Define the lateral extent downgradient of location MO-605351 and the shaft	11-1	65–66.5, 75–76.5, 85–86.5, 100–101.5, 110–111.5	X*	X	X	X	X	X	X	X	X	X

* X = Analysis will be performed.

Table 4.5-1
Proposed Sampling at Consolidated Unit 50-004(a)-00

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Isotopic Plutonium	Tritium
Define the vertical extent of barium, chromium, cobalt, copper, plutonium-239/240, and tritium	50-03022	9–10, 19–20	X[a,b]	X	—[c]
	50-03026	9–10, 19–20	—	X	X
	50-03027	19–20, 29–30	—	X	—
	50-03030	9–10, 19–20	—	—	X
	50-03031	9–10, 19–20	—	—	X
	50-03032	9–10, 19–20	—	—	X
	50-03038	19–20, 29–30	X[d]	X	—
	MO-605108	34–35, 44–45	—	—	X
	MO-605458	14–15, 29–30	X[e]	—	X
	MO-605460	14–15, 24–25	X[f]	—	X
	MO-605462	19–20, 29–30	X[f]	X	—
	MO-605463	19–20, 29–30	X[b]	—	X
	MO-605464	14–15, 24–25	X[e]	—	X
	MO-605473	9–10, 19–20	X[g]	—	—
	MO-605478	19–20, 29–30	—	—	X
	MO-605626	24–25, 29–30	X[b]	X	X
	MO-605627	14–15, 24–25	—	X	X
	MO-605628	14–15, 24–25	X[f]	X	X
Define the lateral extent of barium, cobalt, copper, and nickel	4a-1	0–1, 3–4, 6–7	X[h]	—	—
	4a-2	0–1, 3–4, 6–7	X[i]	—	—
	4a-3	0–1, 3–4, 6–7	X[g]	—	—

[a] X = Analysis will be performed.

[b] Barium only.

[c] — = Analysis will not be performed.

[d] Barium and copper only.

[e] Barium, chromium, cobalt, and copper only.

[f] Chromium only.

[g] Barium, cobalt, and copper only.

[h] Copper and nickel only.

[i] Barium, copper, and nickel only.

Table 4.5-2
Proposed Sampling at SWMU 50-006(a)

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define the vertical extent of chromium	MO-605076	5–6, 9–10	X[a,b]
	MO-605077	5–6, 9–10	X[b]
	MO-605078	5–6, 9–10	X[b]

[a] X = Analysis will be performed.

[b] Chromium only.

Table 4.5-3
Proposed Sampling at SWMU 50-006(d)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Nitrate	Perchlorate	PCBs	Americium-241	Gamma-Emitting Radionuclides	Isotopic Plutonium	Strontium-90	Tritium	Isotopic Uranium
Define the vertical extent of chromium, copper, mercury, nitrate, perchlorate, PCBs, americium-241, cesium-137, plutonium-238, strontium-90, tritium, and uranium-235/236	MO-605083	9–10, 14–15	—[a]	—	—	X[b]	—	—	—	—	—	—
	MO-605084	9–10, 14–15	—	—	—	—	—	—	—	—	X	—
	MO-605085	4–5, 9–10	—	X	X	—	—	—	—	—	—	—
	MO-605087	8–9, 12–13	—	—	X	—	—	—	—	—	—	—
	MO-605088	5–6, 9–10	X[c]	—	X	X	X	X[d]	X	X	X	—
	MO-605504	16–17, 22–23	—	—	—	X	—	—	—	—	X	—
	MO-605506	9–10, 14–15	X[e]	—	X	—	—	—	—	—	X	—
	MO-605511	18–19, 23–24	—	—	—	—	—	—	—	—	—	X
Define the lateral extent of nitrate and perchlorate downgradient of location MO-605085	6d-1	4–5, 9–10	—	X	X	—	—	—	—	—	—	—
Define lateral and vertical extent of radionuclides downgradient of former outfall	6d-2	0–1, 5–6, 9–10	—	—	—	—	X	X[d]	X	X	X	X
	6d-3	0–1, 5–6, 9–10	—	—	—	—	X	X[d]	X	X	X	X

[a] — = Analysis will not be performed.

[b] X = Analysis will be performed.

[c] Copper only.

[d] Cesium-137 only.

[e] Chromium only.

Table 5.0-1
Summary of Investigation Methods

Method	Summary
Spade and Scoop Collection of Soil Samples	This method is typically used to collect shallow (i.e., approximately 0-12 in.) soil or sediment samples. The spade-and-scoop method involves digging a hole to the desired depth, as prescribed in the work plan, and collecting a discrete grab sample. The sample is typically placed in a clean stainless-steel bowl for transfer into various sample containers.
Hand Auger Collection of Soil Samples	This method is typically used for sampling soil or sediment at depths of less than 10–15 ft but in some cases may be used to collect samples of weathered or nonwelded tuff. The method involves hand-turning a stainless-steel bucket auger (typically 3–4 in. inside diameter [I.D.]), creating a vertical hole that can be advanced to the desired sampling depth. When the desired depth is reached during the investigation, the auger will be decontaminated before the hole is advanced through the sampling depth. The sample material will be transferred from the auger bucket to a stainless-steel sampling bowl before the various required sample containers are filled.
Hollow-Stem Auger Drilling	In this method, hollow-stem augers (sections of seamless pipe with auger flights welded to the pipe) act as a screw conveyor to bring cuttings of sediment, soil, and/or rock to the surface. Auger sections are typically 5 ft in length and have outside diameters of 4.25 to 14 in. Drill rods, split-spoon core barrels, Shelby tubes, and other samplers can pass through the center of the hollow-stem auger sections for collection of discrete samples from desired depths. Hollow-stem augers are used as temporary casings when setting wells to prevent cave-ins of the borehole walls.
Split-Spoon Core-Barrel Sampling	In this method, a stainless-steel core barrel (typically 4 in. I.D., 2.5 ft long) is advanced using a powered drilling rig. The core barrel extracts a continuous length of soil and/or rock that can be examined as a unit. The split-spoon core barrel is a cylindrical barrel split lengthwise so that the two halves can be separated to expose the core sample. Once extracted, the section of core is screened for radioactivity and organic vapors and described in a geologic log. A portion of the core is then collected as a discrete sample from the desired depth.
Handling, Packaging, and Shipping of Samples	Field team members seal and label samples before packing them to ensure the sample containers and the containers used for transport are free of external contamination. Field team members package all samples to minimize the possibility of breakage during transport. After all environmental samples are collected, packaged, and preserved, a field team member will transport them to the SMO. The SMO will arrange for shipping the samples to analytical laboratories.
Sample Control and Field Documentation	The collection, screening, and transport of samples will be documented on standard forms generated by the SMO. These include SCLs, COC forms, and sample container labels. SCLs will be completed at the time of sample collection and the logs will be signed by the sampler and a reviewer who verifies the logs for completeness and accuracy. Corresponding labels will be initialed and applied to each sample container, and custody seals will be placed around each sample container. COC forms will be completed and signed to verify the samples were not left unattended.

Table 5.0-1 (continued)

Method	Summary
Field Quality Control Samples	Field quality control samples will be collected as follows: *Field Duplicates*: At a frequency 10%; collected at the same time as a regular sample and submitted for the same analyses. *Equipment Rinsate Blank*: At a frequency of 10%; collected by rinsing sampling equipment with deionized water that will be collected in a sample container and submitted for laboratory analysis. *Trip Blanks*: Required for all field events that include the collection of samples for VOC analysis. Trip blanks containers of certified clean sand will be opened and kept with the other sample containers during the sampling process.
Field Decontamination of Drilling and Sampling Equipment	Dry decontamination will be used to minimize the generation of liquid waste. Dry decontamination includes the use of a wire brush or other tool to remove soil or other material adhering to the sampling equipment, followed by use of a commercial cleaning agent (nonacid, waxless cleaners) and paper wipes.
Containers and Preservation of Samples	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on EPA guidance for environmental sampling, preservation, and quality assurance. Specific requirements for each sample will be printed on the SCL provided by the SMO (size and type of container [e.g., glass, amber glass, and polyethylene]). All samples will be preserved by placing them with ice in insulated containers to maintain a temperature of 4°C.
Management, Characterization, and Storage of IDW	IDW is managed, characterized, and stored in accordance with an approved waste characterization strategy form that documents site history, field activities, and characterization approach for each waste stream managed. Waste characterization will comply with on- or off-site waste acceptance criteria. All stored IDW will be marked with appropriate signage and labels. Drummed IDW will be stored on pallets to prevent deterioration of containers. A waste storage area will be established before waste is generated. Waste storage areas will be located in controlled areas of the Laboratory to prevent unauthorized personnel from inadvertently adding or managing wastes. Each container of waste generated will be individually labeled with waste classification, item identification number, and radioactivity (if applicable), immediately following containerization. All waste will be segregated by classification and compatibility to prevent cross-contamination. Management of IDW is described in Appendix B.
Coordinating and Evaluating Geodetic Surveys	Geodetic surveys focus on obtaining survey data of acceptable quality to use during project investigations. Geodetic surveys will be conducted with a Trimble 5700 DGPS. The survey data will conform to Laboratory Information Architecture project standards IA-CB02, GIS Horizontal Spatial Reference System, and IA-D802, Geospatial Positioning Accuracy Standard for A/E/C/ and Facility Management. All coordinates will be expressed as State Plain Coordinate System 83, NM Central, U.S. feet. All elevation data will be reported relative to the National Geodetic Vertical Datum of 1983.

Table 5.8-1
Summary of Analytical Methods

Analyte	Analytical Method
TAL Metals	SW-846:6010B; SW-846:6020
Chromium Hexavalent Ion	SW-846:7196A
Total Cyanide	SW-846:9012A
Nitrate	EPA Method 300.0
Perchlorate	SW-846:6850
PCBs	SW-846:8082
SVOCs	SW-846:8270C
VOCs	SW-846:8260B
Dioxins/Furans	SW-846:8290
Americium-241	HASL-300:AM-241
Gamma-Emitting Radionuclides	EPA:901.1
Isotopic Plutonium	HASL-300:ISOPU
Isotopic Thorium	HASL-300:ISOTH
Isotopic Uranium	HASL-300:ISOU
Strontium-90	EPA 90.5.0
Tritium	Liquid Scintillation
pH	SW-846:9045C

Appendix A

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

A-1.0 ACRONYMS AND ABBREVIATIONS

AOC	area of concern
bgs	below ground surface
BV	background value
CMR	Chemistry and Metallurgy Research
COC	chain of custody
Consent Order	Compliance Order on Consent
D&D	decontamination and decommissioning
DOE	Department of Energy (U.S.)
EC	expedited cleanup
EDTA	ethylenediaminetetraacetic acid
EPA	Environmental Protection Agency (U.S.)
GPS	global positioning system
IA	interim action
I.D.	inside diameter
IDW	investigation-derived waste
LANL	Los Alamos National Laboratory
LLW	low-level waste
MDA	material disposal area
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photoionization detector
PPE	personal protective equipment
RFI	Resource Conservation and Recovery Act facility investigation
RLW	radioactive liquid waste
RLWTF	Radioactive Liquid Waste Treatment Facility
RPF	Records Processing Facility
SAL	screening action level
SAP	sampling and analysis plan
SCL	sample collection log
SMO	Sample Management Office

SOP	standard operating procedure
SSL	soil screening level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TA	technical area
TAL	target analyte list (EPA)
TPH-DRO	total petroleum hydrocarbons–diesel range organics
VOC	volatile organic compound
WAC	waste acceptance criteria
WCSF	waste characterization strategy form

A-2.0 METRIC CONVERSION TABLE

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

A-3.0 DATA QUALIFIER DEFINITIONS

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

Appendix B

Investigation-Derived Waste Management Plan

B-1.0 INTRODUCTION

This appendix describes how investigation-derived waste (IDW) generated during the Upper Mortandad Canyon Aggregate Area Phase II investigation will be managed. IDW may include, but is not limited to, drill cuttings, excavated media, contact waste, decontamination fluids, and all other waste that has potentially come into contact with contaminants.

B-2.0 IDW

If required based on the estimated amount of material and size of excavation, Area of Contamination requests will be submitted for approval to New Mexico Environment Department (NMED) for remediation sites in which excavation is planned.

All IDW generated during investigation activities will be managed in accordance with applicable standard operating procedures (SOPs). These SOPs incorporate the requirements of all applicable U.S. Environmental Protection Agency and NMED regulations, U.S. Department of Energy orders, and Laboratory requirements. The SOP applicable to the characterization and management of IDW is SOP-5238, Characterization and Management of Environmental Program Waste, (available at http://www.lanl.gov/environment/all/qa.shtml).

The most recent version of the Los Alamos National Laboratory's (the Laboratory's or LANL's) Hazardous Waste Minimization Report will be implemented during the investigation to minimize waste generation. The report is updated annually as a requirement of the Laboratory's Hazardous Waste Facility Permit.

A waste characterization strategy form (WCSF) will be prepared and approved before field work begins and IDW is generated. The WCSF will provide detailed information on IDW characterization methods, management, containerization, and potential volumes. IDW characterization is completed through review of investigation data and/or documentation or by direct sampling of the IDW or the media being investigated (e.g., surface soil, subsurface soil). Waste characterization may include a review of historical information and process knowledge to identify whether listed hazardous waste may be present (i.e., due diligence reviews). If low levels of listed hazardous waste are identified, a "contained in" determination may be submitted for approval to NMED.

Wastes will be containerized and placed in clearly marked and appropriately constructed waste accumulation areas. If IDW is generated within the boundary of an area of contamination, it will be managed as nonhazardous within those boundaries in designated, properly constructed waste management areas. If hazardous, the IDW will be managed in accordance with hazardous waste requirements once it is removed from the area of contamination. If IDW is generated outside of area of contamination boundaries, the initial management of the waste will rely on the data from previous investigations and/or process knowledge. If the analytical data changes the expected waste category, the waste will be managed in accumulation areas appropriate to the final waste determination. Waste accumulation area postings, regulated storage duration, and inspection requirements will be based on the type of IDW and its classification. Container and storage requirements, as well as transportation and disposal requirements, will be detailed in the WCSF and approved before waste is generated. Table B-2.0-1 summarizes the estimated IDW waste streams, waste types, waste volumes, and other data.

The waste streams that are anticipated to be generated during work plan implementation are described below.

B-2.1 Drill Cuttings

This waste stream consists of soil and rock chips generated by the drilling of boreholes to collect samples. Drill cuttings include excess core sample not submitted for analysis and any returned samples sent for analysis. Drill cuttings will be stored in accordance with the approved WCSF.

This waste stream will be characterized based either on direct sampling of the waste in each container or on the results from core samples collected during drilling. The WCSF will specify the sampling suites for direct sampling of the waste stream. Constituents may be analyzed as necessary to meet the waste acceptance criteria (WAC) for a receiving facility or if visual observations indicate that additional contaminants may be present.

Cuttings will be land applied if they meet the criteria in the NMED-approved Notice of Intent Decision Tree for Land Application of Investigation Derived Waste Solids from Construction of Wells and Boreholes. The Laboratory expects that cuttings will be land-applied or treated/disposed of at an authorized on- or off-site facility appropriate for the waste classification. Table B-2.0-1 presents the estimated volumes, characterization and management methods, and expected disposition of this waste stream.

B-2.2 Excavated Environmental Media

Excavated environmental media will consist of soil and rock removed to meet the proposed cleanup levels where cleanup is recommended. The excavated material will be field screened and examined for visible evidence of contamination during the excavation process. The excavated material will remain within the boundary of the site from which it was excavated and will be placed in appropriate containers in accordance with the WCSF.

Incremental samples will be collected as the media are excavated, or the media will be sampled in piles or containers. A minimum of one direct sample will be collected from each 50 yd^3 or each container of material excavated and will be submitted for laboratory analyses for the analytical suites specified in the WCSF. The Laboratory expects most of the excavated environmental media to be designated as nonhazardous, hazardous, or low-level radioactive waste that will be disposed of in accordance with the WCSF. Table B-2.0-1 presents the estimated volumes, characterization and management methods, and expected disposition of this waste stream.

B-2.3 Contact Waste

The contact waste stream consists of potentially contaminated materials that contacted waste during sampling and excavation. This waste stream consists primarily of, but is not limited, to personal protective equipment such as gloves, decontamination wastes such as paper wipes, and disposable sampling supplies. Contact waste will be stored in containers and characterized in accordance with the WCSF.

Characterization of this waste stream will use acceptable knowledge based on data from the media with which it came into contact (e.g., drill cuttings, soil, sumps). The Laboratory expects most of the contact waste to be designated as nonhazardous, nonradioactive waste that will be disposed of in accordance with the WCSF. Table B-2.0-1 presents the estimated volumes, characterization and management methods, and expected disposition of this waste stream.

B-2.4 Decontamination Fluids

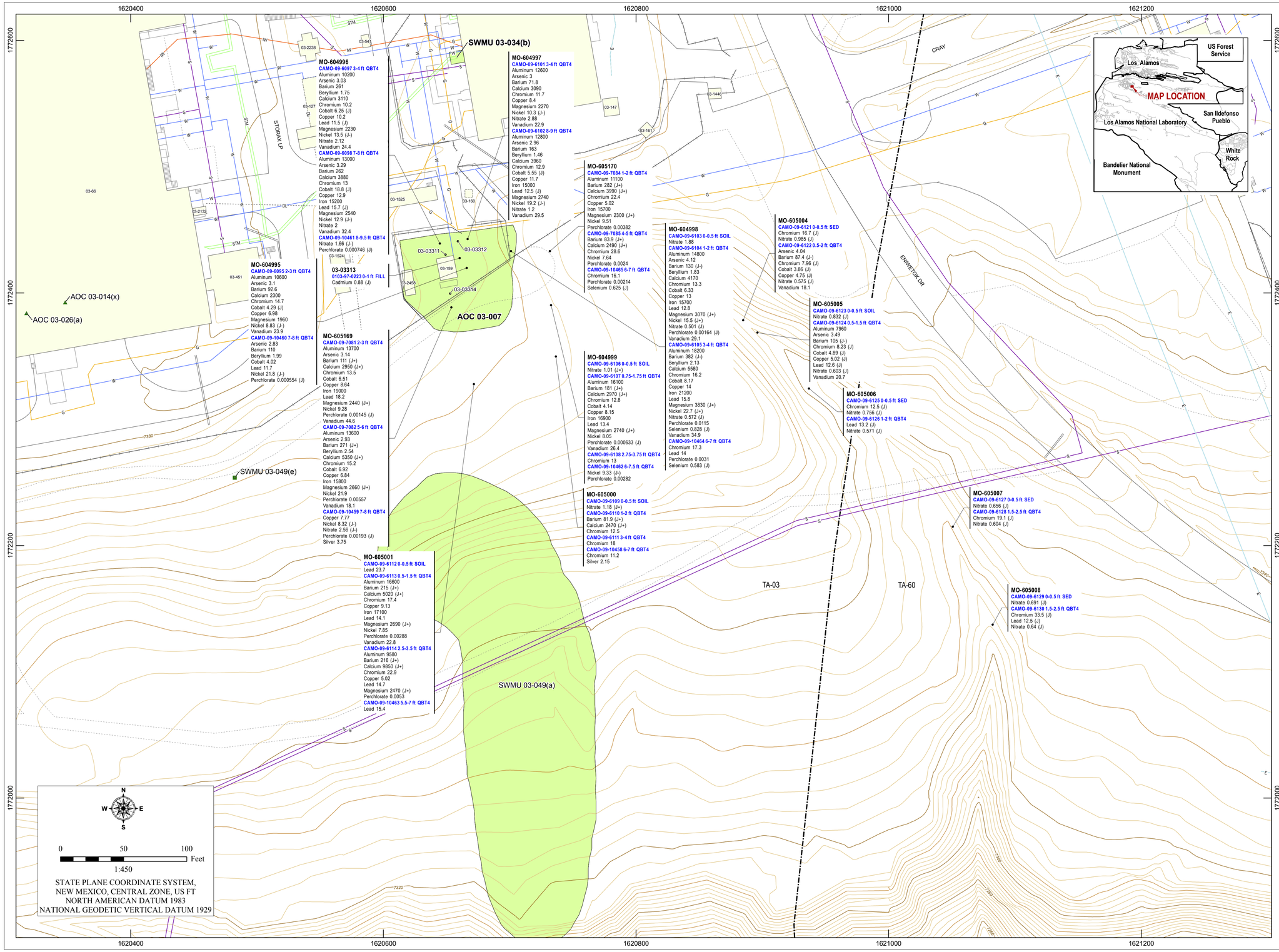
Decontamination fluids consist of liquid wastes generated from decontamination of excavation, sampling, and drilling equipment. For waste minimization, dry decontamination methods will be used to avoid the

generating liquid waste and to minimize the IDW. Dry decontamination uses disposable paper towels and over-the-counter cleaner, such as Fantastik or equivalent. All sampling and measuring equipment, including but not limited to, stainless-steel sampling tools, split-barrel or core samplers will be decontaminated in accordance with SOP-01.08, Field Decontamination of Drilling and Sampling Equipment.

Dry decontamination may be followed by wet decontamination, if necessary. Wet decontamination may include washing with a nonphosphate detergent and water, followed by a water rinse and a second rinse with deionized water. Alternatively, steam cleaning may be used. All wet decontamination fluids will be containerized and characterized by direct sampling for the suites specified in the WCSF. The Laboratory expects any wastes generated during wet decontamination to be nonhazardous liquid waste that will be sent to one of the Laboratory's wastewater treatment facilities in accordance with the WCSF. Table B-2.0-1 presents the estimated volumes, characterization and management methods, and expected disposition of this waste stream.

Table B-2.0-1
Summary of Estimated IDW Generation and Management

Waste Stream	Expected Waste Type	Estimated Volume	Characterization Method	On-Site Management	Expected Disposition
Drill Cuttings	Industrial waste, nonhazardous, nonradioactive	20 yd^3	Analytical results from direct sampling of waste or core samples	Accumulation in 55-gal. drums, covered rolloff containers, or other appropriate containers	Land application, or permitted off-site facility for which waste meets acceptance criteria; or Technical Area 54 (TA-54), Area G
Excavated Environmental Media	Industrial waste, nonhazardous, hazardous, low-level radioactive	10 yd^3	Field screening and analytical results from direct sampling of waste	On ground within site boundary, accumulation in 55-gal. drums, covered rolloff containers, or other appropriate containers	Permitted off-site facility for which waste meets acceptance criteria; or TA-54, Area G
Contact Waste	Industrial waste, nonhazardous, nonradioactive	0.5 yd^3	Acceptable knowledge	Accumulation in 55-gal. drums	Permitted off-site facility for which waste meets acceptance criteria; or TA-54, Area G
Decontamination Fluids	Industrial waste, nonhazardous, nonradioactive	10 gal.	Acceptable knowledge; analytical results from direct sampling of waste	Accumulation in 30-gal. plastic drums	Treatment at an on-site facility for which waste meets acceptance criteria



- Sampling location
- SWMU or AOC
- SWMU or AOC within building
- SWMU or AOC outfall

- Structure or building
- Former structure

- Technical Area (TA) boundary
- Fence
- Paved road
- Dirt road

Elevation contours
- 100- and 20-ft contour
- 10-ft contour
- 2-ft contour

Utilities
- C Communication
- E Electric
- G Gas
- IW Industrial waste
- S Sewer
- W Water
- DL Former drain line

Note: Concentration values are mg/kg

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PLATE 1

INORGANIC CHEMICALS DETECTED OR DETECTED ABOVE BVs AT AOC 03-007

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC09IR-11-0-INORG 16 September 2009 PLANNERER
Los Alamos Technical Associates (LATA-LAO)

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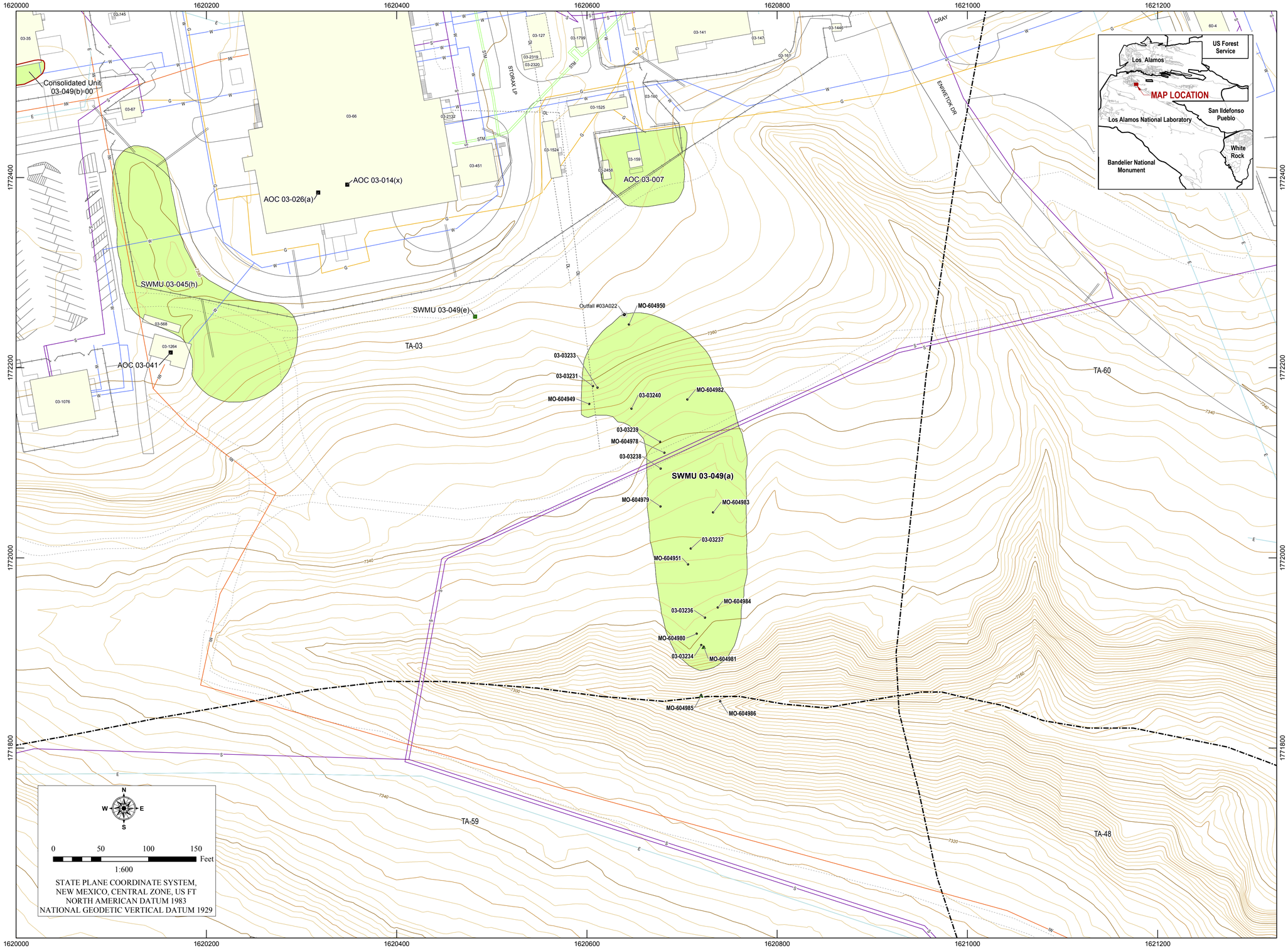

- Proposed sampling location
- Existing sampling location
- SWMU or AOC
- Consolidated unit
- SWMU or AOC within building
- SWMU or AOC outfall

- Structure or building
- Former structure

- Technical Area (TA) boundary
- Fence
- Paved road
- Dirt road

Elevation contours
- 100- and 20-ft contour
- 10-ft contour
- 2-ft contour

Utilities
- C Communication
- E Electric
- G Gas
- IW Industrial waste
- S Sewer
- W Water
- DL Former drain line

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PLATE 2

SITE MAP AND PROPOSED SAMPLING LOCATIONS AT SWMU 03-049(a)

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC-IWP-16-0 18 OCTOBER 2010 CRUZ
Los Alamos Technical Associates (LATA-LAO)

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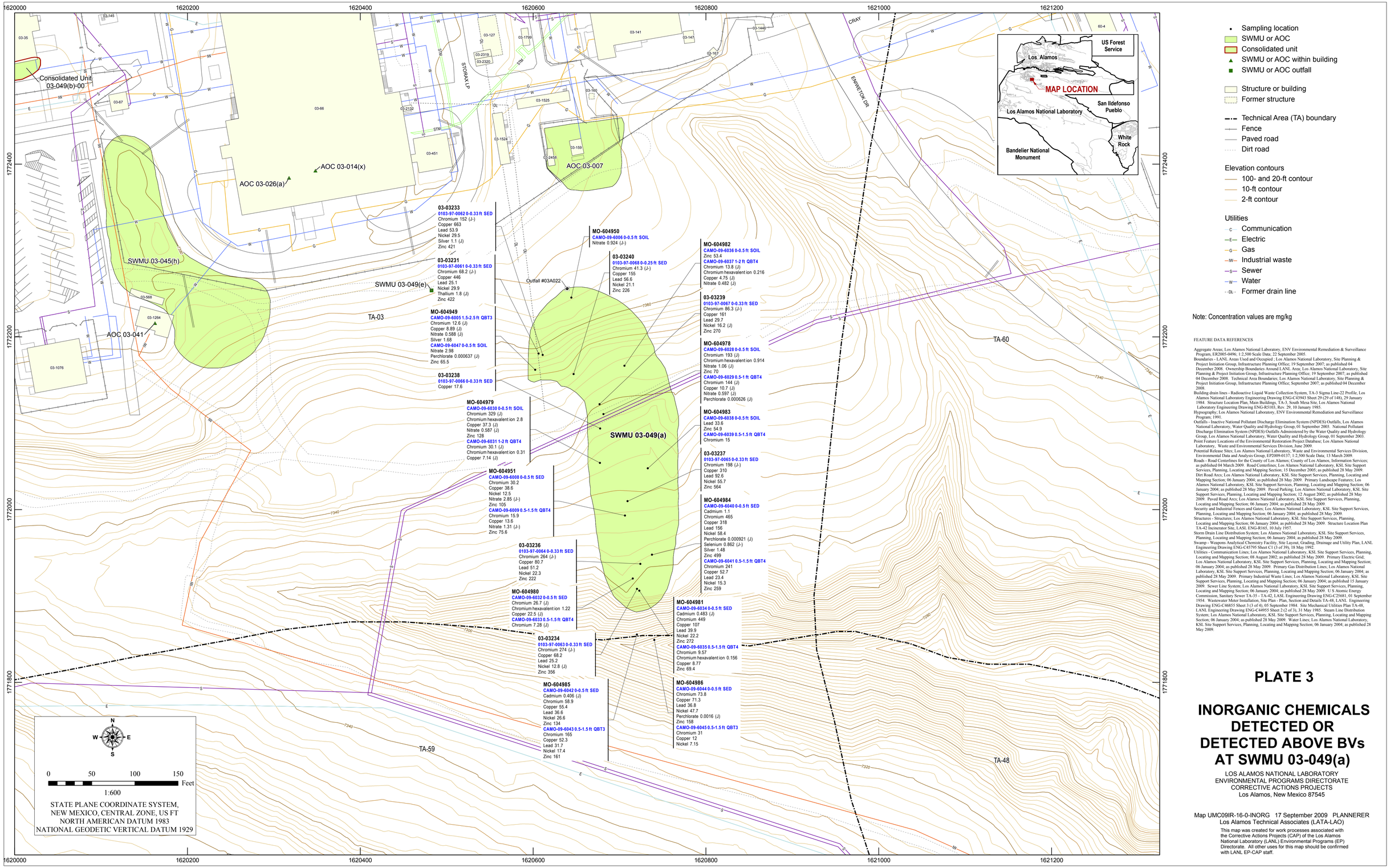

- Sampling location
- SWMU or AOC
- Consolidated unit
- SWMU or AOC within building
- SWMU or AOC outfall

- Structure or building
- Former structure

- Technical Area (TA) boundary
- Fence
- Paved road
- Dirt road

Elevation contours
- 100- and 20-ft contour
- 10-ft contour
- 2-ft contour

Utilities
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- Electric
- Gas
- Industrial waste
- Sewer
- Water
- Former drain line

Note: Concentration values are mg/kg

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PLATE 3

INORGANIC CHEMICALS DETECTED OR DETECTED ABOVE BVs AT SWMU 03-049(a)

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC09IR-16-0-INORG 17 September 2009 PLANNERER
Los Alamos Technical Associates (LATA-LAO)

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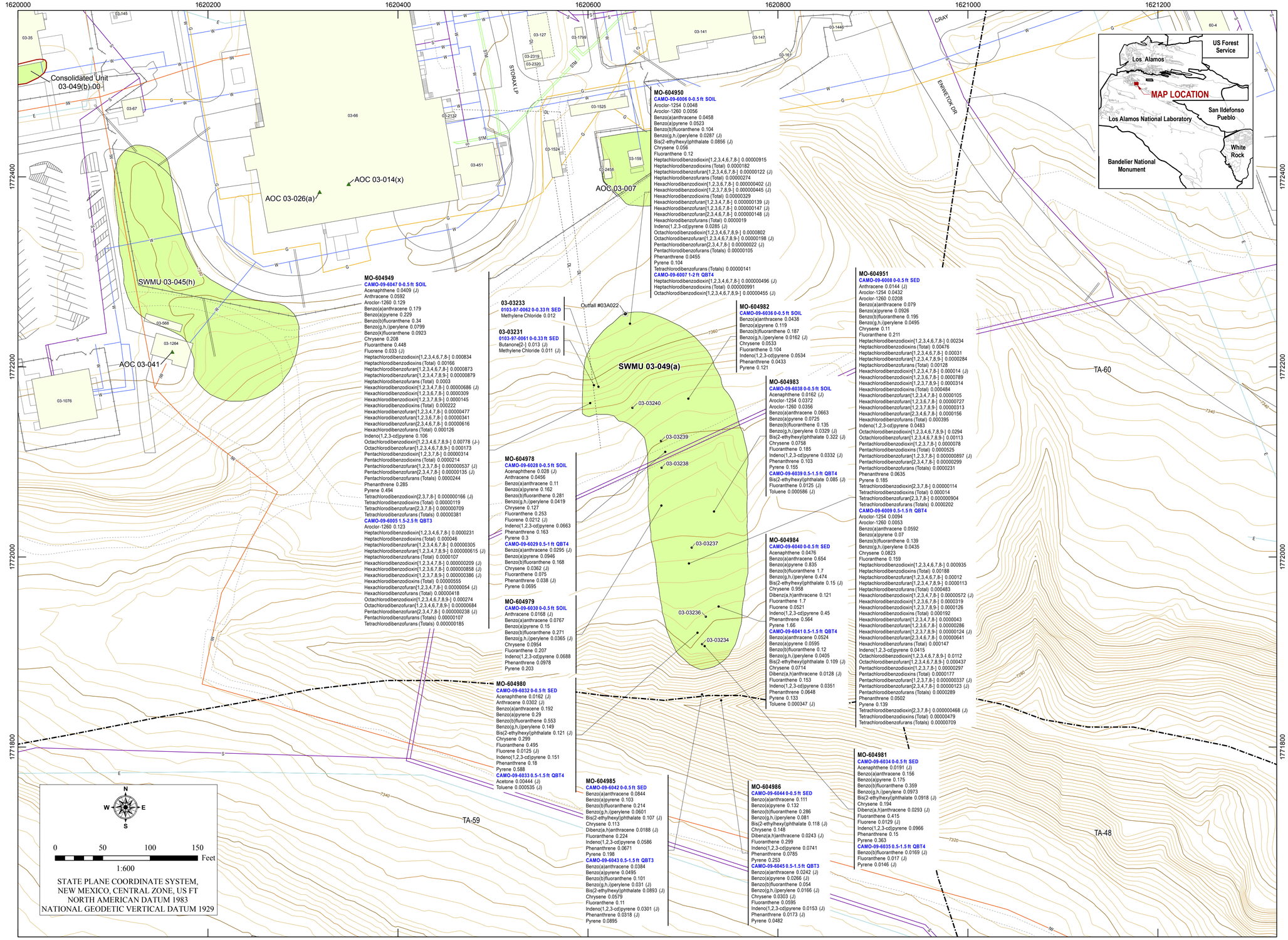

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Note: Concentration values are mg/kg

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PLATE 4

ORGANIC CHEMICALS DETECTED AT SWMU 03-049(a)

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC09IR-16-0-ORG 17 September 2009 PLANNERER
Los Alamos Technical Associates (LATA-LAO)

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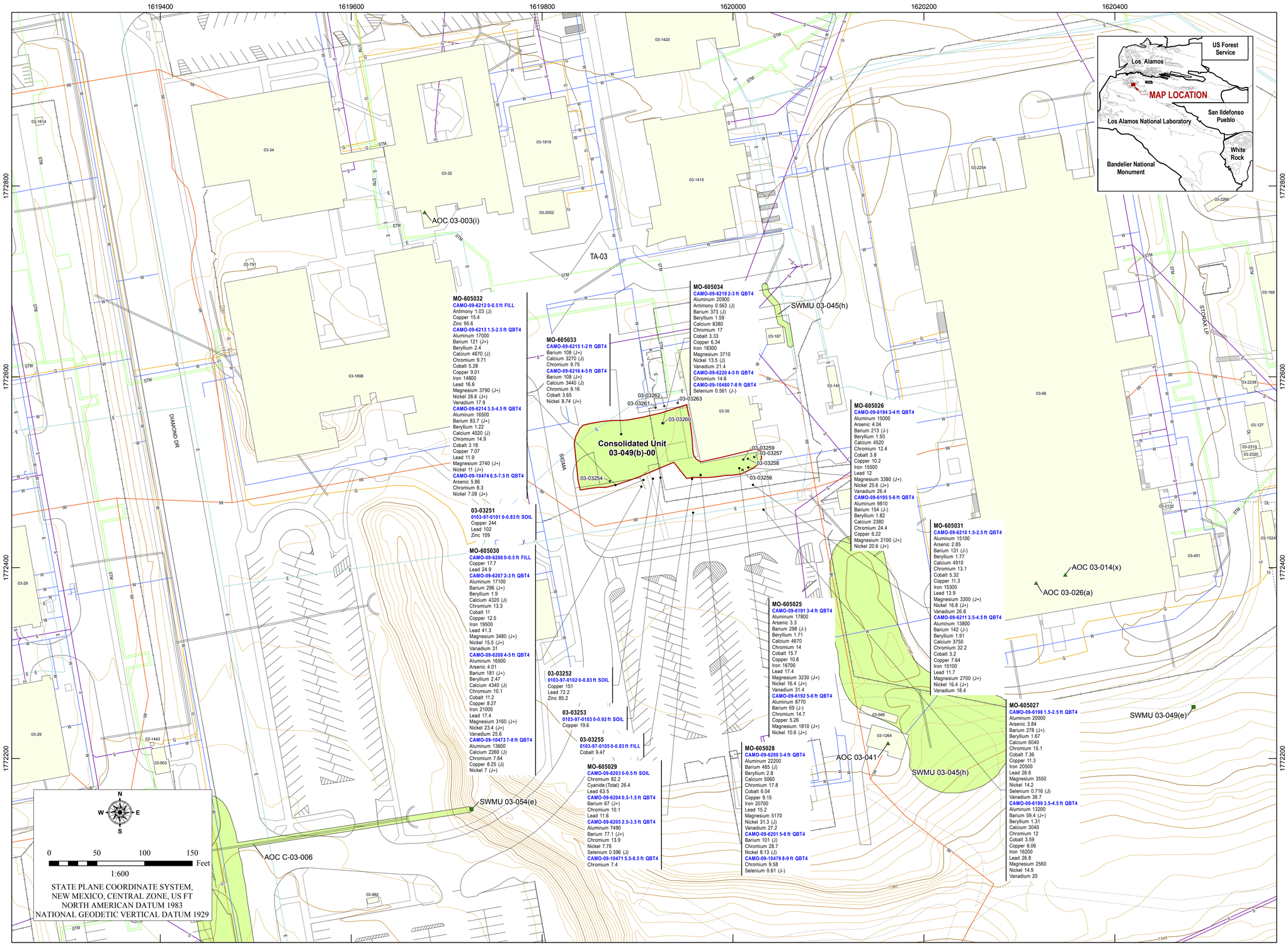

- Sampling location
- SWMU or AOC
- Consolidated unit
- SWMU or AOC within building
- SWMU or AOC outfall

- Structure or building
- Former structure

- Technical Area (TA) boundary
- Fence
- Paved road
- Dirt road

Elevation contours
- 100- and 20-ft contour
- 10-ft contour
- 2-ft contour

Utilities
- Communication
- Electric
- Gas
- Industrial waste
- Sewer
- Water
- Former drain line

Note: Concentration values are mg/kg

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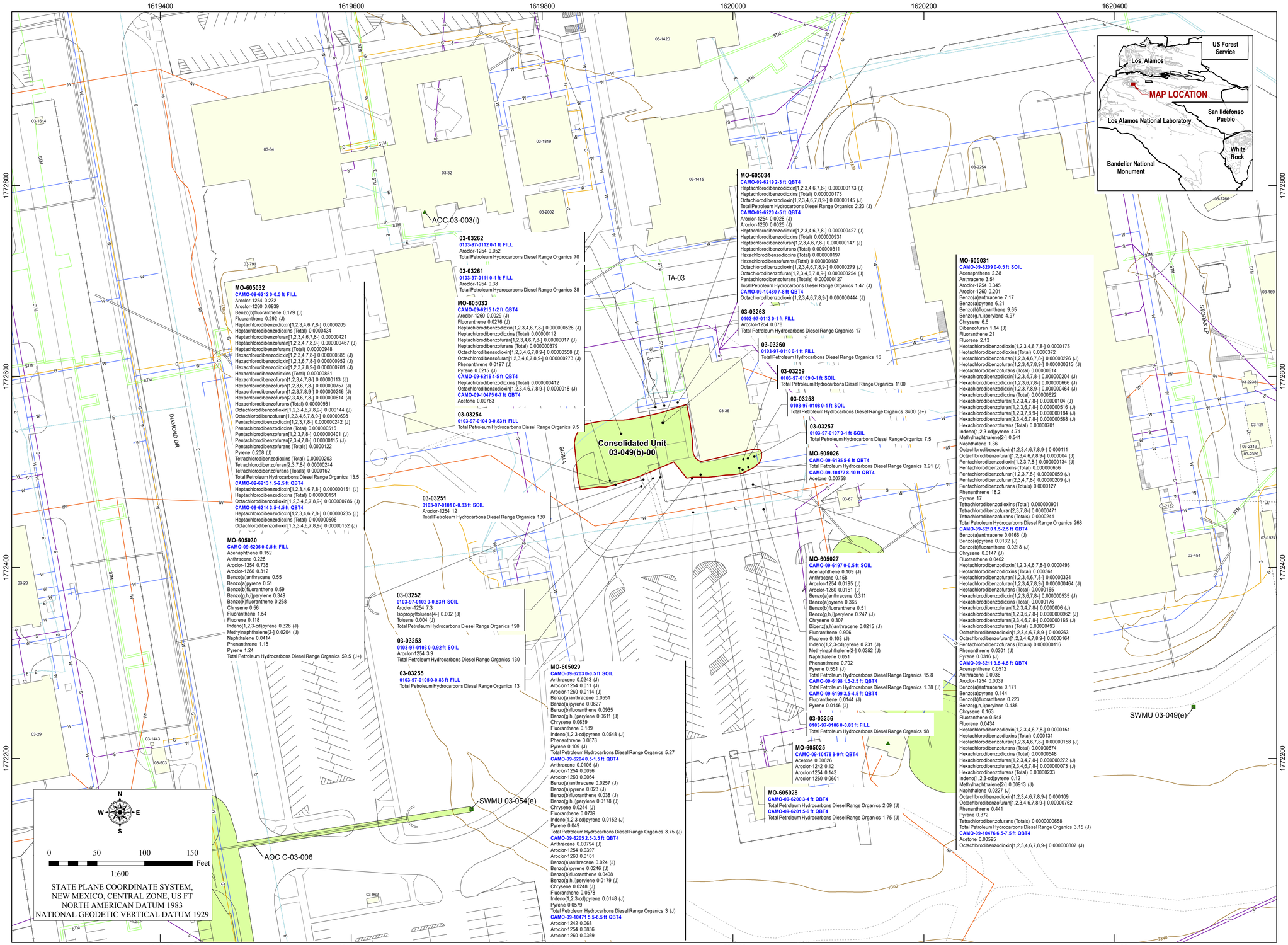
PLATE 5

INORGANIC CHEMICALS DETECTED OR DETECTED ABOVE BVs AT CONSOLIDATED UNIT 03-049(b)-00

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC09IR-17-0-INORG 17 September 2009 PLANNERER
Los Alamos Technical Associates (LATA-LAO)

This map was created for work processes associated with the Corrective Actions Projects (CAP) of the Los Alamos National Laboratory (LANL) Environmental Programs (EP) Directorate. All other uses for this map should be confirmed with LANL EP-CAP staff.



- Sampling location
- SWMU or AOC
- Consolidated unit
- SWMU or AOC within building
- SWMU or AOC outfall

- Structure or building
- Former structure

- Technical Area (TA) boundary
- Fence
- Paved road
- Dirt road

Elevation contours
- 100- and 20-ft contour
- 10-ft contour
- 2-ft contour

Utilities
- Communication
- Electric
- Gas
- Industrial waste
- Sewer
- Water
- Former drain line

Note: Concentration values are mg/kg

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PLATE 6

ORGANIC CHEMICALS DETECTED AT CONSOLIDATED UNIT 03-049(b)-00

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC09IR-17-0-ORG 18 September 2009 PLANNERER
Los Alamos Technical Associates (LATA-LAO)

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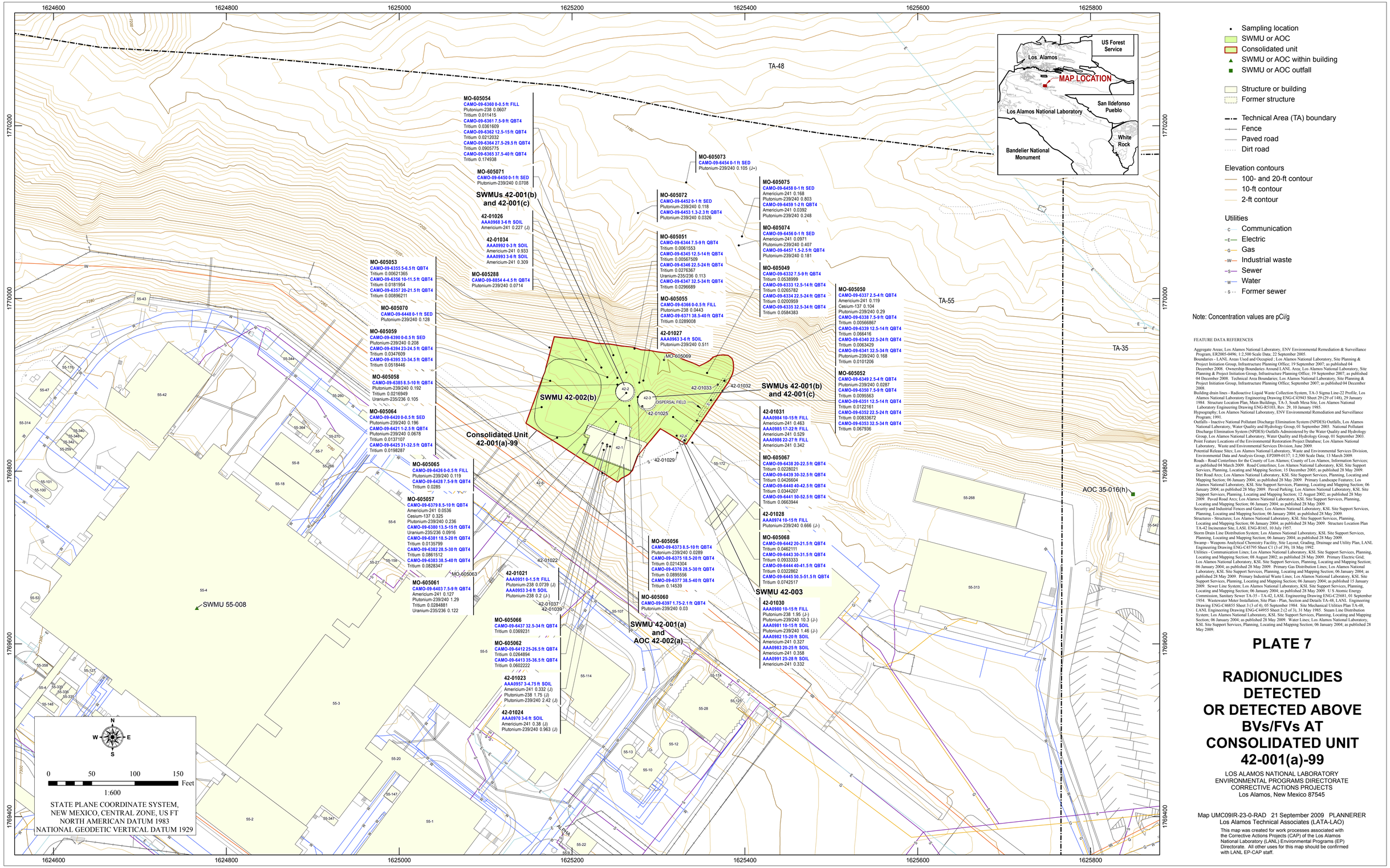

- Sampling location
- SWMU or AOC
- Consolidated unit
- SWMU or AOC within building
- SWMU or AOC outfall

- Structure or building
- Former structure

- Technical Area (TA) boundary
- Fence
- Paved road
- Dirt road

Elevation contours
- 100- and 20-ft contour
- 10-ft contour
- 2-ft contour

Utilities
- Communication
- Electric
- Gas
- Industrial waste
- Sewer
- Water
- Former sewer

Note: Concentration values are pCi/g

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PLATE 7

RADIONUCLIDES DETECTED OR DETECTED ABOVE BVs/FVs AT CONSOLIDATED UNIT 42-001(a)-99

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC09IR-23-0-RAD 21 September 2009 PLANNERER
Los Alamos Technical Associates (LATA-LAO)

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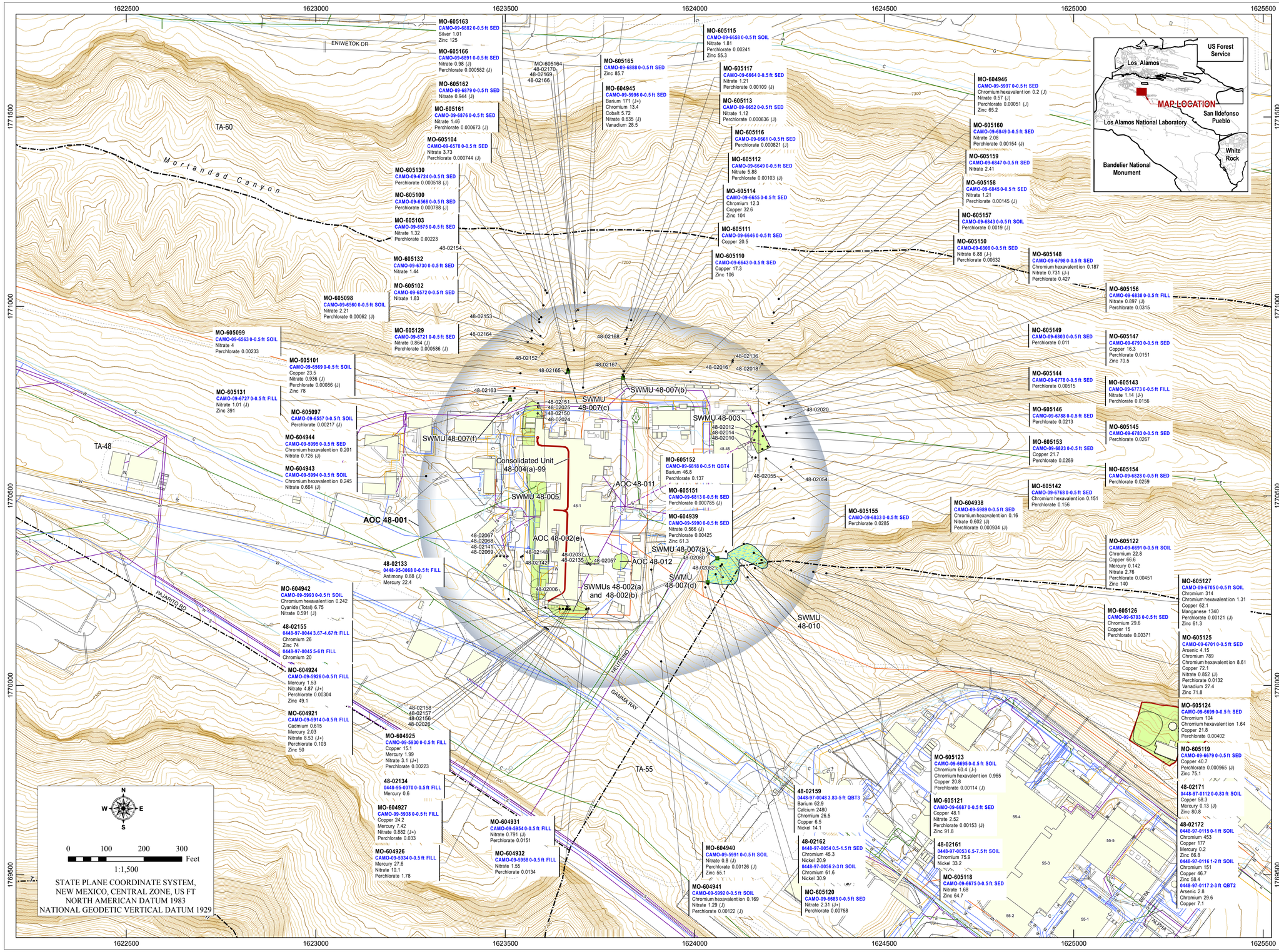

- Sampling location
- SWMU or AOC
- Consolidated unit
- SWMU or AOC outfall
- AOC 48-001 - stack emmissions

- Structure or building
- Former structure
- Swamp
- Drainage

- Technical Area (TA) boundary
- Fence
- Paved road
- Dirt road

Elevation contours
- 100- and 20-ft contour
- 10-ft contour
- 2-ft contour

Utilities
- C Communication
- E Electric
- G Gas
- W Industrial waste
- S Sewer
- W Water
- S Former sewer

Note: Concentration values are mg/kg

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PLATE 8

INORGANIC CHEMICALS DETECTED OR DETECTED ABOVE BVs AT AOC 48-001

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC09IR-25-0-INORG 22 September 2009 PLANNERER
Los Alamos Technical Associates (LATA-LAO)

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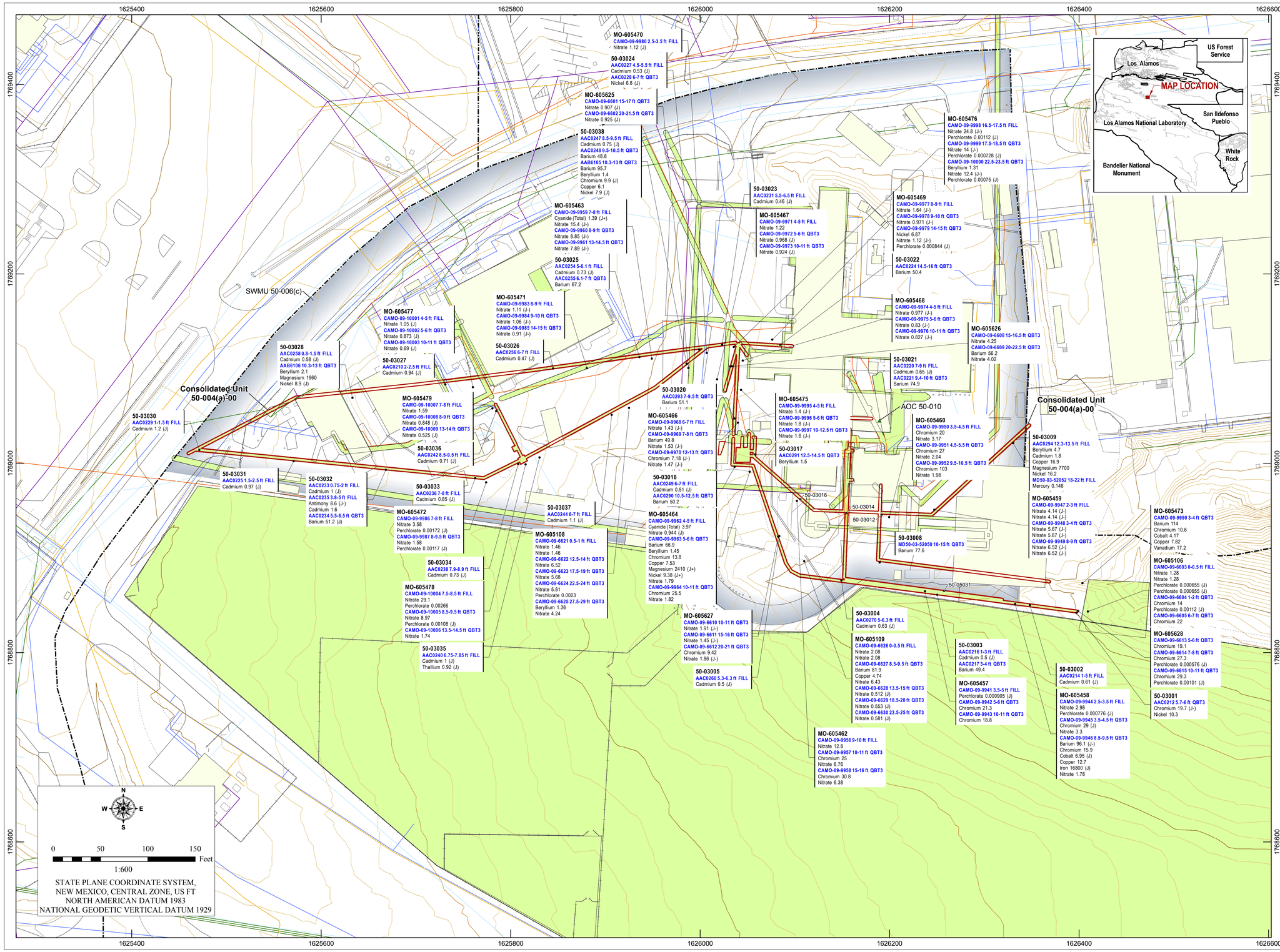

- Sampling location
- SWMU or AOC
- Consolidated unit
- SWMU or AOC within building
- SWMU 50-006(c) - stack emmissions

- Structure or building
- Former structure

- Technical Area (TA) boundary
- Fence
- Paved road
- Dirt road

Elevation contours
- 100- and 20-ft contour
- 10-ft contour
- 2-ft contour

Utilities
- C Communication
- -E- Electric
- -G- Gas
- -W- Industrial waste
- -S- Sewer
- -W- Water

Note: Concentration values are mg/kg

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PLATE 9

INORGANIC CHEMICALS DETECTED OR DETECTED ABOVE BVs AT CONSOLIDATED UNIT 50-004(a)-00

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC09IR-41-0-INORG 23 September 2009 PLANNERER
Los Alamos Technical Associates (LATA-LAO)

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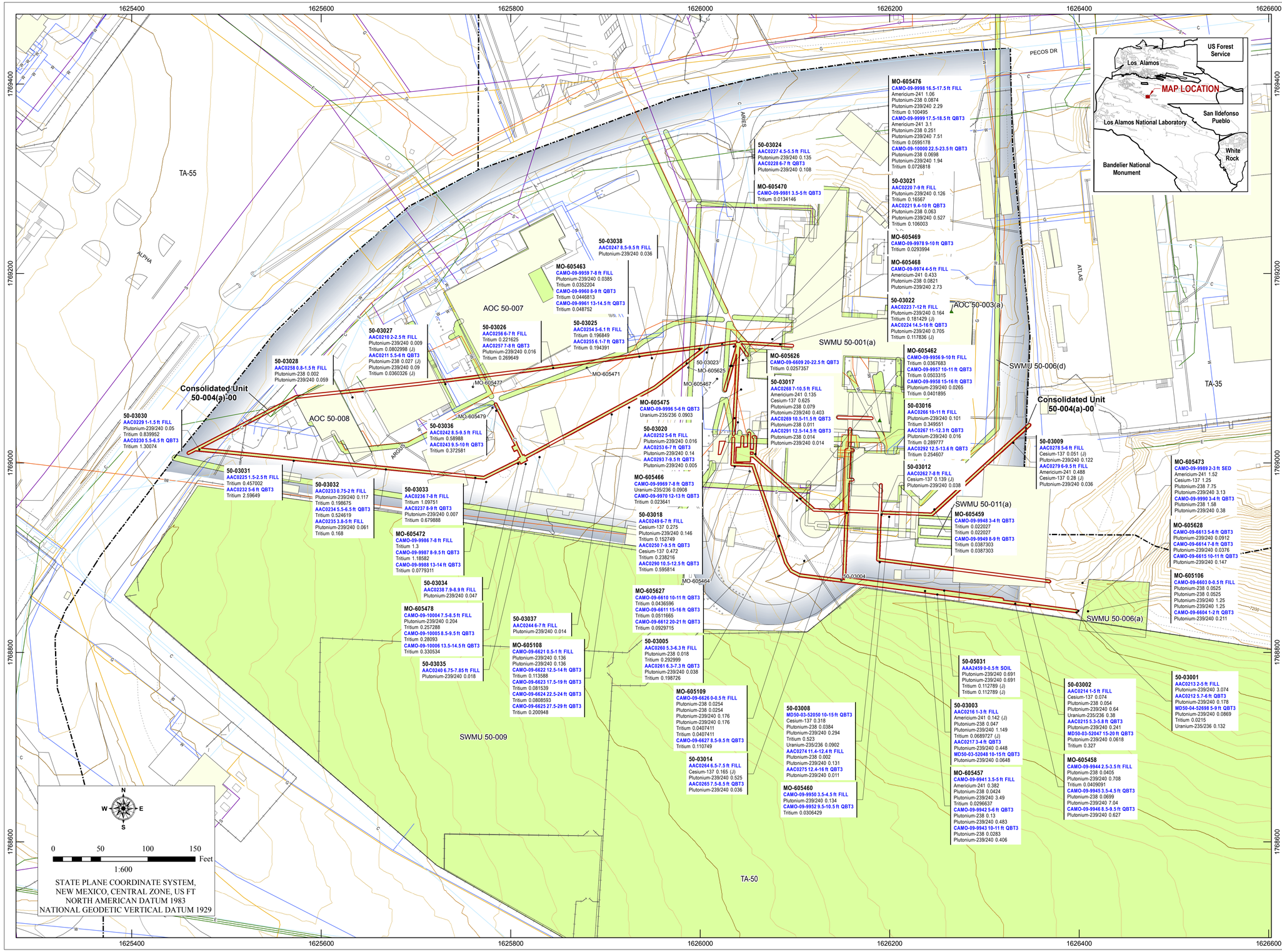

- Sampling location
- SWMU or AOC
- Consolidated unit
- SWMU or AOC within building
- SWMU 50-006(c) - stack emmissions

- Structure or building
- Former structure

- Technical Area (TA) boundary
- Fence
- Paved road
- Dirt road

Elevation contours
- 100- and 20-ft contour
- 10-ft contour
- 2-ft contour

Utilities
- C Communication
- E Electric
- G Gas
- W Industrial waste
- S Sewer
- W Water

Note: Concentration values are pCi/g

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PLATE 10

RADIONUCLIDES DETECTED OR DETECTED ABOVE BVs/FVs AT CONSOLIDATED UNIT 50-004(a)-00

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC09IR-41-0-RAD 24 September 2009 PLANNERER
Los Alamos Technical Associates (LATA-LAO)

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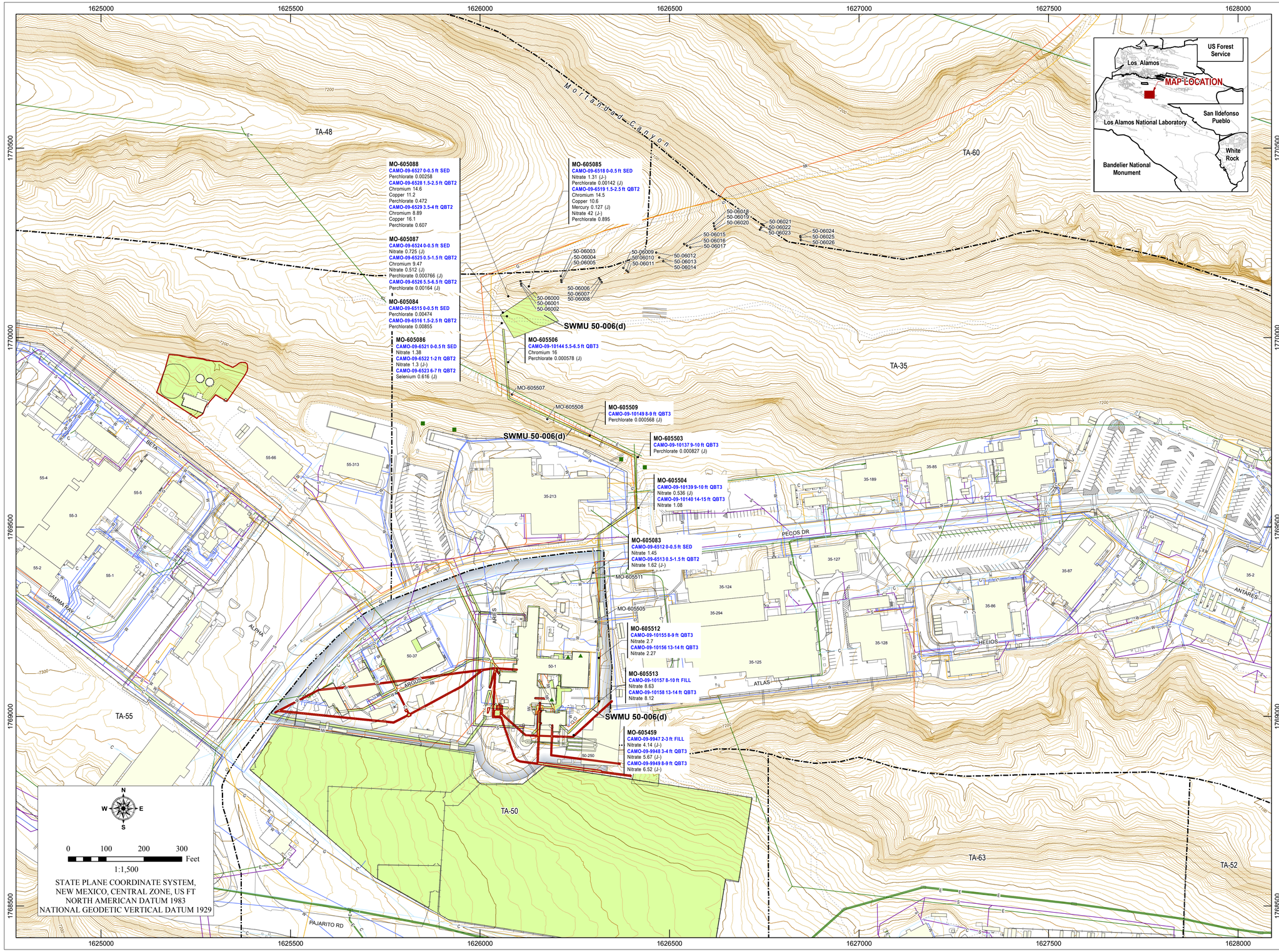

- Sampling location
- SWMU or AOC
- Consolidated unit
- SWMU or AOC within building
- SWMU or AOC outfall
- SWMU 50-006(c) - stack emmissions

- Structure or building
- Former structure

- Technical Area (TA) boundary
- Fence
- Paved road
- Dirt road

Elevation contours
- 100- and 20-ft contour
- 10-ft contour
- 2-ft contour

Utilities
- C Communication
- E Electric
- G Gas
- IW Industrial waste
- S Sewer
- W Water

Note: Concentration values are mg/kg

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PLATE 11

INORGANIC CHEMICALS DETECTED OR DETECTED ABOVE BVs AT SWMU 50-006(d)

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC09IR-44-0-INORG 24 September 2009 PLANNERER
Los Alamos Technical Associates (LATA-LAO)

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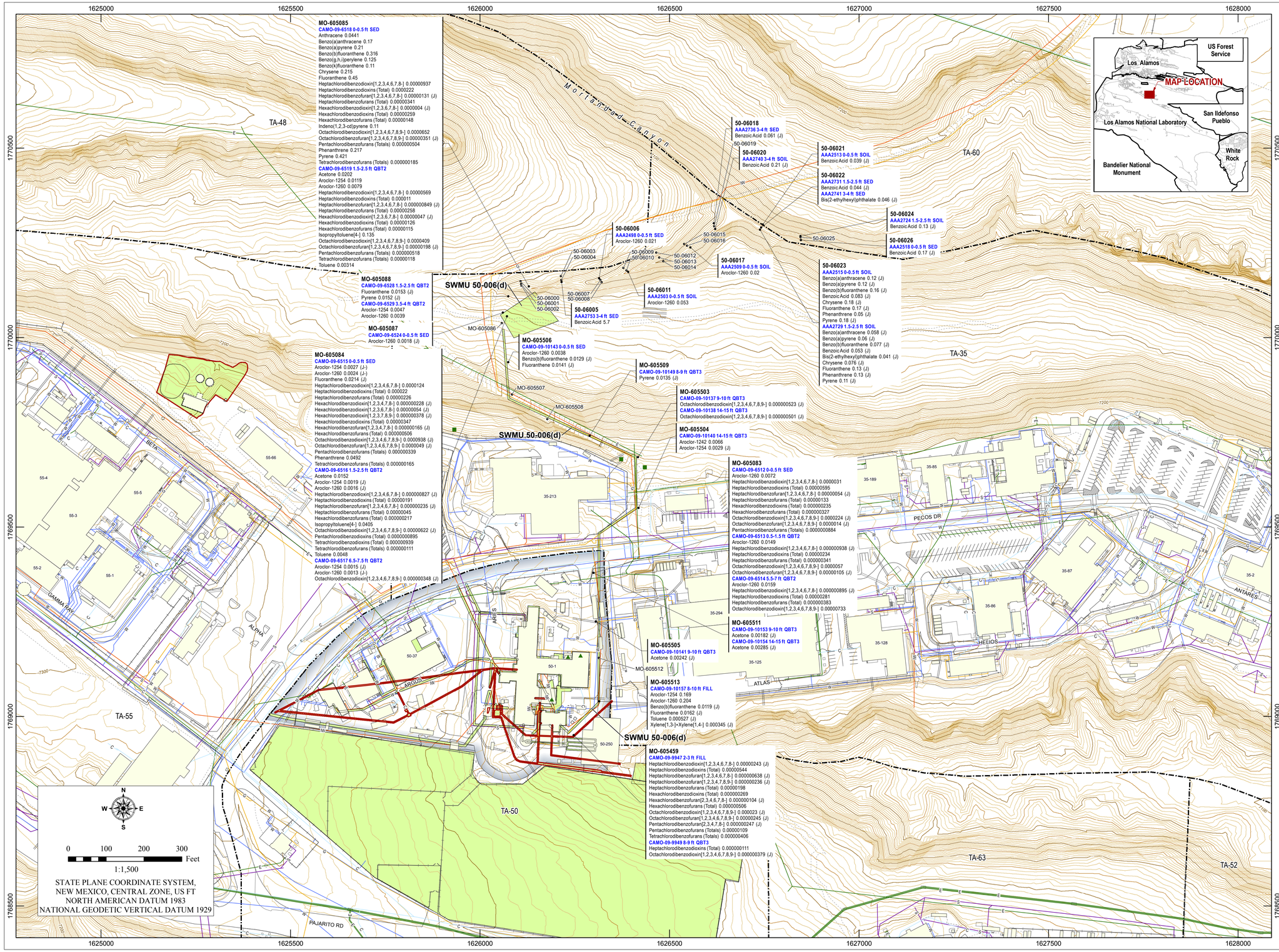

- Sampling location
- SWMU or AOC
- Consolidated unit
- SWMU or AOC within building
- SWMU or AOC outfall
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- Structure or building
- Former structure

- Technical Area (TA) boundary
- Fence
- Paved road
- Dirt road

Elevation contours
- 100- and 20-ft contour
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Utilities
- Communication
- Electric
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- Industrial waste
- Sewer
- Water

Note: Concentration values are mg/kg

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PLATE 12

ORGANIC CHEMICALS DETECTED AT SWMU 50-006(d)

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC09IR-44-0-ORG 24 September 2009 PLANNERER
Los Alamos Technical Associates (LATA-LAO)

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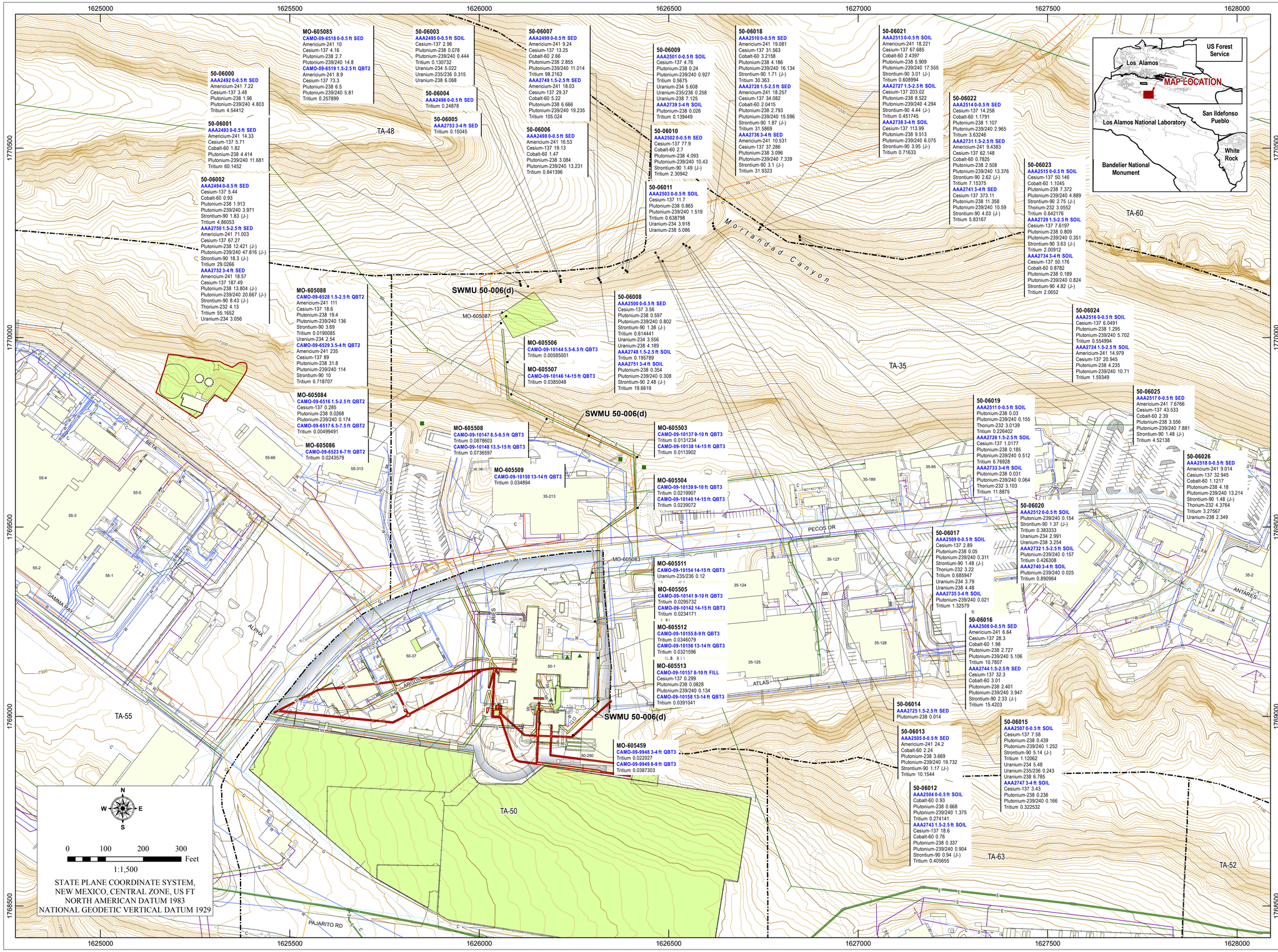

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PLATE 13

RADIONUCLIDES DETECTED OR DETECTED ABOVE BVs/FVs AT SWMU 50-006(d)

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL PROGRAMS DIRECTORATE
CORRECTIVE ACTIONS PROJECTS
Los Alamos, New Mexico 87545

Map UMC09IR-44-0-RAD 24 September 2009 PLANNERER
Los Alamos Technical Associates (LATA-LAO)

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LA-UR-11-2489
May 2011
EP2011-0149

Phase II Investigation Work Plan for Upper Mortandad Canyon Aggregate Area, Revision 1

Prepared by the Environmental Programs Directorate

Los Alamos National Laboratory, operated by Los Alamos National Security, LLC, for the U.S. Department of Energy under Contract No. DE-AC52-06NA25396, has prepared this document pursuant to the Compliance Order on Consent, signed March 1, 2005. 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.

EP2011-0149

Phase II Investigation Work Plan for Upper Mortandad Canyon Aggregate Area, Revision 1

May 2011

Responsible project manager:

Printed Name	Signature	Title	Organization	Date
Kent Rich		Project Manager	Environmental Programs	4/28/11

Responsible LANS representative:

Printed Name	Signature	Title	Organization	Date
Michael J. Graham		Associate Director	Environmental Programs	29 April 11

Responsible DOE representative:

Printed Name	Signature	Title	Organization	Date
George J. Rael		Manager	DOE-LASO	5-3-2011

EXECUTIVE SUMMARY

The Upper Mortandad Canyon Aggregate Area is located in Technical Area 03 (TA-03), TA-48, TA-50, TA-55, and former TA-42 of Los Alamos National Laboratory and includes a total of 119 solid waste management units and areas of concern. Sixty-three of the sites were investigated in 2009 and the results reported in the investigation report for the Upper Mortandad Canyon Aggregate Area.
Two additional sites at TA-35 were also investigated in 2009 and the results reported in the investigation report. Of these 65 sites, 31 require additional sampling to define the extent of contamination. This Phase II investigation work plan presents the proposed sampling and analyses needed to define the vertical and/or lateral extent of one or more contaminants at each of the 31 sites. The results of the Phase II investigation activities will be reported in a Phase II investigation report.

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1.2 Work Plan Objectives 2
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1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility owned by the U.S. Department of Energy (DOE) and managed by Los Alamos National Security, LLC. 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 40 mi^2 of the Pajarito Plateau, which consists of a series of fingerlike mesas separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation from approximately 6200 to 7800 ft above mean sea level. The location of Upper Mortandad Canyon Aggregate Area with respect to the Laboratory technical areas (TAs) and surrounding land holdings is shown in Figures 1.1-1 and 1.1-2.

The solid waste management units (SWMUs) and areas of concern (AOCs) addressed in this Phase II investigation work plan are potentially contaminated with both hazardous and radioactive components. The New Mexico Environment Department (NMED), pursuant to the New Mexico Hazardous Waste Act, regulates cleanup of hazardous wastes and hazardous constituents. DOE regulates cleanup of radioactive contamination, pursuant to DOE Order 5400.5, Radiation Protection of the Public and the Environment; DOE Order 435.1, Radioactive Waste Management; and DOE Order 458.1, Administrative Change 1, Radiation Protection of the Public and the Environment. 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 Phase II work plan describes work activities that will be executed and completed in accordance with the Consent Order.

1.1 Work Plan Overview

The Upper Mortandad Canyon Aggregate Area is located in TA-03, TA-48, TA-50, TA-55, and former TA-42 of the Laboratory and includes a total of 119 SWMUs and AOCs. Sixty-three of the sites were investigated in 2009, and the results were reported in the April 2010 Investigation Report for Upper Mortandad Canyon Aggregate Area, Revision 1 (LANL 2010, 109180.28), which was approved by NMED in June 2010 (NMED 2010, 109653). Two additional sites at TA-35 were also investigated in 2009 and results reported in the investigation report. Of these 65 sites, 31 require additional sampling to define the extent of contamination. This Phase II investigation work plan presents the proposed sampling and analyses needed to define the vertical and/or lateral extent of one or more contaminants at each of the 31 sites. A brief description and additional sampling requirements for the 31 sites are summarized in Table 1.1-1.

Section 2 of this Phase II investigation work plan presents the background and conceptual site model of the Upper Mortandad Canyon Aggregate Area. Sections 3 presents site conditions, and section 4 summarizes previous investigations and data collected and presents the scope of proposed activities for each site. Section 5 presents investigation methods for proposed field activities. Ongoing monitoring and sampling programs in the Upper Mortandad Canyon Aggregate Area are presented in section 6. Section 7 is an overview of the anticipated schedule of the Phase II investigation and reporting activities. The references cited in this report and the map data sources are provided in section 8. Appendix A of this work plan includes a list of acronyms and abbreviations, a glossary, and metric conversion and data qualifier definitions tables. Appendix B describes the management of investigation-derived waste (IDW).

1.2 Work Plan Objectives

The objective of the Phase II work plan is to complete the activities recommended in the investigation report (LANL 2010, 109180.28) for 31 sites requiring additional sampling to define the extent of contamination.

To accomplish this objective, this Phase II work plan

- presents historical and background information on the sites,
- describes the rationale for proposed data collection activities,
- identifies and presents appropriate methods for achieving the investigation objectives and managing IDW, and
- presents a schedule for conducting the investigation activities and reporting the investigation results.

2.0 BACKGROUND

2.1 General Site Information

TA-03, located on South Mesa between Los Alamos Canyon to the north and Twomile Canyon to the south, is the Laboratory's main TA. It contains most of the Laboratory's administrative buildings and public and corporate access facilities. In addition, TA-03 houses several Laboratory activities such as experimental sciences, special nuclear materials, theoretical/computations, and physical support operations. Security requirements at TA-03 range from buildings open to the general public to buildings that have the strictest security.

TA-35, also referred to as Ten Site, is used for nuclear-safeguards research and development (primarily in the areas of lasers, physics, fusion work, materials development, and biochemistry); physical chemistry research and development; research in reactor safety; optical science; and pulsed-power systems. Metallurgy, ceramic technology, and chemical plating also occur at this site. Formerly, the TA was used in source manufacturing, specialty-materials manufacturing, and reactor development, including the construction and operation of several reactors.

Former TA-42 lies within the current boundaries of TA-55. TA-42 was built in 1951 as an incinerator site for radionuclide-contaminated waste. However, the TA was never fully operational, and all the buildings were removed in 1978. In the interim, TA-42 was used for decontamination work and for storage.

TA-48 consists of a building complex used for research and development in nuclear chemistry and radiochemistry, geochemistry, production of medical radioisotopes, and chemical synthesis.

TA-50 manages various wastes for the Laboratory. Waste management activities at TA-50 include treating radioactive liquid waste (RLW), reducing the size and volume of transuranic wastes, and characterizing transuranic wastes. The TA has been in operation since 1963. The TA-50 complex supports a number of waste-management activities for several types of waste, including storing, treating, or disposing of solid and liquid, low-level radioactive waste (LLW), mixed low-level waste, transuranic waste, and hazardous waste. Major facilities at TA-50 are the Radioactive Liquid Waste Treatment Facility (RLWTF) and the Waste Characterization, Reduction, and Repackaging Facility.

2.2 Operational History

Originally, before 1945, TA-03 was built as a firing site. It contained several wooden structures that served as an administration building; a shop; hutments (10- × 10-ft fiberboard buildings used for storage, minor assembly, and checkout of scientific hardware); and magazines. The area also contained a burn pit for destroying explosives (LASL 1947, 005581). The site was decommissioned and cleared in 1949.

In 1950, construction began on the major buildings at TA-03 to replace operational facilities in the Los Alamos townsite. The Van de Graaf accelerator was built on the rim of Twomile Canyon. The Chemistry and Metallurgy Research (CMR) Building (03-29), built in 1952, is a large laboratory facility that houses diverse chemical and metallurgical operations involving plutonium, uranium, other radionuclides, metals, inorganic and organic chemicals, acids, and solvents.

The Administration Building was completed in 1956. In addition to offices, it housed laboratory and shop facilities and extensive photographic operations. In 1959, the Sigma Building (03-66) was completed at the eastern end of the site. The building houses a complex array of equipment and activities concerned with metallurgical and ceramics research and fabrication. Construction of new facilities continued through the 1960s and 1970s. Office buildings, shops, storage areas, an addition to the wastewater treatment plan, a cement batch plant, and numerous transportable buildings filled the areas between the initial buildings. In 1977, the Oppenheimer Study Center was constructed, and in 1981, the Otowi Building was built as an annex to the Administration Building. A computer facility and several national centers for various scientific activities were constructed in the 1990s. A parking structure was completed in 2006.

The first laboratories and offices at TA-35 were completed in 1951. Initial operations involved the preparation of kilocurie sources of radioactive lanthanum. Experimentation with several radionuclides, mainly plutonium and tritium, was conducted at TA-35 in the 1950s and 1960s. Three experimental fission reactors were developed and operated for short periods between 1956 and 1964. By the 1970s, most of the work with radioactive materials was phased out and attention was focused on laser operations. In addition, research on optics, robotics, and nuclear safeguards is conducted at TA-35.

In 1951, an incinerator was built at former TA-42 for volume reduction of low-level plutonium-contaminated wastes. The incinerator, which was never fully operational, was shut down in 1952. In 1978, all structures, debris, and contaminated soil were removed and disposed of at Area G, TA-54. Following removal of contaminated materials, the site was contoured and revegetated (LANL 1992, 007666).

TA-48 was established in 1957 for work in radiochemistry. Initially, the major work was to study samples from bomb tests; however, that work evolved into other types of studies related to weapon tests, research in geochemistry and radiochemistry, and production of radioisotopes for nuclear medicine (DOE 1987, 008663; DOE 1987, 008664; LANL 1992, 007666). TA-48 facilities also have historically been and are currently used to study nuclear properties of radioactive materials using analytical and physical chemistry. Measurements of radioactive substances are performed, and hot cells are used for remote handling of radioactive materials (LANL 1988, 000344; LANL 1992, 007666).

The TA-50 RLWTF was built in 1963 to meet the need for expanded treatment capability and to locate a treatment facility nearer the TAs that were generating the waste. This treatment plant treats low-level wastewater from various areas of the Laboratory. The incinerator complex, built in 1975, and the volume-reduction facility, built in 1983, were prototype facilities for developing and testing improved methods of handling and treating certain types of radioactive waste.

2.3 Conceptual Site Model

The sampling proposed in this Phase II work plan uses a conceptual site model to predict areas of potential contamination and to allow for adequate characterization of these areas. A conceptual site model describes potential contaminant sources, transport mechanisms, and receptors.

2.3.1 Potential Contaminant Sources

Releases at the sites within the Upper Mortandad Canyon Aggregate Area may have occurred as a result of air emissions; potential leaks from septic systems, sumps, tanks, waste lines, and drains; discharges from cooling towers and outfalls; and releases from storage areas, firing sites, and an incinerator. Previous sampling results indicate contamination from inorganic chemicals, organic chemicals, and radionuclides (LANL 2010, 109180.28). Additional sampling is needed to define the extent of contamination at 31 sites.

2.3.2 Potential Contaminant Transport Mechanisms

Current potential transport mechanisms that may lead to exposure include

- dissolution and/or particulate transport of surface contaminants during precipitation and runoff events,
- airborne transport of contaminated surface soil,
- continued dissolution and advective/dispersive transport of chemical contaminants contained in subsurface soil and tuff as a result of past operations,
- disturbance of contaminants in shallow soil and subsurface tuff by Laboratory operations, and
- disturbance and uptake of contaminants in shallow soil by plants and animals.

2.3.3 Potential Receptors

Potential receptors at one or more of the sites may include

- Laboratory workers,
- construction workers, and
- plants and animals both on-site and in areas immediately surrounding the sites.

Laboratory workers could potentially be exposed to contaminants in soil, tuff, and sediment by direct contact, ingestion, or inhalation. Ecological receptors may also be exposed to soil and sediment contaminants.

2.3.4 Cleanup Standards

Soil screening levels (SSLs) for chemicals or screening action levels (SALs) for radionuclides will be used as soil cleanup levels unless they are determined to be impractical or unless values do not exist for the current and reasonable foreseeable future land use scenarios. In some cases where NMED SSLs do not exist, U.S. Environmental Protection Agency (EPA) regional screening values are used.

2.4 Data Overview

This work plan summarizes the available decision-level data used to evaluate whether the nature and extent of contamination are defined for each site. In addition, this work plan proposes sampling and analyses for those sites at which the extent of contamination has not been defined. The data collected during this investigation, along with existing decision-level data, will be used to define nature and extent and perform risk-screening assessments.

3.0 SITE CONDITIONS

Surface and subsurface features and geologic characteristics of the Upper Mortandad Canyon Aggregate Area are described in detail in the investigation report (LANL 2010, 109180.28). Conditions at the sites included in this Phase II investigation work plan are predominantly influenced by

- a semiarid climate with low precipitation and a high evapotranspiration rate that limits the extent of subsurface moisture percolation and, therefore, the amount of moisture available to transport radionuclides or hazardous waste constituents in the subsurface, and
- a thick, relatively dry, unsaturated (vadose) zone that greatly restricts or prevents downward migration of contaminants to the regional aquifer.

These and other elements of the environmental setting in the Upper Mortandad Canyon Aggregate Area are considered when the investigation data are evaluated with respect to the fate and transport of contaminants.

4.0 SITE DESCRIPTIONS AND PROPOSED INVESTIGATION ACTIVITIES

4.1 TA-03

TA-03 is located on the western end of South Mesa and is almost completely developed. The core operational facilities for the Laboratory are located at TA-03, including the principal administration buildings, the library, the CMR Building, the Beryllium Technology Facility, a gas-fired electrical generating plant, and a former sanitary wastewater treatment plant and supporting structures.

4.1.1 AOC 03-004(c), Storage Area, CMR Building Loading Dock

4.1.1.1 Site Description and Operational History

AOC 03-004(c) is an active 85-ft × 50-ft dumpster storage area at the main loading dock of the CMR Building (03-29) (Figure 4.1-1). The area is level and paved with asphalt. Two dumpsters occupying the area are used to stage boxed LLW before disposal. The waste is generated from offices and material-handling areas in the CMR Building. One dumpster receives compactable waste, and the other receives noncompactable waste. Waste consists of gloves, paper products, glass, plastic, and metal. Runoff from the dumpster storage area flows to a storm drain inlet grate about 50 ft southwest of the area. The storm drain eventually discharges at an outfall [SWMU 03-054(e)] in Mortandad Canyon (LANL 1995, 057590).

4.1.1.2 Previous Investigations

In 1997 and 2009, a total of 26 samples (12 soil or fill and 14 tuff) were collected from 12 locations at AOC 03-004(c). Previously sampled locations are shown in Figure 4.1-1. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In July 1997, a Resource Conservation and Recovery Act facility investigation (RFI) was conducted at AOC 03-004(c). Samples were collected and field screened for organic vapors and radioactivity. Screening results did not indicate the presence of organic vapors, and radioactivity was at or below background. Five samples were analyzed for target analyte list (TAL) metals, semivolatile organic compounds (SVOCs), and volatile organic compounds (VOCs). The RFI activities and results were presented in the RFI report, which included the results of five asphalt samples analyzed for isotopic plutonium and isotopic uranium (LANL 1997, 056660.289). These asphalt samples were collected from the asphalt pavement and were all surface samples (0–0.42 ft below ground surface [bgs]). The results of the asphalt samples are screening-level data. Because the samples are engineered material, the results have no applicable background values (BVs), and the results are not directly comparable with the results from soil, fill, or tuff samples. Section 2.3.1 of the HIR provides additional details of previous investigations (LANL 2007, 098955).

Sampling at AOC 03-004(c) consisted of the following activities in 2009:

- Soil and tuff samples were collected at seven sampling locations from three depth intervals: beneath the asphalt, at the soil-tuff-interface interval, and at the interval beginning 5 ft below the soil-tuff interface. Three of the sampling locations were sited next to the two dumpsters, and four were downgradient of the dumpsters.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, polychlorinated biphenyls (PCBs), gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 18), the lateral extent of barium, chromium, copper, and manganese and the vertical extent of chromium are not defined at AOC 03-004(c). The highest concentrations of barium (121 mg/kg), chromium (48.2 mg/kg), copper (16.6 mg/kg), and manganese (599 mg/kg) were detected at the farthest downslope location MO-605048 (Figure 4.1-2). The vertical extent of chromium is not defined at location MO-605048.

4.1.1.3 Proposed Sampling at AOC 03-004(c)

Shallow subsurface samples will be collected at previously sampled location MO-605048, extending the depth at that location to define the vertical extent of chromium. Samples at location MO-605048 will be analyzed for chromium only. Two new sampling locations (4c-1 and 4c-2) will be placed south and west of existing location MO-605048 to define the lateral extent of barium, chromium, copper, and manganese. Samples at locations 4c-1 and 4c-2 will be analyzed for barium, chromium, copper, and manganese. The proposed sampling and analyses at AOC 03-004(c) are presented in Table 4.1-1, and the proposed sampling locations are shown in Figure 4.1-1.

4.1.2 AOC 03-004(d), Former Storage Area at CMR Building

4.1.2.1 Site Description and Operational History

AOC 03-004(d) is a former 75-ft × 20-ft dumpster storage area located on a level, asphalt-covered surface south of the steps at the west end of Wing 9 at the CMR Building (03-29) (Figure 4.1-3). Runoff from this AOC flows to a storm drain inlet grate located approximately 100 ft west of the area. The storm drain discharges at an outfall [SWMU 03-054(e)] into Mortandad Canyon. The dumpster at AOC 03-004(d) was relocated in 1992 to inside Wing 9 of the CMR Building. It typically received contact-handled waste generated from operations of Wing 9 hot cells. The waste consisted of rags, small hardware, paper, machine-shop waste, cleaning materials, and occasionally a decontaminated hot-cell item. All waste was bagged and boxed before it was placed in the dumpster.

4.1.2.2 Previous Investigations

In 1997 and 2009, a total of 37 samples (23 soil or fill and 14 tuff) were collected from 14 locations at AOC 03-004(d). Previously sampled locations are shown in Figure 4.1-3. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

An RFI was conducted at this site in July 1997. Samples were collected and field screened for organic vapors and radioactivity. Screening results were negative for organic vapors, and radioactivity was at or below background. Samples were analyzed for TAL metals, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, SVOCs, and VOCs. The RFI activities and results were presented in the RFI report (LANL 1997, 056660.289). Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at AOC 03-004(d) consisted of the following activities in 2009:

- Soil and tuff samples were collected at seven sampling locations from three depth intervals: beneath the asphalt, at the soil-tuff-interface interval, and at the interval beginning 5 ft below the soil-tuff interface. Three of the sampling locations were within the former dumpster storage area, and four were downgradient of the former storage area.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, PCBs, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 20), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at AOC 03-004(d), except for the lateral extent of chromium downgradient of location MO-605041 (Figure 4.1-4).

4.1.2.3 Proposed Sampling at AOC 03-004(d)

Shallow subsurface samples will be collected at two new sampling locations (4d-1 and 4d-2) to define the lateral extent of chromium. Samples will be analyzed for chromium only. The proposed sampling and analyses at AOC 03-004(d) are presented in Table 4.1-2, and the proposed sampling locations are shown in Figure 4.1-3.

4.1.3 AOC 03-007, Decommissioned Firing Site

4.1.3.1 Site Description and Operational History

AOC 03-007 is a decommissioned firing site located southwest of the Beryllium Technology Facility (building 03-141) within the security fence at the Sigma Complex (Figure 4.1-5). This AOC includes a containment building for explosives experiments (building 03-159) and a personnel safety barrier (structure 03-160). Building 03-159 sits on an 8- × 8-ft concrete slab and has 6-in.-thick × 8-ft-high walls. An opening on one side serves as an entrance. Structure 03-160 sits on a concrete slab and has two 8-ft-high × 4-ft-wide × 6-in.-thick walls. From 1970 to 1975, approximately 50 to 75 explosive shot experiments were detonated within building 03-159. The building was rinsed with water after each shot. Washdown water from within building 03-159 was released to the environment (soil immediately surrounding the building) from engineered gaps between the concrete floor and structure walls. The rinse water drained into small drainages and catchment areas and eventually flowed into Mortandad Canyon. The site was remediated in the late 1970s, and no explosive compounds were detected (LANL 1995, 057590). In the mid-1980s, building 03-159 was modified to serve as a storage building for thoria (oxide) and thorium (metal), which were stored in containers within the building (LANL 1995, 057590).

4.1.3.2 Previous Investigations

In 1997 and 2009, a total of 45 samples (11 soil or fill, 4 sediment, and 30 tuff) were collected from 18 locations at AOC 03-007. Previously sampled locations are shown in Figure 4.1-5. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

An RFI was conducted at this site in July 1997. Samples were collected on the north, east, and south sides of building 03-159 and were field screened for organic chemicals and radioactivity. Screening results indicated that organic chemicals were not detected, and radioactivity was at or below background. Samples were analyzed for TAL metals, gamma-emitting radionuclides, isotopic thorium, explosive compounds, SVOCs, and VOCs. The RFI activities and results were presented in the RFI report (LANL 1997, 056660.289). Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at AOC 03-007 consisted of the following activities in 2009:

- Soil and tuff samples were collected at nine locations downgradient of the former firing site. Samples were collected from two or more depth intervals, generally including the surface interval, the soil-tuff-interface interval, and the interval beginning approximately 5 ft below the soil-tuff interface. Where tuff was found at the surface, only two depth intervals were sampled.
- Sediment and soil samples were collected at five locations within the drainage from two depth intervals: surface sediment or soil and the underlying tuff.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, PCBs, explosive compounds, gamma-emitting radionuclides, isotopic plutonium, isotopic thorium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 23), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at AOC 03-007, except for the lateral and vertical extent of chromium. The vertical extent of chromium is not defined at locations MO-604997, MO-604998, MO-605005, MO-605007, and MO-605008 (Plate 1).

4.1.3.3 Proposed Sampling at AOC 03-007

Shallow subsurface samples will be collected at five previously sampled locations (MO-604997, MO-604998, MO-605005, MO-605007, and MO-605008), extending the depth at these locations to define the vertical extent of chromium. Samples will be analyzed for chromium only.

Samples will also be collected at four new sampling locations to define the lateral extent of chromium. A new sampling location (7-1) will be placed southwest of existing locations MO-604999 and MO-605000. Another new sampling location (7-2) will be placed downgradient of location 7-1 and just above the unpaved access road. New sampling locations 7-3 and 7-4 will be placed in the drainage downgradient of existing location MO-605008 to define the lateral extent of chromium in the drainage. Samples from locations 7-1, 7-2, 7-3, and 7-4 will be analyzed for chromium only. The proposed sampling and analyses at AOC 03-007 are presented in Table 4.1-3, and the proposed sampling locations are shown in Figure 4.1-5.

4.1.4 SWMU 03-045(h), Former Outfall from Cooling Tower

4.1.4.1 Site Description and Operational History

SWMU 03-045(h) consists of a cooling tower outlet pipe that discharged to a storm drain at the north perimeter of the TA-03 Sigma Complex security fence (Figure 4.1-6), approximately 50 ft north of a cooling tower (structure 03-187). The cooling tower outlet pipe is a former National Pollutant Discharge Elimination System– (NPDES-) permitted outfall (03A024) that was removed from the NPDES permit on August 1, 2007 (EPA 2007, 099009). This outlet pipe discharged treated cooling water onto a small area of ground surface, which drained into a buried corrugated metal storm drain that trended northeast of structure 03-187, where it eventually combined with stormwater runoff from surrounding areas. The drainage continued northeast and joined a channel north of Eniwetok Drive, which ultimately drained into Sandia Canyon (LANL 1995, 057590). The cooling tower outlet pipe was active from 1953 to the late 1980s. The pipe was reactivated in early 1995 and remained active until it was plugged in February 1997.

Routine cooling water treatment began in 1968. Treatment included biocides and fungicides to reduce algae growth and chelating agents (such as ethylenediaminetetraacetic acid [EDTA]) to inhibit corrosion. The potential contamination resulting from the northward flow of the discharge from the cooling water outlet pipe into Sandia Canyon was investigated as part of the Upper Sandia Canyon Aggregate Area investigation report (LANL 2010, 110862.24).

In addition, it is possible that the buried corrugated storm drain into which the cooling tower outlet pipe drained may not have been able to handle the large flow of stormwater that results during sporadic and heavy storm events. Should this have occurred, the overflow would have drained due south across asphalt pavement to a drainage located to the southwest of building 03-66. This drainage discharges into upper Mortandad Canyon.

4.1.4.2 Previous Investigations

In 2009, a total of 22 samples (9 soil or fill, 2 sediment, and 11 tuff) were collected from 11 locations at SWMU 03-045(h). Previously sampled locations are shown in Figure 4.1-6. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

Investigation sampling at SWMU 03-045(h) consisted of the following activities in 2009:

- Sediment or soil samples were collected at 10 locations from two depth intervals: the surface sediment or soil interval and the soil-tuff-interface interval. The sampling locations were in the drainage below SWMU 03-045(h).
- Samples were collected from two depth intervals (surface and soil-tuff interface) at one location at the discharge point north of the cooling tower.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, PCBs, gamma-emitting radionuclides, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, pp. 37–38), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 03-045(h), except for the lateral and vertical extent of barium and cobalt and the lateral extent of antimony. The vertical extent of barium is not defined at locations MO-604948, MO-604952, MO-604971, MO-604973, MO-604974, MO-604976, and MO-604977, and the vertical extent of cobalt is not defined at locations MO-604948, MO-604952, and MO-604974 (Figure 4.1-7).

4.1.4.3 Proposed Sampling at SWMU 03-045(h)

Shallow subsurface samples will be collected at seven previously sampled locations (MO-604948, MO-604952, MO-604971, MO-604973, MO-604974, MO-604976, and MO-604977), extending the depths at these locations to define the vertical extent of barium and cobalt. Samples from locations MO-604948, MO-604952, and MO-604974 will be analyzed for barium and cobalt. Samples from the other four locations will be analyzed for barium only.

A new sampling location (45h-1) will be placed in the drainage downgradient of location MO-604948 to define the lateral extent of antimony, barium, and cobalt. Samples at location 45h-1 will be analyzed for antimony, barium, and cobalt. The proposed sampling and analyses at SWMU 03-045(h) are presented in Table 4.1-4, and the proposed sampling locations are shown in Figure 4.1-6.

4.1.5 SWMU 03-049(a), NPDES-Permitted Outfall from Cooling Tower

4.1.5.1 Site Description and Operational History

SWMU 03-049(a) is a currently permitted NPDES outfall (03A022) located south of the Sigma Building (03-66) (Plate 2). The outfall formerly discharged treated cooling water from a former cooling tower (structure 03-127), which served the Sigma Building, and continues to discharge runoff from six roof drains on the Sigma Building. The cooling tower operated from1960 to 1999. From 1984 to 1990, the outfall also received discharge from rinse tanks associated with the electroplating operation in the Sigma Building. The tanks contained the final rinse from electroplating and surface-finishing experimental components. Although the rinse tanks were flushed continually with tap water to reduce contaminant buildup, trace amounts of metals, acids, cyanide, and depleted uranium were introduced into the rinse water. The NPDES permit allowed discharge of 4680 gal./d of treated cooling water and 24,000 gal./d of electroplating rinse water. Between 1990 and 1999, the outfall received treated cooling water and roof-drain runoff. The outfall currently discharges roof-drain runoff to upper Mortandad Canyon (LANL 1995, 057590).

4.1.5.2 Previous Investigations

In 1997 and 2009, a total of 32 samples (6 soil, 14 sediment, and 12 tuff) were collected from 20 locations at SWMU 03-049(a). Previously sampled locations are shown on Plate 2. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In July 1997, an RFI was conducted at SWMU 03-049(a). The investigation evaluated the point of discharge for the outfall and four associated sediment catchment basins through which the discharge flows before flowing into Mortandad Canyon. Field activities included a site survey, geodetic survey, field screening, and sample collection. Sediment samples were collected from each of the sediment basins. Two water samples were collected: one at the NPDES outfall pipe before it entered the sediment catchment basin and the other from flowing water exiting the last sediment catchment basin before it entered Mortandad Canyon. Screening results did not indicate the presence of organic vapors, and radioactivity was at or below background. The sediment samples were analyzed for hexavalent chromium, TAL metals, cyanide, isotopic uranium, and VOCs. Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 03-049(a) consisted of the following activities in 2009:

- Sediment samples were collected at 11 locations within the drainage from two depth intervals: the surface sediment or soil interval and the sediment-tuff or soil-tuff interface. The sampling locations were downgradient of the outfall.
- Sediment samples were collected at one location below outfall 03A022 from two depth intervals: the surface-sediment interval and the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, PCBs, gamma-emitting radionuclides, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 40), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 03-049(a), except for the vertical extent of chromium at location MO-604985 (Plate 3) and the lateral extent of dioxins/furans (Plate 4).

4.1.5.3 Proposed Sampling at SWMU 03-049(a)

Shallow subsurface samples will be collected at previously sampled location MO-604985, extending the depth at this location to define the vertical extent of chromium. Samples at this location will be analyzed for chromium only.

Samples will be collected at location MO-604981 to define the lateral extent of dioxins/furans because samples at this downgradient location were not analyzed for dioxins/furans in 2009. The proposed sampling and analyses at SWMU 03-049(a) are presented in Table 4.1-5, and the proposed sampling locations are shown on Plate 2.

4.1.6 Consolidated Unit 03-049(b)-00, Soil Contamination

4.1.6.1 Site Description and Operational History

Consolidated Unit 03-049(b)-00 consists of SWMU 03-049(b) and AOC C-03-014 (Figure 4.1-8). These sites were consolidated because surface-water drainage from both sites collects in the same locations, and regrading and paving operations may have distributed contamination from one site to the other.

SWMU 03-049(b) is a 50-ft-long × 20-ft-wide discharge area at the south wall of the press building (03-35). It is associated with an inactive vacuum pump that served furnaces in building 03-35. The press building was built in 1953. The vacuum pump evacuated oil from furnaces used for experiments in building 03-35. Experiments included fabricating enriched uranium-loaded graphite and carbide fuel elements. Enriched uranium was processed in the press building. The outlet is located about 8 ft above the ground on the south wall of the press building. The vacuum pump was deactivated in the late 1980s. At about the same time, a 10-ft × 8-ft area under the exhaust pipe outlet was paved with asphalt. Runoff from this area drains southwest toward low-lying areas. The press building ceased to be used in November 1991, but it was reactivated in 1995 (LANL 1995, 057590).

AOC C-03-014 is a 125-ft × 100-ft equipment-storage area located southwest of the press building (03-35). The area is bounded by security fences to the north, south, and west and by building 03-35 to the east. Most of the area is paved, except for a 15-ft-wide strip of grass along the southern security fence that widens to 30 ft southwest of building 03-35. Various equipment and molds from building 03-35 were stored at AOC C-03-014 for salvage or because of the building's space limitations. Equipment is no longer stored outside the building (LANL 1995, 057590).

4.1.6.2 Previous Investigations

In 1997 and 2009, a total of 48 samples (18 soil or fill and 30 tuff) were collected from 23 locations at Consolidated Unit 03-049(b)-00. Previously sampled locations are shown in Figure 4.1-8. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

An RFI was conducted in July 1997 for Consolidated Unit 03-049(b)-00. Field activities included a site survey, geodetic survey, field screening, and sample collection. Screening results indicated that organic vapors were not detected, and radioactivity was at or below background. Samples were collected and analyzed for TAL metals, isotopic uranium, PCBs, total petroleum hydrocarbons–diesel range organics (TPH-DRO), and VOCs. The RFI activities and results were presented in the RFI report (LANL 1997, 056660.289). Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at Consolidated Unit 03-049(b)-00 consisted of the following activities in 2009:

- Soil and tuff samples were collected at 10 locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 5 ft below the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, PCBs, TPH-DRO, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), gamma-emitting radionuclides, isotopic uranium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 43), the lateral extent of aluminum, chromium, total cyanide, lead, and perchlorate is not defined downgradient of locations MO-605027 and MO-605029 (Plate 5). The vertical extent of PCBs is not defined at locations

MO-605025 and MO-605029, and the ~~(Plate 6).~~ lateral extent of PCBs is not defined downgradient of the site (Plate 6). The vertical extent of tritium is not defined at locations MO-605025, MO-605026, MO-605027, and MO-605034, and the lateral extent of tritium is not defined downgradient of location MO-605027 (Figure 4.1-9). The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at Consolidated Unit 03-049(b)-00.

4.1.6.3 Proposed Sampling at Consolidated Unit 03-049(b)-00

Shallow subsurface samples will be collected at two new sampling locations (49b-1 and 49b-2) to define the lateral extent of aluminum, chromium, total cyanide, lead, ~~and~~ perchlorate, and PCBs to the south of locations MO-605029 and MO-605027. Samples from locations 49b-1 and 49b-2 will be analyzed for aluminum, chromium, total cyanide, lead, ~~and~~ perchlorate, and PCBs.

Shallow subsurface samples will be collected at locations MO-605025 and MO-605029, extending the depths to define the vertical extent of PCBs. Samples at ~~this~~ these locations will be analyzed for PCBs. Shallow subsurface samples will be collected at four previously sampled locations (MO-605025, MO-605026, MO-605027, and MO-605034), extending the depths to define the vertical extent of tritium. Samples at these locations will be analyzed for tritium. Samples collected at location 49b-2 will also be analyzed for tritium to define the lateral extent of tritium to the south of location MO-605027.

The proposed sampling and analyses at Consolidated Unit 03-049(b)-00 are presented in Table 4.1-6, and the proposed sampling locations are shown in Figure 4.1-8.

4.1.7 SWMU 03-049(e), Outfall from Sigma Building Roof Drains

4.1.7.1 Site Description and Operational History

SWMU 03-049(e) is identified in the 1990 SWMU report (LANL 1990, 007511) as an area located south of the Sigma Building (03-66) that was potentially contaminated by an outfall pipe of unknown origin (Figures 4.1-6 and 4.1-10). The 1990 SWMU report also states that the outfall discharged to Mortandad Canyon (LANL 1990, 007511). Subsequent investigation of the Sigma Building determined that three of the building's roof drains connect to a single pipe and discharge to the outfall area of SWMU 03-049(e) (LANL 1995, 057590).

4.1.7.2 Previous Investigations

In 2001 and 2009, a total of 28 samples (7 soil or fill, 9 sediment, and 12 tuff) were collected from 16 locations at SWMU 03-049(e). Previously sampled locations are shown in Figure 4.1-10. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 2001, four surface samples were collected from four locations near the outfall and analyzed for anions and TAL metals. Antimony, arsenic, cadmium, chromium, copper, iron, lead, nickel, and zinc were detected above BV at one to four locations. Decision-level data from the 2001 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 03-049(e) consisted of the following activities in 2009:

- Sediment or soil samples were collected at six locations within the drainage, from two depth intervals: the surface-sediment interval and the sediment-tuff- or soil-tuff-interface interval. Four of the sampling locations were sited near the previous 2001 sampling locations, two were downslope of both the previous and new sampling locations, and one was below the outfall.

- Samples were collected at one location at the outfall of the discharge pipe from two depth intervals: the surface-sediment interval and the sediment-tuff-interface interval.
- Sediment or soil samples were collected at five locations from two depth intervals: the surface-sediment interval and the sediment-tuff or soil-tuff interface every 50 ft from the top of the slope to the toe of the colluvium in the drainage downslope of the outfall.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, PCBs, gamma-emitting radionuclides, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 45), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 03-049(e), except for the vertical extent of antimony (MO-605009, and MO-605010); chromium (locations MO-605009, MO-605012, MO-605014, and MO-605018); hexavalent chromium (locations MO-605011, MO-605016, and MO-605017); selenium (location MO-605009); and zinc (locations MO-605010 and MO-605013) (Figure 4.1-11).

4.1.7.3 Proposed Sampling ~~and Soil Removal~~ at SWMU 03-049(e)

Shallow subsurface samples will be collected at nine previously sampled locations (MO-605009, MO-605010, MO-605011, MO-605012, MO-605013, MO-605014, MO-605016, MO-605017, and MO-605018), extending the depths at these locations to define the vertical extent of antimony, chromium, hexavalent chromium, selenium, and zinc. The proposed sampling and analyses at SWMU 03-049(e) are presented in Table 4.1-7, and the proposed sampling locations are shown in Figure 4.1-10.

4.1.8 SWMU 03-054(e), Outfall

4.1.8.1 Site Description and Operational History

SWMU 03-054(e) is an outfall located in upper Mortandad Canyon (Figure 4.1-12). The outfall typically discharges a steady, low-volume flow of effluent that originates from several sources at the CMR Building (03-29). These sources include drainage from roofs over the west wing, where towers vent filtered exhaust, and surface water runoff from the asphalt area around the building.

SWMU 03-054(e) also received effluent from an unintentional one-time release in 1974 from an industrial waste manhole (AOC C-03-006). The overflow resulted from a plug in the industrial waste line and was estimated to be between 500 and 1000 gal. of RLW. The overflow spilled to the surrounding paved area, traveled north along Diamond Drive, flowed into the storm sewer through a storm drain grate, and ultimately discharged into upper Mortandad Canyon through the SWMU 03-054(e) outfall. A small dam was built in the streambed at the base of the canyon to contain the effluent. Subsequent cleanup action, based on residual radioactive contamination cleanup levels of 25 pCi/g, removed approximately 142 ft^3 of contaminated soil from Mortandad Canyon (LANL 1995, 057590).

4.1.8.2 Previous Investigations

In 1995 and 2009, a total of 14 samples (8 soil, 4 sediment, and 2 tuff) were collected from 10 locations at SWMU 03-054(e). Previously sampled locations are shown in Figure 4.1-12. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

An RFI was conducted at SWMU 03-054(e) in April 1995. Screening results indicated organic vapors were not detected, and radioactivity was at or below background. Samples were collected from the outfall area and analyzed for TAL metals, total cyanide, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, PCBs, SVOCs, and VOCs. The RFI activities and results were presented in the RFI report (LANL 1997, 072611). Decision-level data from the 1995 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 03-054(e) consisted of the following activities in 2009:

- Sediment samples were collected at four locations, with two depth intervals sampled at two of the locations: the surface-sediment interval within the drainage and the sediment-tuff interface interval.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, PCBs, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 47), the vertical extent of chromium (locations MO-605022 and MO-605023) and zinc (locations 03-02715, 03-02716, 03-02717, 03-02718, 03-02719, MO-605021 and MO-605024) is not defined (Figure 4.1-13). The lateral and vertical extent of phthalates and dioxins/furans are not defined, and the lateral extent of polycyclic aromatic hydrocarbons (PAHs) is not defined (Figure 4.1-14). The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 03-054(e).

4.1.8.3 Proposed Sampling at SWMU 03-054(e)

Shallow subsurface samples will be collected at two previously sampled locations (MO-605022 and MO-605023), extending the depths at these locations to define the vertical extent of chromium. Samples from these locations will be analyzed for chromium only. Shallow subsurface samples will be collected at two previously sampled locations (MO-605021 and MO-605024), extending the depths at these locations to define the vertical extent of zinc. Samples from location MO-605021 will be used to define the vertical extent at nearby locations 03-02715, 03-02716, and 03-02717 (approximately 10 ft away), and samples from location MO-605024 will be used to define the vertical extent at nearby locations 03-02718 and 03-02719 (approximately 5 ft away). Samples from these locations will be analyzed for zinc only.

Shallow subsurface samples will be collected at four previously sampled locations (MO-605021, MO-605022, MO-605023, and MO-605024), extending the depths at these locations to define the vertical extent of bis(2-ethylhexyl)phthalate and diethylphthalate. Samples from these locations will be analyzed for bis(2-ethylhexyl)phthalate and diethylphthalate.

Shallow subsurface samples will be collected at location MO-605021 to define the vertical extent of dioxin/furans. Samples from this location will be analyzed for dioxin/furans.

One new sampling location (54e-1) will be placed downgradient of existing location MO-605022 to define the lateral extent of bis(2-ethylhexyl)phthalate, diethylphthalate, dioxin/furans, and PAHs. Samples at location 54e-1 will be analyzed for bis(2-ethylhexyl)phthalate, diethylphthalate, dioxins/furans, and PAHs.

The proposed sampling and analyses at SWMU 03-054(e) are presented in Table 4.1-8, and the proposed sampling locations are shown in Figure 4.1-12.

4.1.9 AOC C-03-006, One-Time Spill from Industrial Waste Line Manhole

4.1.9.1 Site Description and Operational History

AOC C-03-006 is the site of an unintentional release from a manhole connected to the industrial waste line. The manhole is located near the corner of Diamond Drive and Pajarito Road (Figure 4.1-15) and is part of the liquid industrial waste collection system that runs from TA-03 to the RLWTF at TA-50. In 1974, the manhole overflowed to a storm sewer in TA-03 and discharged to upper Mortandad Canyon. The overflow resulted from a plug in the industrial waste line and was estimated to be between 500 and 1000 gal. of RLW. The overflow spilled to the surrounding paved area, traveled north along Diamond Drive, flowed into the storm sewer via a storm-drain grate, and ultimately discharged into upper Mortandad Canyon through the outfall at SWMU 03-054(e). A cleanup of the overflow-impacted area began the day after the release. A collection and pumping system was used to flush the contaminated storm drain. Approximately 176 m^3 of pavement was cut to the depth of the base course, excavated, and disposed of at Area G at TA-54. Newly exposed surfaces were monitored, and one section of curbing with radioactivity levels exceeding background levels was removed. Additional surveys and subsequent confirmation sampling determined that no radioactivity exceeding the decontamination criteria (25 pCi/g) was present in the base-course material. The area was restored by repaving and replacing the curb along Diamond Drive and around the manhole, removing the dam built in the stream bed at the base of the canyon, and installing engineering controls (LANL 1995, 057590). The area was further excavated in 1984 when the manhole and the industrial waste line were removed.

4.1.9.2 Previous Investigations

In 1995 and 2009, a total of 18 samples (13 soil or tuff and 5 tuff) were collected from 11 locations at AOC C-03-006. Previously sampled locations are shown in Figure 4.1-15. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

RFI activities were conducted in April 1995 around AOC C-03-006 at the outfall and canyon area associated with SWMU 03-054(e). Eight samples were collected from six locations, with two depth intervals sampled at two locations. The samples were analyzed for TAL metals, total cyanide, SVOCs, VOCs, PCBs, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, and tritium. Zinc, Aroclor-1260, PAHs, europium-152, plutonium-238, plutonium-239/240, and sodium-22 were detected or detected above BVs in one or more samples. The RFI activities and results were presented in the RFI report (LANL 1997, 072611). Decision-level data from the 1995 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at AOC C-03-006 consisted of the following activities in 2009:

- Soil-fill samples were collected at five locations from two depth intervals: the surface soil-fill interval and the soil-tuff-interface interval.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, PCBs, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 50), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at AOC C-03-006, except for the vertical extent of chromium at locations MO-604990, MO-604991, MO-604992, and MO-604993 (Figure 4.1-16). The investigation report stated that the lateral extent of chromium is not defined. In reviewing the data, however, the concentrations of chromium decreased

~~southward~~ to the north from locations MO-604990 and MO-604991 to location MO-604994 (Figure 4.1-16). Therefore, the lateral extent of chromium is defined.

4.1.9.3 Proposed Sampling and Soil Removal at AOC C-03-006

Shallow subsurface samples will be collected at four previously sampled locations (MO-604990, MO-604991, MO-604992, and MO-604993), extending the depths at these locations to define the vertical extent of chromium. Samples will be analyzed for chromium only.

The proposed sampling and analyses at AOC C-03-006 are presented in Table 4.1-9, and the proposed sampling locations are shown in Figure 4.1-15.

4.2 TA-35

TA-35 is located northeast of the intersection of Pajarito Road and Pecos Drive. The structures at TA-35 are located on a finger mesa between Mortandad Canyon on the north and Ten Site Canyon, a tributary of Mortandad Canyon, on the south.

4.2.1 AOC 35-016(g), Drain and Outfall from Building 35-213

4.2.1.1 Site Description and Operational History

AOC 35-016(g) is a former NPDES outfall (04A127) established in 1979 to handle reverse-osmosis discharge and cooling tower blowdown from room 29 in building 35-213, the Target Fabrication Facility (Figure 4.2-1). The outfall was removed from the NPDES permit in September 1997 (EPA 1997, 109528). The former NPDES outfall now handles only cooling tower blowdown from the same room. The drainage runs approximately 100 ft north to its point of discharge on the south rim of Mortandad Canyon.

4.2.1.2 Previous Investigations

In1997 and 2009, a total of 21 samples (13 sediment and 8 tuff) were collected from 11 locations at AOC 35-016(g). Previously sampled locations are shown in Figure 4.2-1. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In March 1995, an RFI was conducted at AOC 35-016(g), and the samples collected were submitted for analysis of inorganic chemicals, organic chemicals, and radionuclides. The sampling results are screening-level results based on current data quality standards but were reported in a RFI report (LANL 1996, 054422). Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

In 1997, additional sampling was conducted at AOC 35-016(g). Eleven samples from six locations were collected and submitted for analysis of inorganic chemicals, organic chemicals, and radionuclides.

Sampling at AOC 35-016(g) consisted of the following activities in 2009:

- Sediment and tuff samples were collected at five locations from two depth intervals: the surface-sediment interval and the sediment-tuff-interface interval.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, SVOCs, gamma-emitting radionuclides, and tritium.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 53), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at AOC 35-016(g), except for the vertical extent of chromium at locations MO-604933 and MO-604935 (Figure 4.2-2); the vertical extent of cesium-137 at locations MO-604933, MO-604936, and MO-604937; and the lateral extent of cesium-137 in the drainage at location MO-604937 (Figure 4.2-3).

4.2.1.3 Proposed Sampling at AOC 35-016(g)

Shallow subsurface samples will be collected at four previously sampled locations (MO-604933, MO-604935, MO-604936, and MO-604937), extending the depths at these locations to define the vertical extent of chromium and cesium-137. Samples at location MO-604933 will be analyzed for chromium and cesium-137 only. Samples at location MO-604935 will be analyzed for chromium only. Samples at locations MO-604936 and MO-604937 will be analyzed for cesium-137 only.

One new sampling location (16g-1) will be placed downgradient of existing location MO-604937 to define the lateral extent of cesium-137. Samples at location 16g-1 will be analyzed for cesium-137.

The proposed sampling and analyses at AOC 35-016(g) are presented in Table 4.2-1, and the proposed sampling locations are shown in Figure 4.2-1.

4.2.2 AOC 35-016(h), Storm Drains and Outfalls Associated with Building 35-213

4.2.2.1 Site Description and Operational History

AOC 35-016(h) consists of three storm drains located north of building 35-213 (Figure 4.2-1). The storm drains were installed in 1979 to handle stormwater runoff from roof drains of building 35-213, runoff from the nearby parking lot, and discharge from a water deionizer in building 35-213. The drain from the water deionizer was rerouted to the RLW drain system in the mid-1990s and no longer discharges to the stormwater system.

The storm drain that handles the runoff from roof drains is located on the north side of building 35-213. The storm drain that used to handle discharge from the water deionizer is located on the northeast side of building 35-213. This storm drain currently handles only stormwater runoff from the area around building 35-213. The third storm drain that handles stormwater from the nearby parking lot is located northwest of building 35-213. All three storm drains discharge into Mortandad Canyon.

4.2.2.2 Previous Investigations

In 1997 and 2009, a total of 23 samples (11 sediment, 1 fill, and 11 tuff) were collected from 11 locations at AOC 35-016(h). Previously sampled locations are shown in Figure 4.2-1. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In March 1995, an RFI was conducted at AOC 35-016(h), and the samples collected were submitted for analysis of inorganic chemicals, organic chemicals, and radionuclides. The sampling results are screening-level data based on the current data quality standard but were reported in a RFI report (LANL 1996, 054422).

In 1997, additional sampling was conducted at AOC 35-016(h). Three samples were collected from one location and submitted for analysis of inorganic chemicals, organic chemicals, and radionuclides. Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at AOC 35-016(h) consisted of the following activities in 2009:

- Sediment samples were collected at 10 locations from two depth intervals: the surface-sediment interval and the sediment-tuff interface interval.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, SVOCs, gamma-emitting radionuclides, and tritium.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 55), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at AOC 35-016(h), except for the vertical extent of chromium at locations 35-02392, MO-605136, MO-605515, MO-605518, and MO-605520 and the vertical extent of hexavalent chromium at locations MO-605136, MO-605515, and MO-605518, (Figure 4.2-4). The lateral extent of chromium downgradient of locations MO-605136, MO-605520, and MO-605516 and the lateral extent of PAHs downgradient of location MO-605516 are also not defined (Figure 4.2-5).

4.2.2.3 Proposed Sampling at AOC 35-016(h)

Shallow subsurface samples will be collected at six previously sampled locations (35-02392, MO-605136, MO-605515, MO-605518, and MO-605520), extending the depths at these locations to define the vertical extent of chromium. Samples at these locations will be analyzed for chromium. Shallow subsurface samples will be collected at three previously sampled locations (MO-605136, MO-605515, and MO-605518), extending the depths at these locations to define the vertical extent of hexavalent chromium. Samples at these locations will be analyzed for hexavalent chromium.

Three new sampling locations (16h-1, 16h-2, and 16h-3) will be placed downgradient of existing sampling locations to define the lateral extent of chromium and PAHs. Samples from location 16h-1 and 16h-2 will be analyzed for chromium only. Samples from location 16h-3 will be analyzed for chromium and PAHs.

The proposed sampling and analyses at AOC 35-016(h) are presented in Table 4.2-2, and the proposed sampling locations are shown in Figure 4.2-1.

4.3 Former TA-42

Former TA-42, now within the current boundaries of TA-55, was located north of Pajarito Road and Pecos Drive on a narrow mesa formed between Mortandad Canyon on the north and Twomile Canyon on the south. The former TA was near the north edge of the mesa next to the steep slope of the Mortandad Canyon wall.

4.3.1 Consolidated Unit 42-001(a)-99, Former TA-42 Incinerator Complex

4.3.1.1 Site Description and Operational History

Consolidated Unit 42-001(a)-99 consists of SWMUs 42-001(a,b,c), 42-002(b), and 42-003 and AOC 42-002(a) (Figure 4.3-1). These sites are associated with the former TA-42 radioactive waste incinerator that was constructed in 1951 and shut down in 1952. From 1957 to 1969, this incinerator facility was used to store and decontaminate radioactively contaminated equipment. In 1969, an unsuccessful attempt was made to reactivate the incinerator to burn uncontaminated classified wastes. By 1970, all operations were discontinued, and all combustibles were removed from the building. The facility was decommissioned in 1977, and the site was decontaminated in 1978 (LANL 1990, 007513).

SWMU 42-001(a) is the historical location of former building 42-1 that housed the incinerator. Former building 42-1 was a 2000-ft^2 steel-frame structure covered with corrugated metal. The building contained the incinerator, a cyclone dust collector, a spray cooler, a Venturi scrubber, a filter bank, and an ash separator. Combustion products passed through an off-gas cleanup system before they were released through an exhaust stack. The off-gas system consisted of a Venturi scrubber, a filter bank, and an ash separator. Ash trapped in the off-gas system and incinerator was transported by underground drainlines to two holding tanks [SWMUs 42-001(b) and 42-001(c)] located immediately north of the incinerator (LANL 1992, 007666). Building 42-1 and its concrete foundation were removed in 1978 (LANL 1995, 050056, p. 23).

SWMUs 42-001(b) and 42-001(c) are the historical locations of two former aboveground ash-holding tanks (former structures 42-2 and 42-3, respectively) that were associated with the incinerator complex. Each tank was 22 ft in diameter and approximately 13 ft high, with a volume of 37,000 gal. The tanks were built in 1951 and removed in 1978. When the tanks were decommissioned in 1978, the contents were assayed and measured for plutonium. Contaminated sludge was removed, mixed with cement, and taken to Area G for storage. The tanks were excavated and disposed of at MDA G. The tank drainlines were filled with asphalt to contain radioactive contamination. It is not known if the drainlines were removed (LANL 1992, 007666).

AOC 42-002(a) is the historical location of an indoor storage (former building 42-1) and decontamination area. Between 1956 and 1969, the main floor of former building 42-1 was used to store and decontaminate equipment.

SWMU 42-002(b) is the location of a historical outdoor decontamination area. Objects (such as vehicles) that were too large to decontaminate inside building 42-1 were decontaminated at the end of the asphalt driveway located west and north of building 42-1. Wash water from decomtamination activities flowed down the embankment on the northwest side of the parking lot. Potentially contaminated soil in that area was not addressed during the 1978 decontamination and decommissioning (D&D) activities (LANL 1992, 007666).

SWMU 42-003 is the historical location of a former septic system that served the former incinerator building (structure 42-1). The septic system was installed in 1951 and consisted of a 565-gal. septic tank (structure 42-4), a drainline from building 42-1 to the tank, a filter trench, a leach field, and an outfall to Mortandad Canyon. The septic tank received RLW from building 42-1. According to the 1992 work plan, the system probably also received solvents, acids, and grease (LANL 1992, 007666). Contaminated liquids were removed periodically from the septic tank and disposed of in Pit 4 at MDA L. Samples collected in Mortandad Canyon in 1952 downstream of former TA-42 showed radioactive contamination in the canyon. In 1973, the septic tank was observed to contain water and possibly may have overflowed (LANL 1992, 007666). Also in 1973, the tank slurry was sampled and found to be radioactively contaminated. The septic system and associated contaminated soil were removed as part of 1978 D&D activities (Harper and Garde 1981, 006286). Before the tank was removed, liquid in the tank was pumped and transported to the TA-50 RLWTF [SWMU 50-001(a)] for treatment. Tank sludge was solidified by adding cement, the tank and sludge were disposed of at MDA G, and the excavated area was backfilled. In addition, contaminated soil in the drain field was excavated (LANL 1992, 007666).

4.3.1.2 Previous Investigations

In 1992 and 2009, a total of 169 samples (53 soil or fill, 12 sediment, and 104 tuff) were collected from 44 locations at Consolidated Unit 42-001(a)-99. Previously sampled locations are shown in Figure 4.3-1. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

After D&D activities were conducted at the site in 1978, the Environmental Surveillance Group collected soil samples and analyzed them for radionuclides. Although low levels of contamination were found, the concentrations met regulatory standards at that time. After concurrence from DOE's Los Alamos Area Office, the area was contoured and revegetated to minimize erosion (LANL 1992, 007666).

In 1991, the Environmental Protection Group performed a reconnaissance study and collected soil samples that were analyzed for radionuclides, PCBs, SVOCs, VOCs, and metals. These results are screening-level data based on current data-quality validation standards.

In 1992, an RFI was conducted at the historical locations of Consolidated Unit 42-001(a)-99 to determine whether potential contamination at the site would be exposed during construction of a new facility. Sampling locations were selected to bound the extent of contamination detected during the 1991 reconnaissance study and to include locations where construction activities might adversely affect residual contamination around proposed structures or utility lines. Forty samples collected were submitted for analysis of various combinations of americium-241, isotopic plutonium, isotopic thorium, isotopic uranium, and TAL metals. The RFI activities and results were presented in the RFI report (LANL 1995, 050056). Decision-level data from the 1992 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at Consolidated Unit 42-001(a)-99 consisted of the following activities in 2009:

- Soil and tuff samples were collected at 18 locations from six depth intervals: the surface interval, the soil-tuff-interface interval, and the intervals beginning 5 ft, 10 ft, 20 ft, and 30 ft below the soil-tuff interface.
- In the backfilled area in the southeast corner of the site, fill and tuff samples were collected at two locations from four depth intervals: the fill/tuff interface interval and the intervals beginning 10 ft, 20 ft, and 30 ft below the soil-tuff interface.
- Sediment samples were collected at seven locations from two depth intervals: the surface-sediment interval within the drainage and the sediment-tuff-interface interval.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, PCBs, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), explosive compounds, dioxins and furans, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 59), the vertical extent of tritium in the mesa-top portion of the site is not defined at location MO-605054 (Plate 7). The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at Consolidated Unit 42-001(a)-99.

4.3.1.3 Proposed Sampling at Consolidated Unit 42-001(a)-99

Subsurface samples will be collected at previously sampled location MO-605054, extending the depth at this location to define the vertical extent of tritium. Samples will be collected to a total depth of 62.5 ft bgs and will be analyzed for tritium only.

The proposed sampling and analyses at Consolidated Unit 42-001(a)-99 are presented in Table 4.3-1, and the proposed sampling location is shown in Figure 4.3-1.

4.4 TA-48

TA-48 was established in 1957 for work in radiochemistry. Initially, the major work was to study samples from bomb tests; however, that work evolved into other types of studies related to weapon tests, research in geochemistry and radiochemistry, and production of radioisotopes for nuclear medicine (DOE 1987, 008663; DOE 1987, 008664; LANL 1992, 007666). TA-48 facilities also have historically been and are currently used to study the nuclear properties of radioactive materials using analytical and physical chemistry. Measurements of radioactive substances are performed, and hot cells are used for remote handling of radioactive materials (LANL 1988, 000344; LANL 1992, 007666).

4.4.1 AOC 48-001, Air Exhaust System

4.4.1.1 Site Description and Operational History

AOC 48-001 consists of the air exhaust system at the main radiochemistry laboratory in building 48-1 and surface and near-surface soil potentially impacted by deposition from the stack emissions (Figure 4.4-1). The radiochemistry laboratory in building 48-1 was constructed in 1957 to analyze samples collected from nuclear weapons tests. Currently, radiochemical analyses are conducted at building 48-1 to support a variety of programs. The building's exhaust system consists of nine stacks. Three stacks exhaust unfiltered discharges from chemical hoods, three stacks are associated with combustion boilers, one stack exhausts individually filtered glove boxes, one stack exhausts filtered air from hot cell laboratories, and one stack exhausts air from a welding and degreasing booth. Discharges from the chemical hoods are not filtered because the chemicals used in the hoods (e.g., perchloric acid) degrade filters. However, these hoods are equipped with wet scrubbers. The glove box stack (stack FE54) is permitted and monitored under the National Emissions Standards for Hazardous Air Pollutants Program of the Clean Air Act. According to the RFI work plan, monitoring data are available for stack FE54 beginning in 1967 for plutonium and beginning in 1974 for uranium and fission products (LANL 1992, 007666). These data indicate releases of plutonium, uranium, and fission products, primarily cesium-137, cerium-144, and strontium-90.

4.4.1.2 Previous Investigations

In 1993, 1997, and 2009, a total of 186 samples (103 soil or fill, 61 sediment, and 22 tuff) were collected from 119 locations at AOC 48-001. Previously sampled locations are shown in Figure 4.4-1. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 1991, samples were collected east and northwest of building 48-1. These samples contained elevated levels of alpha radioactivity, with surface samples slightly exceeding DOE-guideline levels. Organic chemicals were detected at low concentrations.

In 1993, a Phase I RFI was conducted at AOC 48-001 to determine the presence of soil contamination associated with discharges from the air exhaust system. The EPA computer model, AIRDOS, was used to estimate the areal extent of potential contamination based on historical stack release data. This area was surveyed for radioactivity and organic vapors. Radiation levels were at background levels, and organic vapors were not detected. Samples were collected to the north and east of building 48-1. All samples were field screened for radioactivity and organic chemicals and were submitted for analysis of inorganic vapors, radionuclides, and organic chemicals using a combination of fixed and mobile laboratories. The RFI activities and results were presented in the RFI report (LANL 1995, 050289). An additional 67 samples were collected from 31 locations in a 1997 RFI. Decision-level data from the 1993 and 1997 investigations are included in the investigation report (LANL 2010, 109180.28).

Sampling at AOC 48-001 consisted of the following activities in 2009:

- Soil samples were collected at nine locations from the surface-soil interval (0–0.5 ft bgs).

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, total cyanide, PCBs, SVOCs, dioxin and furans, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic thorium, isotopic uranium, strontium-90, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 63), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at AOC 48-001, except for the lateral extent of total cyanide at location MO-604942 (Plate 8).

4.4.1.3 Proposed Sampling at AOC 48-001

Surface samples will be collected at two new sampling locations (1-1 and 1-2) to define the lateral extent of total cyanide upgradient and downgradient of previously sampled location MO-604942 near the ~~southeast~~ southwest corner of building 48-1. Samples from the new sampling locations will be analyzed for total cyanide only.

The proposed sampling and analyses at AOC 48-001 are presented in Table 4.4-1, and the proposed sampling locations are shown in Figure 4.4-1.

4.4.2 SWMU 48-002(a), Container Storage Area

4.4.2.1 Site Description and Operational History

SWMU 48-002(a) consists of a former container storage area located at the south~~west corner~~ end of the main radiochemistry laboratory (building 48-1) (Figure 4.4-2). The storage area was located against the south wall of building 48-1 on an area of soil between the building and an asphalt roadway. An inspection of SWMU 48-002(a) in 1986 noted the presence of approximately 200 rusty flasks in decayed and broken wooden-frame holders (Perkins 1986, 000808). Each of the flasks reportedly held about 2 qt of high-purity mercury. The flasks are estimated to have been present at SWMU 48-002(a) since about 1976 and were removed from the site in 1989 (LANL 1990, 007513). The RFI work plan reports that available documentation contained no indication of any spills or leaks associated with this site (LANL 1992, 007666).

4.4.2.2 Previous Investigations

In 1993, 1995, and 2009, a total of 56 samples (17 fill and 39 tuff) were collected from 16 locations at SWMUs 48-002(a) and 48-002(b). Previously sampled locations are shown in Figure 4.4-2. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

A Phase I RFI was conducted at SWMUs 48-002(a) and 48-002(b). In July 1993, five sampling locations were hand-augered to 8 ft, and soil samples were collected at 1-ft intervals. In addition, one surface soil sample was collected. All samples were submitted for analysis of metals, radionuclides, SVOCs, and VOCs using a combination of fixed and mobile laboratories. In October 1993, six surface soil samples were collected to evaluate possible mercury migration from the SWMU. Based on the results of the Phase I sampling for SWMUs 48-002(a) and 48-002(b), an expedited cleanup (EC) plan was prepared (LANL 1995, 046092.38).

In 1995, an EC was implemented at SWMUs 48-002(a) and 48-002(b). The EC involved developing soil cleanup levels for mercury and PAHs; soil sampling and analysis to delineate the area exceeding cleanup levels; excavation of soil contaminated above cleanup levels; confirmation sampling; and site restoration (backfilling, grading, and revegetation). The area of soil to the east of SWMU 48-002(a) was excavated during the cleanup (LANL 1995, 050289). Decision-level data from the 1993 investigation and the 1995 EC are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMUs 48-002(a) and 48-002(b) consisted of the following activities in 2009:

- Soil and tuff samples were collected at 13 locations from three or four depth intervals: the surface interval, soil-tuff-interface interval, the interval beginning 5 ft below the soil-tuff interface, and the interval beginning 10 ft below the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), dioxins and furans, PCBs, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 65), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMUs 48-002(a) and 48-002(b), except for the vertical extent of perchlorate at locations MO-604925 and MO-604932 (Figure 4.4-3).

4.4.2.3 Proposed Sampling at SWMU 48-002(a)

Subsurface samples will be collected at two previously sampled locations (MO-604925 and MO-604932), extending the depths at these locations to define the vertical extent of perchlorate. Samples will be analyzed for perchlorate only.

The proposed sampling and analyses at SWMUs 48-002(a) and 48-002(b) are presented in Table 4.4-2, and the proposed sampling locations are shown in Figure 4.4-2.

4.4.3 SWMU 48-002(b), Container Storage Area

4.4.3.1 Site Description and Operational History

SWMU 48-002(b) consists of a former container storage area located at a loading dock on the south side of the main radiochemistry laboratory (building 48-1) (Figure 4.4-2). The storage area was located against the south wall of building 48-1, near the southeast corner of the building. A 1986 inspection of SMWU 48-002(b) noted the presence of labeled and unlabeled drums and evidence of spills and leaks (Perkins 1986, 000808). Spills from leaky drums were also observed at the site during a November 1988 field survey (LANL 1990, 007513). The date the materials began to be stored at this site is not known, and no evidence was found that the site was managed as a formal container storage area. All materials were removed from the site by July 1991 (LANL 1992, 007666).

4.4.3.2 Previous Investigations

The summary of previous investigations at SWMU 48-002(b) is presented in the discussion of SWMU 48-002(a) in section 4.4.2.2.

4.4.3.3 Proposed Sampling at SWMU 48-002(b)

Proposed sampling for SWMU 48-002(b) is described in section 4.4.2.3 for SWMU 48-002(a).

4.4.4 SWMU 48-003, Septic System

4.4.4.1 Site Description and Operational History

SWMU 48-003 consists of a former septic system that served TA-48 from 1957 to 1986. This septic system consisted of a septic tank (former structure 48-5), a dosing chamber, a filter bed (former structure 48-6), and an outfall that discharged into Mortandad Canyon (Figure 4.4-4). The septic tank and dosing chamber were 21 ft 7 in. long and the filter bed measured 81 ft 2 in. long × 40 ft 7 in. wide. The septic system operated until 1986, at which time the septic tank and filter bed were decommissioned and removed (LANL 1990, 007513). A laboratory and diagnostics facility (building 48-45) was constructed over the site of the septic tank and filter bed. After the septic system was decommissioned, sanitary wastewater from TA-48 was sent to the sanitary lagoons at TA-35 and later to the consolidated treatment plant at TA-46. Although this septic system primarily received sanitary wastewater from TA-48 facilities, the system reportedly received hazardous and radioactive materials through accidental discharges (LANL 1992, 007666).

4.4.4.2 Previous Investigations

In 1993, 1997, and 2009, a total of 115 samples (21 soil or fill, 20 sediment, and 74 tuff) were collected from 34 locations at SWMU 48-003. Previously sampled locations are shown in Figure 4.4-4. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 1993, a Phase I RFI was conducted to determine the presence of surface and subsurface contamination at the former location of the septic system. A radiation survey conducted in this area determined that radiation levels were at background levels. Surface and subsurface samples were collected. All samples were field screened for radioactivity and organic vapors and submitted for analysis of inorganic chemicals, radionuclides, and organic chemicals using a combination of fixed and mobile laboratories. The RFI activities and results were presented in the RFI report (LANL 1995, 050289). Decision-level data from the 1993 RFI are included in the investigation report (LANL 2010, 109180.28).

Based on the responses to NMED's review of the Phase I RFI report (LANL 1996, 054448; LANL 1996, 055064), a sampling and analysis plan (SAP) was prepared to collect additional samples for analysis of metals, radionuclides, and SVOCs (LANL 1997, 055326). Ten samples were collected from five locations in 1997, as directed by the SAP, but these data have not been reported previously. Decision-level data from the 1997 RFI are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 48-003 consisted of the following activities in 2009:

- Soil and tuff samples were collected at 15 locations on the mesa top from five depth intervals: the surface interval, the soil-tuff-interface interval, the intervals beginning 5 ft, 10 ft, and 15 ft below the soil-tuff interface.
- Sediment and tuff samples on the slope (sediment pockets) were collected at four locations from two depth intervals: the surface-sediment interval and the sediment-tuff-interface interval.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, americium-241, isotopic plutonium, isotopic thorium, isotopic uranium, strontium-90, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 71), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 48-003, except for the vertical extent of strontium-90 at locations 48-02136 and 48-02140 (Figure 4.4-5).

4.4.4.3 Proposed Sampling at SWMU 48-003

Shallow subsurface samples will be collected at two previously sampled locations (48-02136 and 48-02140), extending the depths at these locations to define the vertical extent of strontium-90. Samples will be analyzed for strontium-90 only.

The proposed sampling and analyses at SWMU 48-003 are presented in Table 4.4-3, and the proposed sampling locations are shown in Figure 4.4-4.

4.4.5 SWMU 48-007(b), Cooling Tower Outfall from Building 48-1

4.4.5.1 Site Description and Operational History

SWMU 48-007(b) is an outfall that formerly discharged noncontact cooling water used to cool a magnet and laser housed in the main radiochemistry laboratory (building 48-1) (Figure 4.4-6). This outfall is located north of building 48-1 and formerly discharged up to 4300 gal./d of cooling water. Water discharged from the outfall flowed into Mortandad Canyon (LANL 1992, 007666). This outfall formerly operated as an NPDES-permitted outfall (016 EPA 04A) but was removed from the NPDES permit on September 19, 1997, because industrial wastewater discharges were discontinued. Presently, the outfall receives only stormwater (LANL 2007, 098955).

4.4.5.2 Previous Investigations

In 1997 and 2009, a total of 28 samples (4 soil, 8 sediment, and 16 tuff) were collected from 10 locations at SWMU 48-007(b). Previously sampled locations are shown in Figure 4.4-6. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 1993, a Phase I RFI was conducted at SWMU 48-007(b). The outfall location was surveyed for radiation and organic vapors. The results indicated radiation levels were at background levels, and organic vapors were not detected. Samples were collected and were field screened for radioactivity and organic vapors and submitted for analysis of inorganic chemicals and radionuclides using a combination of fixed and mobile laboratories. The sampling results are screening-level results based on current data quality standards but were reported in the RFI report (LANL 1995, 050289).

In 1997, four additional soil samples were collected from two locations at SWMU 48-007(b) and submitted for laboratory analysis of gamma-emitting radionuclides. The RFI activities and results were presented in the RFI report (LANL 1997, 056565). Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 48-007(b) consisted of the following activities in 2009:

- Soil and tuff samples were collected at four locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 2 ft below the soil-tuff interface at locations downgradient of the outfall.

- Soil and tuff samples were collected at four locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 2 ft below the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, gamma-emitting radionuclides, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 84), the vertical extent of aluminum (location MO-605111); chromium (locations MO-605110 and MO-605114); hexavalent chromium (location MO-605112); lead (location MO-605114); nickel (location MO-605111); perchlorate (locations MO-605111, MO-605116, and MO-605117); and vanadium (location MO-605111) is not defined (Figure 4.4-7). The investigation report stated that the vertical extent of iron is not defined. However, in reviewing the data all concentrations of iron (Figure 4.4-7) are less than the maximum Qbt 2, 3, and 4 background concentration (19,500 mg/kg). Therefore, the vertical extent of iron is defined. The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 48-007(b).

4.4.5.3 Proposed Sampling at SWMU 48-007(b)

Shallow subsurface samples will be collected at five previously sampled locations (MO-605111, MO-605112, MO-605114, MO-605116, and MO-605117), extending the depths to define the vertical extent of aluminum, chromium, hexavalent chromium, lead, nickel, perchlorate, and vanadium. The samples collected at location MO-605111 will also serve to define vertical extent at location MO-605110, which is 5 ft upgradient of location MO-605111. Samples from location MO-605111 will be analyzed for aluminum, chromium, nickel, perchlorate, and vanadium. Samples from location MO-605112 will be analyzed for hexavalent chromium only. Samples from location MO-605114 will be analyzed for chromium and lead only. Samples from location MO-605116 and MO-605117 will be analyzed for perchlorate only.

The proposed sampling and analyses at SWMU 48-007(b) are presented in Table 4.4-4, and the proposed sampling locations are shown in Figure 4.4-6.

4.4.6 SWMU 48-007(c), Floor Drain Outfall from Building 48-1

4.4.6.1 Site Description and Operational History

SWMU 48-007(c) is an outfall that previously received discharges from nine floor drains, a trench drain, and six roof drains at building 48-1 (Figure 4.4-8). This outfall is located north of building 48-1 and discharges into Mortandad Canyon (LANL 1992, 007666). Former sources of discharge to the floor drains included floor washings, backflow preventers, drainage and condensate from a vacuum pump, steam condensate, a boiler drain, a fire drain, and a water-heater pressure-relief valve. This outfall previously operated as an NPDES-permitted outfall (131 EPA 04A) but was removed from the NPDES permit on January 14, 1998, because industrial wastewater discharges were discontinued (LANL 1997, 056565). Currently, this outfall receives only stormwater.

4.4.6.2 Previous Investigations

In 1997 and 2009, a total of 27 samples (4 soil, 10 sediment, and 13 tuff) were collected from 10 locations at SWMU 48-007(c). Previously sampled locations are shown in Figure 4.4-8. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 1993, a Phase I RFI was conducted at SWMU 48-007(c) to determine the presence of contamination associated with former discharges to the outfall. The outfall location was surveyed for radiation and organic vapors. The survey determined radiation levels to be at background, and no organic vapors were detected. Samples were collected and were field screened for radioactivity and organic vapors and were submitted for analysis of inorganic chemicals and radionuclides using a combination of fixed and mobile laboratories. The RFI activities and results were presented in the RFI report (LANL 1995, 050289).

In 1997, additional soil samples were collected at SWMU 48-007(c) and submitted for laboratory analysis of radionuclides. The RFI activities and results were presented in the RFI report (LANL 1997, 056565). Decision-level data from the 1993 and 1997 investigations are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 48-007(c) consisted of the following activities in 2009:

- Soil and tuff samples were collected at four locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 2 ft below the soil-tuff interface at locations downgradient of the outfall.
- Soil and tuff samples were collected at two locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 2 ft below the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, hexavalent chromium, nitrate, perchlorate, cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, gamma-emitting radionuclides, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 88), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 48-007(c), except for the vertical extent of chromium at locations MO-605163 and MO-605164 and the lateral and vertical extent of lead at location MO-605165 (Figure 4.4-9).

4.4.6.3 Proposed Sampling at SWMU 48-007(c)

Shallow subsurface samples will be collected at previously sampled locations MO-605163 and MO-605164, extending the depth at these locations to define the vertical extent of chromium. Samples from these locations will be analyzed for chromium.

Shallow subsurface samples will be collected at previously sampled location MO-605165, extending the depth at this location to define the vertical extent of lead. Samples from location MO-605165 will be analyzed for lead only.

Surface and shallow subsurface samples will be collected at a new sampling location (7c-1), downgradient of previously sampled location MO-605165, to define the lateral extent of lead to the toe of the slope. Samples from location 7c-1 will be analyzed for lead.

The proposed sampling and analyses at SWMU 48-007(c) are presented in Table 4.4-5, and the proposed sampling locations are shown in Figure 4.4-8.

4.4.7 SWMU 48-007(f), Outfall from Building 48-46

4.4.7.1 Site Description and Operational History

SWMU 48-007(f) is an inactive outfall that formerly received discharges from two sink drains in an office and laboratory building (48-46). This outfall is located northwest of building 48-1 (Figure 4.4-10) and discharged into Mortandad Canyon (LANL 1992, 007666). In approximately 1993, the outfall ceased to operate. This outfall formerly operated as an NPDES-permitted outfall (137 EPA 04A) but was removed from the NPDES permit on December 6, 1995.

4.4.7.2 Previous Investigations

In 1997 and 2009, a total of 28 samples (6 soil, 5 sediment, and 17 tuff) were collected from 10 locations at SWMU 48-007(f). Previously sampled locations are shown in Figure 4.4-10. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 1993, a Phase I RFI was conducted at SWMU 48-007(f) to determine the presence of contamination associated with discharges to the outfall. The outfall location was surveyed for radiation and organic vapors. The survey results indicated radiation was at background levels and organic vapors were not detected. Samples were collected and were field screened for radioactivity and organic vapors and submitted for analysis of inorganic chemicals and radionuclides using a combination of fixed and mobile laboratories. These results are screening-level data based on current data-quality validation standards, but the results were reported in the RFI report (LANL 1995, 050289).

In 1997, additional soil samples were collected at SWMU 48-007(f) and analyzed for radionuclides. The RFI activities and results were presented in the RFI report (LANL 1997, 056565). Decision-level data from the 1997 investigation are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 48-007(f) consisted of the following activities in 2009:

- Soil and tuff samples were collected at four locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 2 ft below the soil-tuff interface at locations downgradient of the outfall.
- Soil and tuff samples were collected at four locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 2 ft below the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, gamma-emitting radionuclides, tritium, isotopic uranium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 90), the lateral and vertical extent of all inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 48-007(f), except for the lateral and vertical extent of chromium (at locations MO-605097, MO-605099, MO-605100, MO-605101, and MO-605103) and the vertical extent of barium (at location MO-605097) (Figure 4.4-11).

4.4.7.3 Proposed Sampling at SWMU 48-007(f)

Shallow subsurface samples will be collected at five previously sampled locations (MO-605097, MO-605099, MO-605100, MO-605101, and MO-605103), extending the depth at these locations to define

the vertical extent of chromium. Samples from these locations will be analyzed for chromium. Samples from location MO-605097 will also be analyzed for barium.

Surface and shallow subsurface samples will be collected at a new sampling location (7f-1), downgradient of previously sampled location MO-605104, to define the lateral extent of chromium to the toe of the slope. Samples from location 7f-1 will be analyzed for chromium only.

The proposed sampling and analyses at SWMU 48-007(f) are presented in Table 4.4-6, and the proposed sampling locations are shown in Figure 4.4-10.

4.4.8 AOC 48-011, Radiation Detector Disposal Shaft

4.4.8.1 Site Description and Operational History

AOC 48-011 consists of a 3-ft-diameter × 65-ft-deep shaft drilled in 1976 or 1977 into the tuff on the east side of building 48-1 (Figure 4.4-12) for use in radiation-counting experiments. As part of these experiments, a 2-ft-diameter × 3-ft-long stainless-steel cylinder containing a sodium-iodide radiation detector was lowered into the shaft. This cylinder also contained approximately 3000 lb of lead shielding. As the cylinder was being lowered into the shaft, the cable broke and the cylinder fell to the bottom of the shaft. Because efforts to retrieve the cylinder were unsuccessful, it was left in place and covered (LANL 1992, 007666).

4.4.8.2 Previous Investigations

In 2009, a total of four tuff samples were collected from one location at AOC 48-011 (Figure 4.4-12). The sampling results are presented in the investigation report (LANL 2010, 109180.28).

Sampling at AOC 48-011 consisted of the following activities in 2009:

- Tuff samples were collected at one location from four depth intervals: the intervals beginning at 65 ft bgs, 75 ft bgs, 85 ft bgs and 100 ft bgs.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, gamma-emitting radionuclides, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 92), the vertical extent of all inorganic chemicals, organic chemicals, and radionuclides is defined at AOC 48-011. Lateral extent was not evaluated because only one location was sampled, as directed by the approved work plan (LANL 2008, 100750; NMED 2008, 101110).

4.4.8.3 Proposed Sampling at AOC 48-011

Subsurface samples will be collected at a new sampling location (11-1) to define the lateral extent of inorganic chemicals, organic chemicals, and radionuclides. The new location will be placed downgradient and to the east of the shaft and southeast of previously sampled location MO-605351. Samples from location 11-1 will be analyzed for TAL metals, nitrate, cyanide, perchlorate, SVOCs, VOCs, PCBs, dioxins and furans, gamma-emitting radionuclides, and tritium.

The proposed sampling and analyses at AOC 48-011 are presented in Table 4.4-7, and the proposed sampling location is shown in Figure 4.4-12.

4.5 TA-50

TA-50 is located immediately northeast of the intersection of Pajarito Road and Pecos Drive and occupies an area of approximately 21 acres: 11.8 acres are associated with MDA C and 8.7 acres are associated with the RLWTF. MDA C was used from 1948 until it was decommissioned in 1974 and consists of pits and shafts that received radioactive and hazardous wastes. Treatment facilities include the RLWTF and associated waste transfer and storage systems, equipment-decontamination areas, and solid waste volume-reduction facilities.

4.5.1 Consolidated Unit 50-004(a)-00, Historical Waste Lines and Underground Vault

4.5.1.1 Site Description and Operational History

Consolidated Unit 50-004(a)-00 (Figure 4.5-1) consists of SWMUs 50-004(a,b,c), which are former components and one existing component (waste line 56) of the TA-50 RLWTF.

SWMU 50-004(a) consists of the locations of former underground RLW and industrial waste lines. These waste lines routed wastes to the TA-50 RLWTF from TAs located along Pajarito Road. Most of these waste lines were decommissioned and removed in 1975, when excavated soil was characterized for radioactive constituents and remediated to meet regulatory levels (LANL 1992, 007672).

SWMU 50-004(b) is the location of a decommissioned underground vault (former structure 50-3) that housed three stainless-steel-lined concrete storage tanks. The tanks, ranging in volume from 1000 to 4500 gal., were used to collect and store wastewater from the former Omega Reactor at TA-02. Waste lines to this tank vault included waste line 49 from TA-35 and waste line 50 from building 50-1. Waste line 49, the vault, and the tanks were removed in 1989. Soil sampled during decommissioning was screened for radionuclides and chemical constituents. No elevated concentrations were detected (LANL 1992, 007672).

SWMU 50-004(c) consists of 13 industrial waste lines (lines 44, 45, 45a, 46, 47, 48, 48a, 49, 54, 55, 56, 65, and 67) and 3 associated manholes (structures 50-6, 50-55, and 50-56) that discharged to the decommissioned underground tank vault (former structure 50-3). With the exception of waste line 56, all waste lines and manholes associated with the underground vault [SWMU 50-004(b)] were removed between 1981 and 1989 (Elder et al. 1986, 006666; LANL 1992, 007672). Waste line 56 remains in service. Radionuclide contamination encountered during decommissioning of the waste lines and manholes was remediated to regulatory levels through removal of the pipe and soil to approximately 19 ft bgs. Field screening for radionuclides confirmed regulatory levels were met (LANL 1992, 007672).

4.5.1.2 Previous Investigations

In 1994 and 2009, a total of 156 samples (57 soil or fill, 1 sediment, and 98 tuff) were collected from 58 locations at Consolidated Unit 50-004(a)-00. Previously sampled locations are shown in Figure 4.5-1. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In 1994, an RFI was conducted at SWMUs 50-004(a) and 50-004(c) with the objective of determining the presence of radionuclides and hazardous constituents from historical operational releases. During the RFI at SWMU 50-004(a), a 520-ft length of the original 6-in. vitrified clay pipe waste line trench and the manholes were investigated. Five vertical boreholes located approximately 100 ft apart were advanced along the waste line trench. Eleven samples collected from the five boreholes at SWMU 50-004(a) were field screened for radionuclides and organic vapors. Radionuclide-screening results were all at or near

background levels. The samples were submitted to an off-site laboratory for analysis of inorganic chemicals, organic chemicals, and radionuclides.

In 1994, 67 samples were collected from depths up to approximately 14 ft at 29 locations at SWMU 50-004(c). Samples were field screened for radionuclides and organic vapors and submitted for off-site laboratory analysis of organic chemicals, inorganic chemicals, and radionuclides. The RFI activities and results were presented in the RFI report (LANL 1996, 054836).

In 2003, additional samples were collected at SWMUs 50-004(a) and 50-004(c) and analyzed for metals, radionuclides, PCBs, pesticides, SVOCs, TPH-DRO, and VOCs (LANL 2005, 087834). Decision-level data from the 1994 and 2003 investigation activities are included in the investigation report (LANL 2010, 109180.28).

Sampling at Consolidated Unit 50-004(a)-00 consisted of the following activities in 2009:

- Eighty-two fill and tuff samples were collected from 27 locations at depth intervals ranging from 0–29 ft bgs. Samples were collected from two to five depth intervals at each location. Depth intervals were varied by location but were no more than 5 ft apart vertically.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 108), the vertical extent of chromium, the lateral and vertical extent of barium, cobalt, and copper, and the lateral extent of nickel are not defined at multiple locations (Plate 9). The vertical extent of plutonium-239/240 and tritium is also not defined at multiple locations (Plate 10). The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at Consolidated Unit 50-004(a)-00.

4.5.1.3 Proposed Sampling at Consolidated Unit 50-004(a)-00

Shallow subsurface samples will be collected at ~~26~~ 18 previously sampled locations (~~50-03001,~~ 50-030~~02~~2, ~~50-03005, 50-03018, 50-03021, 50-03022, 50-03025,~~ 50-03026, 50-03027, 50-03030, 50-03031, 50-03032, 50-03038, ~~MO-605106,~~ MO-605108, MO-605458, MO-605460, MO-605462, MO-605463, MO-605464, ~~MO-605468,~~ MO-605473, MO-605478, MO-605626, MO-605627, and MO-605628), extending the depths at these locations to define the vertical extent of barium, chromium, cobalt, copper, plutonium-239/240, and tritium. Samples from each location will be analyzed as specified in Table 4.5-1.

Samples from location MO-605463 will be used to define the vertical extent of barium at nearby location 50-03025 (approximately 10 ft away). Samples from location MO-605627 will be used to define the vertical extent of plutonium-239/240 at location 50-03005. Samples from location MO-605626 will be used to define the vertical extent of barium and plutonium-239/240 at location 50-03021. Samples from location MO-605464 will be used to define the vertical extent of barium at nearby location 50-03018 (10 ft away). Samples from location MO-605628 will be used to define the vertical extent of tritium at location 50-03001 and the vertical extent of chromium at nearby location MO-605106 (approximately 10 ft away). Samples from location MO-605458 will be used to define the vertical extent of tritium at nearby location 50-03002 (approximately 10 ft away).

Shallow subsurface samples will be collected at three new sampling locations (4a-1, 4a-2, and 4a-3) to define the lateral extent of barium, cobalt, copper, and nickel. Location 4a-1 will be sited to the east of previously sampled location 50-03009, and samples will be analyzed for copper and nickel only.

Location 4a-2 will be sited downgradient of location MO-605464, and samples will be analyzed for barium, copper, and nickel. Location 4a-3 will be sited east of location MO-605473, and samples will be analyzed for barium, cobalt, and copper.

The proposed sampling and analyses at Consolidated Unit 50-004(a)-00 are presented in Table 4.5-1, and the proposed sampling locations are shown in Figure 4.5-1.

4.5.2 SWMU 50-006(a), Operational Releases from Sump

4.5.2.1 Site Description and Operational History

SWMU 50-006(a) is the outfall area at the head of Ten Site Canyon impacted by two accidental operational releases when a sump in a pumping station (building 50-2) overflowed, causing untreated wastewater to be discharged to waste lines 55 and 67 (the waste lines for treated effluent) (Figure 4.5-2). The releases occurred in July and September 1974 (LANL 1995, 049925). In February 1975, waste line 67 was plugged at its outfall. A soil sample collected from the outfall area when waste line 67 was plugged showed elevated levels of gross-alpha radioactivity. Analysis of additional soil samples collected below the waste line 67 outfall in September 1976 showed elevated levels of gross-alpha radioactivity extending 984 ft downgradient of the outfall. In 1981, both waste lines 55 and 67 were completely removed (Elder et al. 1986, 006666). During waste line removal, elevated levels of radionuclides, including plutonium-239, ruthenium-106, cesium-137, strontium-89, and yttrium-90, were detected. As a result, the outfall area was partially remediated by the removal of 70 m^3 of contaminated soil from the outfall location (LANL 1992, 007672).

4.5.2.2 Previous Investigations

In 1993 and 2009, a total of 132 samples (22 soil, 104 sediment, and 6 tuff) were collected from 65 locations at SWMU 50-006(a). Previously sampled locations are shown in Figure 4.5-2. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

A Phase I RFI was conducted in 1993 at SWMU 50-006(a) to determine the nature and extent of radionuclide and hazardous chemical contamination in and around the area of the Ten Site Canyon outfall. Samples were collected below the former waste line outfall, on both banks of the drainage channel, and in the canyon drainage channel at regular intervals over a distance of approximately 1300 ft downstream from the TA-50 boundary. Samples were field screened for organic vapors and radioactivity. Elevated gross-alpha radiation was detected at one screening sample location, resulting in the selection of additional sampling locations upstream and downstream from the area with elevated gross-alpha radiation. A total of 134 samples were collected from 53 locations and analyzed for inorganic chemicals, VOCs, SVOCs, PCBs, and radionuclides. The RFI activities and results were presented in the RFI report (LANL 1995, 049925).

In 1996, an interim action (IA) was implemented to remove the contaminated sediment. Approximately 0.72 yd^3 of radioactively contaminated soil was excavated and removed. Ten confirmation samples were collected from the excavated area and analyzed for gross-alpha and gross-beta radioactivity. The results were reported in the IA report (LANL 1997, 055834). Decision-level data from the 1993 RFI and the 1996 IA are included in the investigation report (LANL 2010, 109830).

Sampling at SWMU 50-006(a) consisted of the following activities in 2009:

- Soil and tuff samples were collected at three locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 5 ft below the soil-tuff interface.

Samples were analyzed at off-site fixed laboratories for TAL metals, anions, perchlorate, total phosphorous, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, strontium-90, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, p. 110), the vertical extent of chromium is not defined at locations MO-605076, MO-605077, and MO-605078. The investigation report stated that the lateral extent of cadmium and fluoride is not defined. However, cadmium was not detected above BV at any of the locations sampled in 2009 (Figure 4.5-3). Cadmium was detected above BV at multiple locations in canyon reaches TS-1W and TS-1C in Ten Site Canyon, below SWMU 50-006(a), but decreased downgradient (LANL 2006, 094161). In the case of fluoride, concentrations were 1.2 mg/kg or less. Because fluoride is naturally occurring, the concentrations likely reflect natural levels. Therefore, the lateral extent of cadmium and fluoride is defined. The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 50-006(a).

4.5.2.3 Proposed Sampling at SWMU 50-006(a)

Shallow subsurface samples will be collected at three previously sampled locations MO-605076, MO-605077, and MO-605078, extending the depth at these locations to define the vertical extent of chromium. Samples will be analyzed for chromium only.

The proposed sampling and analyses at SWMU 50-006(a) are presented in Table 4.5-2, and the proposed sampling locations are shown in Figure 4.5-2.

4.5.3 SWMU 50-006(d), Drainline and Associated NPDES-Permitted Outfall

4.5.3.1 Site Description and Operational History

SWMU 50-006(d) consists of a drainline (structure 50-64) and associated NPDES-permitted outfall 051 in Mortandad Canyon for treated wastewater from the RLWTF (building 50-1) (Figure 4.5-4). Structure 50-64 is a 6-in.-diameter iron discharge pipe that was rerouted in 1983 to accommodate construction of the TA-35 target fabrication facility (building 35-213). In 1985, EPA Region 6 issued an administrative order to DOE requiring modification of the outfall to mitigate ongoing stream-bank erosion caused by the discharge pipe ending 25 ft short of the stream channel. DOE extended the pipe into the stream channel, and subsequently EPA Region 6 closed the order in 1986 (LANL 1992, 007672).

4.5.3.2 Previous Investigations

In 1993 and 2009, a total of 92 samples (28 soil or fill, 33 sediment, and 31 tuff) were collected from 44 locations at SWMU 50-006(d). Previously sampled locations are shown in Figure 4.5-4. The sampling results are presented in the investigation report (LANL 2010, 109180.28).

In a 1993 RFI, 52 samples were collected from 27 locations in the canyon downgradient from SWMU 50-006(d), from depths ranging between 0 and 4 ft bgs. Samples were analyzed for gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, strontium-90, tritium, PCBs, and SVOCs. Results of the 1993 RFI were not reported previously, but decision-level data from the 1993 RFI are included in the investigation report (LANL 2010, 109180.28).

Sampling at SWMU 50-006(d) consisted of the following activities in 2009:

- Soil and tuff samples were collected at four locations from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 5 ft below the soil-tuff interface. The samples were collected from below the outfall.
- Soil and tuff samples were collected at one location from three depth intervals: the surface interval, the soil-tuff-interface interval, and the interval beginning 5 ft below the soil-tuff interface. The samples were collected from the drainage.
- Tuff samples were collected at 12 locations from two depth intervals: the base of the pipe and the interval beginning 5 ft below the base of the pipe.

Samples were analyzed at off-site fixed laboratories for TAL metals, nitrate, perchlorate, total cyanide, SVOCs, VOCs (in samples deeper than 0.5 ft bgs), PCBs, dioxins and furans, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, strontium-90, tritium, and pH.

Based on the sampling results presented in the investigation report (LANL 2010, 109180.28, pp. 115–116), the lateral and vertical extent of chromium, copper, mercury, nitrate, and perchlorate are not defined. The vertical extent of chromium is not defined at locations MO-605085 and MO-605506. The vertical extent of copper is not defined at locations MO-605085 and MO-605088. The vertical extent of mercury and nitrate is not defined at location MO-605085. The vertical extent of perchlorate is not defined at locations ~~MO-605084,~~ MO-605085, MO-605087, MO-605088, and MO-605506 (Plate 11).

The vertical extent of PCBs is not defined at locations MO-605083, MO-605085, MO-605088, and MO-605504. The investigation report stated the lateral extent of PAHs and PCBs is not defined. However, PAHs and PCBs were not detected in samples at locations downgradient of location MO-605085 (Plate 12). Therefore, the lateral extent of PAHs and PCBs is defined at SWMU 50-006(d).

The vertical extent of americium-241 (location MO-605088); cesium-137 (locations MO-605085 and MO-605088); plutonium-238 (locations MO-605085 and MO-605088); strontium-90 (location MO-605088); thorium-232 (locations 50-06002, 50-06019, and 50-06026); tritium (locations MO-605084, MO-605085, MO-605088, and MO-605506); and uranium-235/236 (location MO-605511) is not defined (Plate 13). The lateral and vertical extent of all other inorganic chemicals, organic chemicals, and radionuclides are defined at SWMU 50-006(d).

The 1993 RFI samples were collected in Effluent Canyon and Mortandad Canyon. The area encompassing these locations is included in reaches E-1E of Effluent Canyon and M-2W of Mortandad Canyon (Figure 4.5-4), which have been investigated separately (LANL 2006, 094161). The Mortandad Canyon investigation report stated, on the basis of multiple years of sediment and water sampling data, that Effluent Canyon reach E-1E has been a primary source of radionuclide contamination in Mortandad Canyon, but that the concentrations of radionuclides have generally declined substantially with time. The Mortandad Canyon investigation report also found the risk from contamination to be below the target level. Therefore, no additional samples will be collected at the 1993 RFI locations.

4.5.3.3 Proposed Sampling ~~and Soil Removal~~ at SWMU 50-006(d)

Shallow subsurface samples will be collected at ~~seven~~ eight previously sampled locations (MO-605083, MO-605084, MO-605085, MO-605087, MO-605088, MO-605504, MO-605506, and MO-605511), extending the depth at these locations to define the vertical extent of chromium, copper, mercury, nitrate, perchlorate, PCBs, americium-241, cesium-137, plutonium-238, strontium-90, tritium, and uranium-235/236. Samples from each location will be analyzed as specified in Table 4.5-3.

New sampling location (6d-1) will be placed downgradient of existing location MO-605085 to define the lateral (downgradient) extent of ~~chromium, copper, mercury,~~ nitrate~~,~~ and perchlorate because nitrate and perchlorate were not included in the Mortandad Canyon investigation. Samples from location 6d-1 will be analyzed for ~~chromium, copper, mercury,~~ nitrate~~,~~ and perchlorate. Lateral extent of chromium, copper, and mercury is defined by the results of the Mortandad Canyon investigation.

Additional samples will be collected at two new locations (6d-2 and 6d-3) below the former outfall location and in the vicinity of existing location MO-605088 (above the drainage channel) to define the lateral and vertical extent of radionuclides. Samples from these locations will be analyzed for americium-241, cesium-137, isotopic plutonium, strontium-90, tritium, and isotopic uranium.

The proposed sampling and analyses at SWMU 50-006(d) are presented in Table 4.5-3, and the proposed sampling locations are shown in Figure 4.5-4.

5.0 INVESTIGATION METHODS

A summary of investigation methods to be implemented is presented in Table 5.0-1. The standard operating procedures (SOPs) used to implement these methods are available at http://www.lanl.gov/environment/all/qa/adep.shtml.

Descriptions of the field investigation methods are provided below. Additional procedures may be added as necessary to describe and document quality-affecting activities.

Chemical analyses will be performed in accordance with the current analytical statement of work (LANL 2008, 109962). Accredited non-Laboratory contract analytical laboratories will use the most recent EPA- and industry-accepted extraction and analytical methods for the requested analyses.

5.1 Sampling Locations

Proposed sampling locations are identified for each site based on engineering drawings, surveyed locations of existing structures (from the geographic information system database), previous sampling locations, and topography or other features identified in the field (e.g., drainage channels, sediment accumulation areas). The coordinates of proposed new sampling locations will be obtained by georeferencing the points from the proposed sampling maps. Coordinates will be located and flagged or otherwise marked in the field using a differential global positioning system (GPS) unit. If any proposed sampling locations are moved because of field conditions, utilities, or other unexpected reasons, the new locations will be surveyed immediately following sample collection as described in section 5.2. Surveying and establishing sampling locations will be conducted in accordance with the latest version of standard operating procedure SOP-5028, Coordinating and Evaluating Geodetic Surveys.

5.2 Geodetic Surveys

Geodetic surveys will be conducted in accordance with the latest version of SOP-5028, Coordinating and Evaluating Geodetic Surveys, to locate historical structures and previous sampling locations and to document field activities such as sample collection. The surveyors will use a Trimble GeoXT hand-held GPS or equivalent for the surveys. The coordinate values will be expressed in the New Mexico State Plane Coordinate System (transverse Mercator), Central Zone, North American Datum 1983. Elevations will be reported per the National Geodetic Vertical Datum of 1929. All GPS equipment used will meet the accuracy requirements specified in the SOP.

5.3 Surface and Shallow Subsurface Sampling

Soil and rock samples will be collected by the most efficient, least invasive method practicable. The methods will be determined by the field team based on site conditions such as topography, the nature of the material to be sampled, the depth intervals sampled, accessibility, and the level of disruption to Laboratory activities. Typically, samples will be collected using spade-and-scoop, hand-auger, or hollow-stem auger drilling methods.

5.3.1 Spade-and-Scoop Method

Surface and shallow subsurface samples will be collected in accordance with SOP-06.09, Spade and Scoop Method for the Collection of Soil Samples. Stainless-steel shovels, spades, scoops, and bowls will be used for ease of decontamination. If the surface location is at bedrock, an axe or hammer and chisel may be used to collect samples. Samples collected for analyses will be placed in the appropriate sample containers, depending upon the analytical method requirement.

5.3.2 Sediment Samples

Sediment samples will be collected from areas of sediment accumulation that include sediment judged to be representative of the historical period of Laboratory operations (i.e., post-1943). Sediment samples will be collected using either spade-and-scoop and/or hand-auger methods. Proposed sediment sampling locations have been identified and are shown in the figures in the preceeding sections. The actual sediment sampling locations will be selected in the field based on geomorphic relationships in areas likely to have been affected by discharges from Laboratory operations. Because sediment is dynamic and subject to redistribution by runoff events, some locations may need to be adjusted when this work plan is implemented. In the course of collecting sediment samples, it may be determined, based on field conditions, that the selected location is not appropriate (e.g., the sediment is much shallower than anticipated, the sediment is predominantly coarse grained, or the sediment shows evidence of being older than the target age). Sediment sampling locations will be adjusted as appropriate, any revised locations will be surveyed, and the updated coordinates will be submitted for inclusion in the appropriate database.

5.4 Subsurface Sampling

Subsurface sampling is proposed to include surface soil and fill, sediment, and tuff. Any adjustments will be noted on sample collection logs and recorded in the Phase II investigation report as deviations from this investigation work plan. Subsurface samples will be collected following the current version of SOP-06.24, Sample Collection from Split-Spoon Samplers and Shelby-Tube Samplers, and SOP-06.26, Core-Barrel Sampling for Subsurface Earth Materials.

5.4.1 Hollow-Stem Auger

A hollow-stem auger may be used to drill holes deeper than approximately 15 ft or to shallower depths where hand-auger refusal is encountered. The hollow-stem auger consists of a hollow steel shaft with a continuous spiraled steel flight welded onto the exterior of the stem. The stem is connected to an auger bit; when it is rotated, it transports cuttings to the surface. The hollow stem of the auger allows insertion of drill rods, split-spoon core barrels, Shelby tubes, and other samplers through the center of the auger so samples may be retrieved during drilling operations. The hollow stem also acts to case the borehole core temporarily so a well casing (riser) may be inserted down through the center of the auger once the desired depth is reached, thus minimizing the risk of possible collapse of the borehole. A bottom plug or pilot bit can be fastened onto the bottom of the auger to keep out most of the soil and/or water that tends

to clog the bottom of augers during drilling. Drilling without a center plug is acceptable if the soil plug, formed in the bottom of the auger, is removed before sampling or installing a well casing. The soil plug can be removed by washing out the plug using a side-discharge rotary bit or auguring out the plug with a solid-stem auger bit sized to fit inside the hollow-stem auger.

During sampling, the auger will be advanced to just above the desired sampling interval. The sample will be collected by driving a split-spoon sampler into undisturbed soil-tuff to the desired depth. Samples will be collected in accordance with SOP-06.26, Core-Barrel Sampling for Subsurface Earth Materials.

5.4.2 Hand Auger

Hand augers may be used to drill shallow holes. The hand auger is advanced by turning the auger into the soil or tuff until the barrel is filled. The auger is removed and the sample is placed in a stainless-steel bowl. Hand-auger samples will be collected in accordance with SOP-06.10, Hand Auger and Thin-Wall Tube Sampler.

Because the chromium and nickel concentrations at some previously hand-augered sampling locations are suspected of being influenced by the use of stainless-steel auger buckets, carbon-steel auger buckets will be used to collect the proposed samples at locations not accessible to a drill rig and must be sampled by the hand-auger method.

5.4.3 Borehole Abandonment

All boreholes will be properly abandoned according to the current version of SOP-5.03, Monitoring Well and RFI Borehole Abandonment.

Shallow boreholes (less than approximately 20 ft deep or advanced by methods other than a drill rig) will be abandoned by filling the borehole with bentonite chips, which are subsequently hydrated, in 1- to 2-ft lifts. The borehole will be visually inspected while the bentonite chips are added to ensure bridging does not occur.

Deeper boreholes will be pressure-grouted from the bottom of the borehole to the surface using the tremie pipe method. Acceptable grout materials include cement or bentonite grout, neat cement, or concrete.

The use of backfill materials, such as bentonite and grout, will be documented in a field logbook with regard to volume (calculated and actual), intervals of placement, and additives used to enhance backfilling. All borehole abandonment information will be provided in the Phase II investigation report.

5.5 Chain of Custody and Sample Collection Logs

The collection, screening, and transport of samples will be documented on standard forms generated by the Sample Management Office (SMO). These include sample container labels and combined sample collection log (SCL)/chain-of-custody (COC) forms. Sample collection portions of the combined forms will be completed at the time of sample collection and signed by the sampler and a reviewer who will verify the logs for completeness and accuracy. Chain-of-custody portions of the combined forms will be completed and signed to verify the samples are not left unattended. Corresponding labels will be initialed and applied to each sample container, and custody seals will be placed around container lids or openings. Documentation and handling of all samples will be conducted in accordance with WES-EDA-QP-219, Sample Control and Field Documentation, and with SOP-5057, Handling, Packaging, and Transporting Field Samples.

5.6 Field-Screening Methods

The primary field-screening methods to be used on samples include radiological screening and organic vapor screening using a photoionization detector (PID). Field screening will be used primarily for health and safety purposes and for determining transportability of samples from the field sites to the SMO and from the SMO to the analytical laboratories. Field-screening results may be used at the discretion of the field personnel to collect additional samples beyond those planned or to extend the depth of sampling as required. Field changes to sampling plans will be approved by the subcontractor technical representative and will be documented on field paperwork and in the Phase II investigation report.

5.6.1 Radiological Screening

Based on the results of past sampling, field screening for radioactivity will be conducted primarily to ensure worker health and safety rather than to direct sampling. Radiological screening will target gross-alpha, -beta, and -gamma radiation. Field screening for alpha, beta, and gamma radiation will be conducted within 6 in. from soil and core material using appropriate field instruments as determined by the Laboratory's Health Physics Operations Group. Instruments will be calibrated in accordance with the Health Physics Operations Group procedures or equivalent procedures. All instrument calibration activities will be documented daily in the field logbooks in accordance with SOP-5181, Notebook Documentation for Waste and Environmental Services Technical Field Activities.

5.6.2 Organic Vapor Field Screening

Because VOCs are not known to have been used at the sites being investigated, VOC screening will be conducted primarily to ensure worker health and safety rather than to direct sampling. Screening will be conducted using a PID capable of measuring quantities as low as 1 ppm. Vapor screening of soil, sediment, and subsurface core for VOCs will be conducted using a PID equipped with an 11.7 electron volt lamp. All samples will be screened for VOCs in headspace gas in accordance with SOP-06.33, Headspace Vapor Screening with a Photo Ionization Detector.

The PID will be calibrated daily to the manufacturer's standard for instrument operation, and the daily calibration results will be documented in the field logbooks. All instrument background checks, background ranges, and calibration procedures will be documented daily in the field logbooks in accordance with SOP-5181, Notebook Documentation for Waste and Environmental Services Technical Field Activities.

5.7 Quality Assurance/Quality Control Samples

Quality assurance/quality control samples will include field duplicate, equipment rinsate, and field trip blank samples. Field duplicate samples and field rinsate blanks will be collected at an overall frequency of at least 1 for every 10 regular samples or as directed by the current version of SOP-5059, Field Quality Control Samples. Field trip blanks will be collected at a rate of at least one per day on days when VOC samples are being collected.

5.8 Laboratory Analytical Methods

The analytical suites for laboratory analyses and the specific analytical methods to be used are summarized in Table 5.8-1. All analytical methods are presented in the statement of work for analytical laboratories (LANL 2008, 109962). Sample collection and analysis will be coordinated with the SMO.

5.9 Health and Safety

The field investigations described in this Phase II investigation work plan will comply with all applicable requirements pertaining to worker health and safety. An integrated work document and a site-specific health and safety plan will be in place before conducting fieldwork.

5.10 Equipment Decontamination

Equipment for drilling and sampling will be decontaminated before and after sampling activities to minimize the potential for cross-contamination. All equipment will be decontaminated using dry decontamination methods whenever possible to minimize generating liquid waste. All sampling equipment will be decontaminated using dry decontamination methods if possible, as described in SOP-5061, Field Decontamination of Equipment. If dry decontamination methods are not effective as determined by field screening of the equipment after dry decontamination, drilling/exploration equipment that may come in contact with the borehole will be decontaminated by steam-cleaning, hot-water pressure-washing, or another method before each new borehole is drilled. If wet decontamination is necessary, the equipment will be decontaminated on a high-density polyethylene liner on a temporary decontamination pad. Cleaning solutions and wash water will be collected and contained for proper disposal. Decontamination solutions will be sampled and analyzed to determine the final disposition of the wastewater and the effectiveness of the decontamination procedures.

5.11 Investigation-Derived Waste

IDW generated during field-investigation activities may include, but is not limited to, drill cuttings; contaminated soil; contaminated personal protective equipment (PPE), sampling supplies, and plastic; fluids from the decontamination of PPE and sampling equipment; and all other waste that has potentially come into contact with contamination.

All IDW generated during field-investigation activities will be managed in accordance with applicable EPA and NMED regulations, DOE orders, and Laboratory requirements. Appendix B presents the IDW management plan.

6.0 MONITORING PROGRAMS

SWMUs 03-045(h), 03-049(a), 03-049(e), 03-054(e), 42-001(a,b,c), 42-002(b), 48-003, 48-007(b), 48-007(c), 50-006(a), and 50-006(d), and AOCs 35-016(g), 35-016(h), 42-002(a), and 48-001 are subject to the stormwater monitoring requirements of the Laboratory's NPDES individual permit for stormwater discharges from SWMUs and AOCs.

7.0 SCHEDULE

Preparation of investigation activities is scheduled to start by October 3, 2011. Fieldwork is expected to start April 24, 2012, and will take approximately two months to complete. Fieldwork is scheduled to be completed by June 26, 2012. A submittal date of no later than January 31, 2013, is proposed for the Phase II investigation report.

8.0 REFERENCES AND MAP DATA SOURCES

8.1 References

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

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

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LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report," Vol. I of IV (TA-0 through TA-9), Los Alamos National Laboratory document LA-UR-90-3400, Los Alamos, New Mexico. (LANL 1990, 007511)

LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report," Vol. III of IV (TA-26 through TA-50), Los Alamos National Laboratory document LA-UR-90-3400, Los Alamos, New Mexico. (LANL 1990, 007513)

LANL (Los Alamos National Laboratory), May 1992. "RFI Work Plan for Operable Unit 1129," Los Alamos National Laboratory document LA-UR-92-800, Los Alamos, New Mexico. (LANL 1992, 007666)

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LANL (Los Alamos National Laboratory), August 1995. "RFI Report for Potential Release Sites 42-001(a), 42-001(b), 42-001(c), 42-002(a), 42-002(b), 42-003," Los Alamos National Laboratory document LA-UR-95-2881, Los Alamos, New Mexico. (LANL 1995, 050056)

LANL (Los Alamos National Laboratory), September 1995. "RFI Report for Potential Release Sites 48-001, 48-002(e), 48-003, 48-005, 48-007(a), 48-007(b), 48-007(c), 48-007(d), 48-007(f), 48-010," Los Alamos National Laboratory document LA-UR-95-3328, Los Alamos, New Mexico. (LANL 1995, 050289)

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LANL (Los Alamos National Laboratory), October 2006. "Mortandad Canyon Investigation Report," Los Alamos National Laboratory document LA-UR-06-6752, Los Alamos, New Mexico. (LANL 2006, 094161)

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8.2 Map Data Sources

Data sources used in original figures and/or plates created for this report are described below and identified by legend title.

Legend Item	Data Source
LANL Technical Areas	Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; September 2007; as published 04 December 2008.
Paved roads	Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Paved parking	Paved Parking; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Dirt roads	Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
LANL structures	Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
LANL fence lines	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.
LANL communications lines	Communication Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 08 August 2002; as published 28 May 2009.
LANL electric lines	Primary Electric Grid; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
LANL gas lines	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.
LANL sewer lines	Sewer Line System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Legend Item	Data Source
LANL steam lines	Steam Line Distribution System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 January 2009.
LANL water lines	Water Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
LANL industrial waste lines	Primary Industrial Waste Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 October 2008.
LANL historical sampling locations	Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, Waste and Environmental Services Division, 5 June 2010.
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Contours	Hypsography, 2, 10, 20, and 100 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

Table 1.1-1
Sites under Phase II Investigation in the Upper Mortandad Canyon Aggregate Area

Consolidated Unit	SWMU/AOC	Brief Description	Phase I Investigation Results	Proposed Activities
TA-03				
	AOC 03-004(c)	Storage area at the main loading dock of the CMR Building (03-29)	Extent not defined (lateral extent of barium, chromium, copper, and manganese; vertical extent of chromium)	Additional sampling for extent
	AOC 03-004(d)	Former dumpster storage area located at the west end of Wing 9 of the CMR Building (03-29)	Extent not defined (lateral extent of chromium)	Additional sampling for extent
	AOC 03-007	Decommissioned firing site located southwest of the Beryllium Technology Facility (03-141)	Extent not defined (lateral/vertical extent of chromium)	Additional sampling for extent
Consolidated Unit 03-045(h)-00	SWMU 03-045(h)	Former NPDES-permitted outfall at the north perimeter of the Sigma Complex security fence, approximately 50 ft north of a cooling tower (03-187)	Extent not defined (lateral/vertical extent of barium and cobalt; lateral extent of antimony)	Additional sampling for extent
	SWMU 03-049(a)	NPDES-permitted outfall south of the Sigma Building (03-66) that discharges treated cooling water from a cooling tower (03-127) and roof-drain runoff to Mortandad Canyon	Extent not defined (vertical extent of chromium; lateral extent of dioxins/furans)	Additional sampling for extent
Consolidated Unit 03-049(b)-00	SWMU 03-049(b)	Discharge area from a former vacuum pump at the south wall of the Press Building (03-35)	Extent not defined (lateral extent of aluminum, chromium, total cyanide, lead, and perchlorate; vertical extent of PCBs; lateral/vertical extent of tritium)	Additional sampling for extent
	AOC C-03-014	Equipment storage area located southwest of the Press Building (03-35)		
	SWMU 03-049(e)	Outfall from a pipe that connects three roof drains, located south of the Sigma Building (03-66)	Extent not defined (vertical extent of antimony, chromium, hexavalent chromium, selenium, and zinc)	Additional sampling for extent
	SWMU 03-054(e)	Outfall located in upper Mortandad Canyon, receives roof drains and stormwater runoff at the CMR Building (03-29); received an unintentional one-time release from an industrial waste manhole (AOC C-03-006) in 1974	Extent not defined (vertical extent of chromium and zinc; lateral/vertical extent of phthalates and dioxins/furans; lateral extent of PAHs)	Additional sampling for extent

Table 1.1-1 (continued)

Consolidated Unit	SWMU/AOC	Brief Description	Phase I Investigation Results	Proposed Activities
	AOC C-03-006	Unintentional release at an industrial waste line manhole in 1974 that discharged to the outfall [SWMU 03-054(e)]	Extent not defined (vertical extent of chromium)	Additional sampling for extent
TA-35				
	AOC 35-016(g)	Drain and outfall from building 35-213	Extent not defined (vertical extent of chromium; lateral/vertical extent of cesium-137)	Additional sampling for extent
	AOC 35-016(h)	Stormdrains and outfalls associated with building 35-213	Extent not defined (lateral/vertical extent chromium; vertical extent of hexavalent chromium; lateral extent of PAHs)	Additional sampling for extent
Former TA-42				
Consolidated Unit 42-001(a)-00	SWMU 42-001(a)	Former location for building 42-1 that housed the incinerator	Extent not defined (vertical extent of tritium)	Additional sampling for extent
	SWMU 42-001(b)	Former location of one of the two ash storage tanks associated with the incinerator		
	SWMU 42-001(c)	Former location of the other ash storage tank		
	AOC 42-002(a)	Former location of an indoor storage and decontamination area (building 42-1)		
	SWMU 42-002(b)	Former location of the outdoor decontamination area		
	SWMU 42-003	Former septic system that served building 42-1		
TA-48				
	AOC 48-001	Air exhaust system at building 48-1	Extent not defined (lateral extent of total cyanide)	Additional sampling for extent
	SWMU 48-002(a)	Former container storage area located at the southwest corner of building 48-1	Extent not defined (vertical extent of perchlorate)	Additional sampling for extent
	SWMU 48-002(b)	Former container storage area located at a loading dock on the south side of building 48-1	Extent not defined (vertical extent of perchlorate)	Additional sampling for extent
	SWMU 48-003	Former septic system that served TA-48 from 1957 to 1986	Extent not defined (vertical extent of strontium-90)	Additional sampling for extent

Table 1.1-1 (continued)

Consolidated Unit	SWMU/AOC	Brief Description	Phase I Investigation Results	Proposed Activities
	SWMU 48-007(b)	Former NPDES-permitted outfall located north of building 48-1; currently discharges stormwater into Mortandad Canyon	Extent not defined (vertical extent of aluminum, chromium, hexavalent chromium, lead, nickel, perchlorate, and vanadium)	Additional sampling for extent
	SWMU 48-007(c)	Former NPDES-permitted outfall located north of building 48-1; currently discharges stormwater into Mortandad Canyon	Extent not defined (vertical extent of chromium; lateral/vertical extent of lead)	Additional sampling for extent
	SWMU 48-007(f)	Former NPDES-permitted outfall located north of building 48-1 that received discharges from two sink drains in building 48-46	Extent not defined (lateral/vertical extent chromium; vertical extent of barium)	Additional sampling for extent
	AOC 48-011	A 3-ft diameter by 65-ft deep shaft that was drilled into tuff on the east side of building 48-1	Extent not defined (lateral extent of inorganic chemicals, organic chemicals, and radionuclides)	Additional sampling for extent
TA-50				
Consolidated Unit 50-004(a)-00	SWMU 50-004(a)	Location of former underground radioactive liquid waste and industrial waste lines	Extent not defined (vertical extent of chromium; lateral/vertical extent of barium, cobalt, and copper; lateral extent of nickel; vertical extent plutonium-239/240 and tritium)	Additional sampling for extent
	SWMU 50-004(b)	Location of a former underground vault that housed three stainless-steel-lined concrete storage tanks		
	SWMU 50-004(c)	Thirteen industrial waste lines and three associated manholes that discharged to the underground tank vault [SWMU 50-004(b)]		
	SWMU 50-006(a)	Outfall area impacted by two accidental operational releases	Extent not defined (vertical extent of chromium)	Additional sampling for extent
	SWMU 50-006(d)	A drainline and associated NPDES-permitted outfall (051) in Mortandad Canyon for treated wastewater from the RLWTF	Extent not defined (lateral/vertical extent chromium, copper, mercury, nitrate, and perchlorate; vertical extent of PCBs; vertical extent of americium-241, cesium-137, plutonium-238, strontium-90, tritium, and uranium-235/236)	Additional sampling for extent

Note: Shading denotes consolidated unit.

Table 4.1-1
Proposed Sampling at AOC 03-004(c)

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define vertical extent of chromium	MO-605048	9–10, 14–15	X[a,b]
Define lateral extent of barium, chromium, copper, and manganese south and west of location MO-605048	4c-1 4c-2	1–2[c], 6–7, 9–10, 14–15 1–2[c], 6–7, 9–10, 14–15	X[d] X[d]

[a] X = Analysis will be performed.

[b] Chromium only.

[c] Depth to be adjusted below ground surface to ensure sample is below asphalt.

[d] Barium, chromium, copper, and manganese only.

Table 4.1-2
Proposed Sampling at AOC 03-004(d)

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define lateral extent of chromium downgradient of location MO-605041	4d-1 4d-2	1–2[a], 2–3, 6–7 1–2[a], 2–3, 6–7	X[b,c] X[c]

[a] Depth to be adjusted below ground surface to ensure sample is below asphalt.

[b] X = Analysis will be performed.

[c] Chromium only.

Table 4.1-3
Proposed Sampling at AOC 03-007

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define vertical extent of chromium	MO-604997 MO-604998 MO-605005 MO-605007 MO-605008	12–13, 16–17 10–11, 14–15 2–3, 4–5 3–4, 6–7 3–4, 6–7	X[a,b] X[b] X[b] X[b] X[b]
Define lateral extent of chromium	7-1 7-2 7-3 7-4	0–1, 3–4, 8–9 0–1, 3–4, 8–9 0–1, 3–4, 5–6 0–1, 3–4, 5–6	X[b] X[b] X[b] X[b]

[a] X = Analysis will be performed.

[b] Chromium only.

Table 4.1-4
Proposed Sampling at SWMU 03-045(h)

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define vertical extent of barium and cobalt	MO-604948 MO-604952 MO-604971 MO-604973 MO-604974 MO-604976 MO-604977	2–3, 5–6 8–9, 11–12 3–4, 6–7 3–4, 6–7 3–4, 6–7 3–4, 6–7 3–4, 6–7	X[a,b] X[b] X[c] X[c] X[b] X[c] X[c]
Define lateral extent of antimony, barium, and cobalt downgradient of location MO-604948	45h-1	0–1, 2–3, 6–7	X[d]

[a] X = Analysis will be performed.
[b] Barium and cobalt only.
[c] Barium only.
[d] Antimony, barium, and cobalt only.

Table 4.1-5
Proposed Sampling at SWMU 03-049(a)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Dioxins/Furans
Define vertical extent of chromium	MO-604985	2–3, 6–7	X[a,b]	—[c]
Define lateral extent of dioxins/furans	MO-604981	0–1, 2–3	—	X

[a] X = Analysis will be performed.
[b] Chromium only.
[c] — = Analysis will not be performed.

Table 4.1-6
Proposed Sampling at Consolidated Unit 03-049(b)-00

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Total Cyanide	Perchlorate	PCBs	Tritium
~~Define vertical extent of PCBs~~	~~MO-605029~~	~~8–9, 11–12~~	~~—~~[a]	~~—~~	~~—~~	~~X~~[b]	~~—~~
Define vertical extent of PCBs and tritium	MO-605025 MO-605026 MO-605027 MO-605029 MO-605034	~~7–8,~~ 9–10, 11–12 7–8, 9–10 6–7, 9–10 8–9, 11–12 6–7, 9–10	~~—~~[a] — — — — —	— — — — —	— — — — —	X[b] ~~—X~~ — — X —	X X X — X
Define lateral extent of aluminum, chromium, total cyanide, lead, perchlorate, PCBs, and tritium	49b-1 49b-2	1–2, 4–5, 8–9, 11–12 1–2, 4–5, 8–9, 11–12	X[c] X[c]	X X	X X	~~—~~X ~~—~~X	— X

[a] — = Analysis will not be performed.

[b] X = Analysis will be performed.

[c] Aluminum, chromium, and lead only.

Table 4.1-7
Proposed Sampling at SWMU 03-049(e)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Hexavalent Chromium
Define the vertical extent of antimony, chromium, hexavalent chromium, selenium, and zinc	MO-605009 MO-605010 MO-605011 MO-605012 MO-605013 MO-605014 MO-605016 MO-605017 MO-605018	3–4, 6–7 3–4, 6–7 3–4, 6–7 3–4, 6–7 3–4, 6–7 3–4, 6–7 3–4, 6–7 3–4, 6–7 3–4, 6–7	X[a,b] X[d] — X[e] X[f] X[e] — — X[e]	—[c] — X — — — X X —

[a] X = Analysis will be performed.

[b] Antimony, chromium, and selenium only.

[c] — = Analysis will not be performed.

[d] Antimony and zinc only.

[e] Chromium only.

[f] Zinc only.

Table 4.1-8
Proposed Sampling at SWMU 03-054(e)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	SVOCs	Dioxins/Furans
Define vertical extent of chromium, zinc, bis(2-ethylhexyl)phthalate, diethylphthalate, and dioxins/furans	MO-605021 MO-605022 MO-605023 MO-605024	2–3, 4–5 2–3, 4–5 3-4, 5–6 2–3, 4–5	X[a,b] X[d] X[d] X[b]	X[c] X[c] X[c] X[c]	X —[e] — —
Define lateral extent of bis(2-ethylhexyl)phthalate, diethylphthalate, dioxins/furans, and PAHs	54e-1	0–1, 2–3, 6–7	—	X[f]	X

[a] X = Analysis will be performed.

[b] Zinc only.

[c] Bis(2-ethylhexyl)phthalate and diethylphthalate only.

[d] Chromium only.

[e] — = Analysis will not be performed.

[f] Bis(2-ethylhexyl)phthalate and diethylphthalate, and PAHs only.

Table 4.1-9
Proposed Sampling at AOC C-03-006

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define vertical extent of chromium	MO-604990 MO-604991 MO-604992 MO-604993	6–7, 12–13 15–16, 19–20 6–7, 12–13 6–7, 12–13	X[a,b] X[b] X[b] X[b]

[a] X = Analysis will be performed.

[b] Chromium only.

Table 4.2-1
Proposed Sampling at AOC 35-016(g)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Gamma-Emitting Radionuclides
Define the vertical extent of chromium and cesium-137	MO-604933 MO-604935 MO-604936 MO-604937	4–5, 6–7 4–5, 6–7 4–5, 6–7 4–5, 6–7	X[a,b] X[b] — —	X[c] —[d] X[c] X[c]
Define the lateral extent of cesium-137	16g-1	0–1, 4–5, 6–7	—	X[c]

[a] X = Analysis will be performed.

[b] Chromium only.

[c] Cesium-137 only.

[d] — = Analysis will not be performed.

Table 4.2-2
Proposed Sampling at AOC 35-016(h)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Chromium Hexavalent Ion	SVOCs
Define the vertical extent of chromium and hexavalent chromium	35-02392 MO-605136 MO-605515 MO-605518 MO-605520	4–5, 6–7 3–4, 6–7 3–4, 6–7 3–4, 6–7 3–4, 6–7	X[a,b] X[b] X[b] X[b] X[b]	—[c] X X X —	— — — — —
Define the lateral extent of chromium and PAHs	16h-1 16h-2 16h-3	0–1, 3–4, 6–7 0–1, 3–4, 6–7 0–1, 3–4, 6–7	X[b] X[b] X[b]	— — —	— — X[d]

[a] X = Analysis will be performed.

[b] Chromium only.

[c] — = Analysis will not be performed.

[d] PAHs only.

Table 4.3-1
Proposed Sampling at Consolidated Unit 42-001(a)-99

Sampling Objective	Location Number	Depth (ft)	Tritium
Define the vertical extent of tritium	MO-605054	50–52.5, 60–62.5	X*

* X = Analysis will be performed.

Table 4.4-1
Proposed Sampling at AOC 48-001

Sampling Objective	Location Number	Depth (ft)	Total Cyanide
Define the lateral extent of total cyanide upgradient and downgradient of location MO-604942	1-1 1-2	0–0.5 0–0.5	X* X

* X = Analysis will be performed.

Table 4.4-2
Proposed Sampling at SWMUs 48-002(a) and 48-002(b)

Sampling Objective	Location Number	Depth (ft)	Perchlorate
Define the vertical extent of perchlorate	MO-604925 MO-604932	15–16, 19–20 15–16, 19–20	X* X

* X = Analysis will be performed.

Table 4.4-3
Proposed Sampling at SWMU 48-003

Sampling Objective	Location Number	Depth (ft)	Strontium-90
Define the vertical extent of strontium-90	48-02136 48-02140	2–3, 4–5 3–4, 5–6	X* X

* X = Analysis will be performed.

Table 4.4-4
Proposed Sampling at SWMU 48-007(b)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Chromium Hexavalent Ion	Perchlorate
Define the vertical extent of aluminum, chromium, hexavalent chromium, lead, nickel, perchlorate, and vanadium	MO-605111 MO-605112 MO-605114 MO-605116 MO-605117	5–6, 7–8 5–6, 7–8 5–6, 7–8 5–6, 7–8 5–6, 7–8	X[a,b] — X[d] — —	—[c] X — — —	X — — X X

[a] X = Analysis will be performed.

[b] Aluminum, chromium, nickel, and vanadium only.

[c] — = Analysis will not be performed.

[d] Chromium and lead only.

Table 4.4-5
Proposed Sampling at SWMU 48-007(c)

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define the vertical extent of chromium and lead	MO-605163 MO-605164 MO-605165	4–5, 6–7 4–5, 6–7 4–5, 6–7	X[a,b] X[b] X[c]
Define the lateral extent of lead downgradient of location MO-605165	7c-1	0–1, 3–4, 6–7	X[c]

[a] X = Analysis will be performed.

[b] Chromium only.

[c] Lead only.

Table 4.4-6
Proposed Sampling at SWMU 48-007(f)

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define the vertical extent of barium and chromium	MO-605097 MO-605099 MO-605100 MO-605101 MO-605103	5–6, 7–8 5–6, 7–8 5–6, 7–8 5–6, 7–8 5–6, 7–8	X[a,b] X[c] X[c] X[c] X[c]
Define the lateral extent of chromium downgradient of location MO-605104	7f-1	0–1, 3–4, 5–6	X[c]

[a] X = Analysis will be performed.

[b] Barium and chromium only.

[c] Chromium only.

Table 4.4-7
Proposed Sampling at AOC 48-011

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Nitrate	Cyanide	Perchlorate	SVOCs	VOCs	PCBs	Dioxins/Furans	Gamma-Emitting Radionuclides	Tritium
Define the lateral extent downgradient of location MO-605351 and the shaft	11-1	65–66.5, 75–76.5, 85–86.5, 100–101.5, 110–111.5	X*	X	X	X	X	X	X	X	X	X

* X = Analysis will be performed.

Table 4.5-1
Proposed Sampling at Consolidated Unit 50-004(a)-00

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Isotopic Plutonium	Tritium
Define the vertical extent of barium, chromium, cobalt, copper, plutonium-239/240, and tritium	50-03022	9–10, 19–20	X[a,b]	X	—[c]
	50-03026	9–10, 19–20	—	X	X
	50-03027	19–20, 29–30	—	X	—
	50-03030	9–10, 19–20	—	—	X
	50-03031	9–10, 19–20	—	—	X
	50-03032	9–10, 19–20	—	—	X
	50-03038	19–20, 29–30	X[d]	X	—
	MO-605108	34–35, 44–45	—	—	X
	MO-605458	14–15, 29–30	X[e]	—	X
	MO-605460	14–15, 24–25	X[f]	—	X
	MO-605462	19–20, 29–30	X[f]	X	—
	MO-605463	19–20, 29–30	X[b]	—	X
	MO-605464	14–15, 24–25	X[e]	—	X
	~~MO-605468~~	~~14–15, 24–25~~	~~—~~	~~—~~	~~—~~
	MO-605473	9–10, 19–20	X[g]	—	—
	MO-605478	19–20, 29–30	—	—	X
	MO-605626	24–25, 29–30	X[b]	X	X
	MO-605627	14–15, 24–25	—	X	X
	MO-605628	14–15, 24–25	X[f]	X	X
Define the lateral extent of barium, cobalt, copper, and nickel	4a-1	0–1, 3–4, 6–7	X[h]	—	—
	4a-2	0–1, 3–4, 6–7	X[i]	—	—
	4a-3	0–1, 3–4, 6–7	X[g]	—	—

[a] X = Analysis will be performed.

[b] Barium only.

[c] — = Analysis will not be performed.

[d] Barium and copper only.

[e] Barium, ~~and~~ chromium, cobalt, and copper only.

[f] Chromium only.

[g] Barium, ~~C~~cobalt, and copper only.

[h] Copper and nickel only.

[i] Barium, copper, and nickel only.

Table 4.5-2
Proposed Sampling at SWMU 50-006(a)

Sampling Objective	Location Number	Depth (ft)	TAL Metals
Define the vertical extent of chromium	MO-605076 MO-605077 MO-605078	5–6, 9–10 5–6, 9–10 5–6, 9–10	X[a,b] X[b] X[b]

[a] X = Analysis will be performed.

[b] Chromium only.

Table 4.5-3
Proposed Sampling at SWMU 50-006(d)

Sampling Objective	Location Number	Depth (ft)	TAL Metals	Nitrate	Perchlorate	PCBs	Americium-241	Gamma-Emitting Radionuclides	Isotopic Plutonium	Strontium-90	Tritium	Isotopic Uranium
Define the vertical extent of chromium, copper, mercury, nitrate, perchlorate, PCBs, americium-241, cesium-137, plutonium-238, strontium-90, tritium, and uranium-235/236	MO-605083 MO-605084 MO-605085 MO-605087 MO-605088 MO-605504 MO-605506 MO-605511	9–10, 14–15 9–10, 14–15 4–5, 9–10 8–9, 12–13 5–6, 9–10 16–17, 22–23 9–10, 14–15 18–19, 23–24	—[a] — — X[c] — X[c] X[c] — X[f] X[e] —	— — X — — — — — —	— X X X X X X X —	X[b] — — X X X X — — —	— — — — X — — — —	— — — X[d] X[d] X[d] — — — —	— — — X — X — — — —	— — — X X — — — — —	— X — X — X — X X —	— — — — — — — X — —
Define the lateral extent of chromium, copper, mercury, nitrate, and perchlorate downgradient of location MO-605085	6d-1	4–5, 9–10	— X[c]	X	X	—	—	—	—	—	—	—
Define lateral and vertical extent of radionuclides downgradient of former outfall	6d-2 6d-3	0–1, 5–6, 9–10 0–1, 5–6, 9–10	— —	— —	— —	— —	X X	X[d] X[d]	X X	X X	X X	X X

[a] — = Analysis will not be performed.

[b] X = Analysis will be performed.

[c] Copper only.

[e] Chromium, copper, and mercury only.

[d] Cesium-137 only.

~~[e] Copper only.~~

[fe] Chromium only.

Table 5.0-1
Summary of Investigation Methods

Method	Summary
Spade and Scoop Collection of Soil Samples	This method is typically used to collect shallow (i.e., approximately 0-12 in.) soil or sediment samples. The spade-and-scoop method involves digging a hole to the desired depth, as prescribed in the work plan, and collecting a discrete grab sample. The sample is typically placed in a clean stainless-steel bowl for transfer into various sample containers.
Hand Auger Collection of Soil Samples	This method is typically used for sampling soil or sediment at depths of less than 10–15 ft but in some cases may be used to collect samples of weathered or nonwelded tuff. The method involves hand-turning a stainless-steel bucket auger (typically 3–4 in. inside diameter [I.D.]), creating a vertical hole that can be advanced to the desired sampling depth. When the desired depth is reached during the investigation, the auger will be decontaminated before the hole is advanced through the sampling depth. The sample material will be transferred from the auger bucket to a stainless-steel sampling bowl before the various required sample containers are filled.
Hollow-Stem Auger Drilling	In this method, hollow-stem augers (sections of seamless pipe with auger flights welded to the pipe) act as a screw conveyor to bring cuttings of sediment, soil, and/or rock to the surface. Auger sections are typically 5 ft in length and have outside diameters of 4.25 to 14 in. Drill rods, split-spoon core barrels, Shelby tubes, and other samplers can pass through the center of the hollow-stem auger sections for collection of discrete samples from desired depths. Hollow-stem augers are used as temporary casings when setting wells to prevent cave-ins of the borehole walls.
Split-Spoon Core-Barrel Sampling	In this method, a stainless-steel core barrel (typically 4 in. I.D., 2.5 ft long) is advanced using a powered drilling rig. The core barrel extracts a continuous length of soil and/or rock that can be examined as a unit. The split-spoon core barrel is a cylindrical barrel split lengthwise so that the two halves can be separated to expose the core sample. Once extracted, the section of core is screened for radioactivity and organic vapors and described in a geologic log. A portion of the core is then collected as a discrete sample from the desired depth.
Handling, Packaging, and Shipping of Samples	Field team members seal and label samples before packing them to ensure the sample containers and the containers used for transport are free of external contamination. Field team members package all samples to minimize the possibility of breakage during transport. After all environmental samples are collected, packaged, and preserved, a field team member will transport them to the SMO. The SMO will arrange for shipping the samples to analytical laboratories.
Sample Control and Field Documentation	The collection, screening, and transport of samples will be documented on standard forms generated by the SMO. These include SCLs, COC forms, and sample container labels. SCLs will be completed at the time of sample collection and the logs will be signed by the sampler and a reviewer who verifies the logs for completeness and accuracy. Corresponding labels will be initialed and applied to each sample container, and custody seals will be placed around each sample container. COC forms will be completed and signed to verify the samples were not left unattended.

Table 5.0-1 (continued)

Method	Summary
Field Quality Control Samples	Field quality control samples will be collected as follows: *Field Duplicates*: At a frequency 10%; collected at the same time as a regular sample and submitted for the same analyses. *Equipment Rinsate Blank*: At a frequency of 10%; collected by rinsing sampling equipment with deionized water that will be collected in a sample container and submitted for laboratory analysis. *Trip Blanks*: Required for all field events that include the collection of samples for VOC analysis. Trip blanks containers of certified clean sand will be opened and kept with the other sample containers during the sampling process.
Field Decontamination of Drilling and Sampling Equipment	Dry decontamination will be used to minimize the generation of liquid waste. Dry decontamination includes the use of a wire brush or other tool to remove soil or other material adhering to the sampling equipment, followed by use of a commercial cleaning agent (nonacid, waxless cleaners) and paper wipes.
Containers and Preservation of Samples	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on EPA guidance for environmental sampling, preservation, and quality assurance. Specific requirements for each sample will be printed on the SCL provided by the SMO (size and type of container [e.g., glass, amber glass, and polyethylene]). All samples will be preserved by placing them with ice in insulated containers to maintain a temperature of 4°C.
Management, Characterization, and Storage of IDW	IDW is managed, characterized, and stored in accordance with an approved waste characterization strategy form that documents site history, field activities, and characterization approach for each waste stream managed. Waste characterization will comply with on- or off-site waste acceptance criteria. All stored IDW will be marked with appropriate signage and labels. Drummed IDW will be stored on pallets to prevent deterioration of containers. A waste storage area will be established before waste is generated. Waste storage areas will be located in controlled areas of the Laboratory to prevent unauthorized personnel from inadvertently adding or managing wastes. Each container of waste generated will be individually labeled with waste classification, item identification number, and radioactivity (if applicable), immediately following containerization. All waste will be segregated by classification and compatibility to prevent cross-contamination. Management of IDW is described in Appendix B.
Coordinating and Evaluating Geodetic Surveys	Geodetic surveys focus on obtaining survey data of acceptable quality to use during project investigations. Geodetic surveys will be conducted with a Trimble 5700 DGPS. The survey data will conform to Laboratory Information Architecture project standards IA-CB02, GIS Horizontal Spatial Reference System, and IA-D802, Geospatial Positioning Accuracy Standard for A/E/C/ and Facility Management. All coordinates will be expressed as State Plain Coordinate System 83, NM Central, U.S. feet. All elevation data will be reported relative to the National Geodetic Vertical Datum of 1983.

Table 5.8-1
Summary of Analytical Methods

Analyte	Analytical Method
TAL Metals	SW-846:6010B; SW-846:6020
Chromium Hexavalent Ion	SW-846:7196A
Total Cyanide	SW-846:9012A
Nitrate	EPA Method 300.0
Perchlorate	SW-846:6850
PCBs	SW-846:8082
SVOCs	SW-846:8270C
VOCs	SW-846:8260B
Dioxins/Furans	SW-846:8290
Americium-241	HASL-300:AM-241
Gamma-Emitting Radionuclides	EPA:901.1
Isotopic Plutonium	HASL-300:ISOPU
Isotopic Thorium	HASL-300:ISOTH
Isotopic Uranium	HASL-300:ISOU
Strontium-90	EPA 90.5.0
Tritium	Liquid Scintillation
pH	SW-846:9045C

Appendix B

Investigation-Derived Waste Management Plan

B-1.0 INTRODUCTION

This appendix describes how investigation-derived waste (IDW) generated during the Upper Mortandad Canyon Aggregate Area Phase II investigation will be managed. IDW may include, but is not limited to, drill cuttings, excavated media, contact waste, decontamination fluids, and all other waste that has potentially come into contact with contaminants.

B-2.0 IDW

If required based on the estimated amount of material and size of excavation, Area of Contamination requests will be submitted for approval to New Mexico Environment Department (NMED) for remediation sites in which excavation is planned.

All IDW generated during investigation activities will be managed in accordance with applicable standard operating procedures (SOPs). These SOPs incorporate the requirements of all applicable U.S. Environmental Protection Agency and NMED regulations, U.S. Department of Energy orders, and Laboratory requirements. The SOP applicable to the characterization and management of IDW is SOP-5238, Characterization and Management of Environmental Program Waste, (available at http://www.lanl.gov/environment/all/qa.shtml).

The most recent version of the Los Alamos National Laboratory's (the Laboratory's or LANL's) Hazardous Waste Minimization Report will be implemented during the investigation to minimize waste generation. The report is updated annually as a requirement of ~~Module VIII of~~ the Laboratory's Hazardous Waste Facility Permit.

A waste characterization strategy form (WCSF) will be prepared and approved before field work begins and IDW is generated. The WCSF will provide detailed information on IDW characterization methods, management, containerization, and potential volumes. IDW characterization is completed through review of investigation data and/or documentation or by direct sampling of the IDW or the media being investigated (e.g., surface soil, subsurface soil). Waste characterization may include a review of historical information and process knowledge to identify whether listed hazardous waste may be present (i.e., due diligence reviews). If low levels of listed hazardous waste are identified, a "contained in" determination may be submitted for approval to NMED.

Wastes will be containerized and placed in clearly marked and appropriately constructed waste accumulation areas. If IDW is generated within the boundary of an area of contamination, it will be managed as nonhazardous within those boundaries in designated, properly constructed waste management areas. If hazardous, the IDW will be managed in accordance with hazardous waste requirements once it is removed from the area of contamination. If IDW is generated outside of area of contamination boundaries, the initial management of the waste will rely on the data from previous investigations and/or process knowledge. If the analytical data changes the expected waste category, the waste will be managed in accumulation areas appropriate to the final waste determination. Waste accumulation area postings, regulated storage duration, and inspection requirements will be based on the type of IDW and its classification. Container and storage requirements, as well as transportation and disposal requirements, will be detailed in the WCSF and approved before waste is generated. Table B-2.0-1 summarizes the estimated IDW waste streams, waste types, waste volumes, and other data.

The waste streams that are anticipated to be generated during work plan implementation are described below.

B-2.1 Drill Cuttings

This waste stream consists of soil and rock chips generated by the drilling of boreholes to collect samples. Drill cuttings include excess core sample not submitted for analysis and any returned samples sent for analysis. Drill cuttings will be stored in accordance with the approved WCSF.

This waste stream will be characterized based either on direct sampling of the waste in each container or on the results from core samples collected during drilling. The WCSF will specify the sampling suites for direct sampling of the waste stream. Constituents may be analyzed as necessary to meet the waste acceptance criteria (WAC) for a receiving facility or if visual observations indicate that additional contaminants may be present.

Cuttings will be land applied if they meet the criteria in the NMED-approved Notice of Intent Decision Tree for Land Application of Investigation Derived Waste Solids from Construction of Wells and Boreholes. The Laboratory expects that cuttings will be land-applied or treated/disposed of at an authorized on- or off-site facility appropriate for the waste classification. Table B-2.0-1 presents the estimated volumes, characterization and management methods, and expected disposition of this waste stream.

B-2.2 Excavated Environmental Media

Excavated environmental media will consist of soil and rock removed to meet the proposed cleanup levels where cleanup is recommended. The excavated material will be field screened and examined for visible evidence of contamination during the excavation process. The excavated material will remain within the boundary of the site from which it was excavated and will be placed in appropriate containers in accordance with the WCSF.

Incremental samples will be collected as the media are excavated, or the media will be sampled in piles or containers. A minimum of one direct sample will be collected from each 50 yd^3 or each container of material excavated and will be submitted for laboratory analyses for the analytical suites specified in the WCSF. The Laboratory expects most of the excavated environmental media to be designated as nonhazardous, hazardous, or low-level radioactive waste that will be disposed of in accordance with the WCSF. Table B-2.0-1 presents the estimated volumes, characterization and management methods, and expected disposition of this waste stream.

B-2.3 Contact Waste

The contact waste stream consists of potentially contaminated materials that contacted waste during sampling and excavation. This waste stream consists primarily of, but is not limited, to personal protective equipment such as gloves, decontamination wastes such as paper wipes, and disposable sampling supplies. Contact waste will be stored in containers and characterized in accordance with the WCSF.

Characterization of this waste stream will use acceptable knowledge based on data from the media with which it came into contact (e.g., drill cuttings, soil, sumps). The Laboratory expects most of the contact waste to be designated as nonhazardous, nonradioactive waste that will be disposed of in accordance with the WCSF. Table B-2.0-1 presents the estimated volumes, characterization and management methods, and expected disposition of this waste stream.

B-2.4 Decontamination Fluids

Decontamination fluids consist of liquid wastes generated from decontamination of excavation, sampling, and drilling equipment. For waste minimization, dry decontamination methods will be used to avoid the

generating liquid waste and to minimize the IDW. Dry decontamination uses disposable paper towels and over-the-counter cleaner, such as Fantastik or equivalent. All sampling and measuring equipment, including but not limited to, stainless-steel sampling tools, split-barrel or core samplers will be decontaminated in accordance with SOP-01.08, Field Decontamination of Drilling and Sampling Equipment.

Dry decontamination may be followed by wet decontamination, if necessary. Wet decontamination may include washing with a nonphosphate detergent and water, followed by a water rinse and a second rinse with deionized water. Alternatively, steam cleaning may be used. All wet decontamination fluids will be containerized and characterized by direct sampling for the suites specified in the WCSF. The Laboratory expects any wastes generated during wet decontamination to be nonhazardous liquid waste that will be sent to one of the Laboratory's wastewater treatment facilities in accordance with the WCSF. Table B-2.0-1 presents the estimated volumes, characterization and management methods, and expected disposition of this waste stream.

Table B-2.0-1
Summary of Estimated IDW Generation and Management

Waste Stream	Expected Waste Type	Estimated Volume	Characterization Method	On-Site Management	Expected Disposition
Drill Cuttings	Industrial waste, nonhazardous, nonradioactive	20 yd^3	Analytical results from direct sampling of waste or core samples	Accumulation in 55-gal. drums, covered rolloff containers, or other appropriate containers	Land application, or permitted off-site facility for which waste meets acceptance criteria; or Technical Area 54 (TA-54), Area G
Excavated Environmental Media	Industrial waste, nonhazardous, hazardous, low-level radioactive	10 yd^3	Field screening and analytical results from direct sampling of waste	On ground within site boundary, accumulation in 55-gal. drums, covered rolloff containers, or other appropriate containers	Permitted off-site facility for which waste meets acceptance criteria; or TA-54, Area G
Contact Waste	Industrial waste, nonhazardous, nonradioactive	0.5 yd^3	Acceptable knowledge	Accumulation in 55-gal. drums	Permitted off-site facility for which waste meets acceptance criteria; or TA-54, Area G
Decontamination Fluids	Industrial waste, nonhazardous, nonradioactive	10 gal.	Acceptable knowledge; analytical results from direct sampling of waste	Accumulation in 30-gal. plastic drums	Treatment at an on-site facility for which waste meets acceptance criteria