SWMU 16 - Buried Precipitator Dust Pans Area

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5.5.16 SWMU 16 - Buried Precipitator Dust Pans Area

The location of SWMU 16 is shown on Figure 5.5.16-1a and SWMU 16 monitoring stations and sample locations are provided on Figure 5.5.16-1b. Past operators have reported that there may be buried steel precipitator dust pans covered by several feet of slag and/or soil located in a mounded area north of the coarse slag pile (*see* Figure 5.5.16-1b). SWMU 16 is located east of SWMU 15, west of SWMU 4 and south of SWMUs 5 and 7. Figure 5.5.16-2 is a photograph of a precipitator dust pan.

During the 2012 field investigation, it was noted that the location of SWMU 16 was misidentified on the prior locator maps. A differential global positioning system (GPS) was used to delineate the location of SWMU 16, which is shown on figures presented in this section.

Two rounds of investigation activities were conducted at the Buried Precipitator Dust Pans Area. The first round, in 2010, involved geophysical surveys to evaluate whether precipitator dust pans were buried in this area. The second round, in 2012, involved excavation of test trenches to observe evaluate the materials that are in the mounded area.

5.5.16.1 Geophysical Surveys

A total field magnetometer (Mag) survey and an electromagnetic (EM) survey were completed July 13, 2010 for the purpose of locating buried precipitator dust pans in the area north of the coarse slag pile. The survey area encompassed a much larger area than the small area designated as SWMU 16 in the RFI Work Plan, as shown on Figure 5.5.16-1b. Both surveys were completed by Geolex Inc. (Geolex) in the accessible portions of the area identified by Rhodia as the most likely dust pan burial area.

The area north of the coarse slag pile was divided into four approximately 50 meter square grids: A0, B0, C0, and D0, shown in Figure 5.5.16-1b. A mound approximately six-meters in diameter in area B0 was not surveyed because of metallic debris and the size of the mound, which would have reduced detection depth. No EM data was collected in grid D0 due to the large amount of metallic surface debris, which would have masked deeper EM signals. Areas A0, B0 and C0 had more manageable amounts of surface debris, which was removed as much as was practical; however some debris remained just below the surface and is visible as small anomalies in the data (*see* Appendix 5.5.16-A).

The geophysical surveys did not identify any large anomalies in the area designated as SWMU 16. However, four large (one to two meter) anomalies were identified by Geolex as potential buried precipitator dust pans within the boundaries of SWMU 15 (*see* Section 5.5.15). All other anomalies were determined to be either non-ferrous or too small to be a response from a metallic object the size of a precipitator pan.

5.5.16.2 2012 Field Activities

Four test trenches (TP-1, 2, 3 and 4) were excavated on October 3, 2012. The trenches were spaced approximately 20 feet apart across the mounded area north of the coarse slag pile (*see* Figure 5.5.16-1b). The test trenches were excavated to expose the underlying native soil, which was encountered from 2 to 7 feet below the ground surface. The onsite EPA representatives approved this excavation depth (i.e., modification to the work plan) on October 3, 2012. The test pit logs are included in Appendix 5.5.16-B.

Soil samples were collected from test pits where non-native or non-slag material was present, and the material did not smoke. The objective of the 2012 investigation was to characterize any non-native or non-slag materials within the mounded area of SWMU 16.

Test Pit 1 (TP-1) began two feet east of a previously installed soil gas monitoring point near the western corner of SWMU 16 and proceeded approximately 25 feet to the northeast. Light gray granulated slag was encountered from the surface to one foot below ground surface with gray coarse slag below. Native soil was encountered at a depth of 5 to 5.5 feet. One six inch thick seam of black precipitator dust was encountered near the southwest end of the excavation at a depth of 1 to 1.5 feet. Originally, this material was believed to be black slag and was not sampled before the excavation was backfilled.

TP-2 was excavated approximately 20 feet to the north and east of TP-1. A 3 to 6 inch thick layer of dark gray material was encountered above native soil at a depth of 3.5 to 4 feet below ground surface. This material was sampled (BPDP-1; 3.5-4 feet) and submitted for laboratory analysis. The excavation generally consisted of granular slag overlying coarse slag.

TP-3 was excavated approximately 20 feet to the south and east of TP-2. Light gray granulated slag was encountered from 0 to 1 foot below ground surface with dark gray to black precipitator dust present from 1 to 5 feet. As the excavation depth approached five feet, the spoil pile began to smoke and was immediately moved back into the trench. No samples were collected from trench TP-3 due to the smoking soils, which indicates the presence of elemental phosphorus.

The final test trench (TP-4) was excavated from the northeastern corner of SWMU 16 and extended approximately 40 feet to the southwest. Granular slag was encountered from 0 to 1 foot below ground surface, with coarse slag from 1 to 7 feet on the northeastern end of the excavation. A pocket of precipitator dust (BPDP-2; 4-4.5 ft) was encountered within the coarse slag from 2 to 5 feet near the northeastern end of the excavation. As the excavation proceeded to the southwest, additional black precipitator dust was encountered from 1 to 7 feet. A sample (BPDP-; 3-4 ft) was taken from this area. No smoking soil was observed. Native soil was encountered at 7 feet below ground surface.

The test excavations were backfilled and re-graded to original conditions following completion of the excavation activities.

The ground surface at SWMU 16 is covered by slag, which contains naturally occurring radioactive materials (NORM). The radioactivity is almost exclusively due to trace levels of uranium and its decay products (Lloyd, 1983). Slag also contains certain metals, but the concentrations are not likely to represent a public health hazard (*see* Appendix 5.5.12-A). Additional information regarding slag is presented in Sections 5.5.12 and 5.5.13 of this report. Since the ground surface is covered by slag and slag has been sufficiently characterized for risk assessment purposes, no soil samples of slag have been collected for this SWMU

As noted above, precipitator dust was found in several test trenches. Information regarding precipitator dust characteristics can be found in Section 5.5.15 of this report.

Soil data from SWMU 16 were compared to the background/reference area concentrations. Concentrations above the 95% upper confidence limit of the mean background/reference area concentrations are highlighted on the constituent delineation figures presented in this section. Where a 95% upper limit could not be calculated, the maximum detected concentration or the maximum detection limit was selected.

Constituent concentrations are described in this report as above background/reference area concentrations if the mean and maximum concentrations of the SWMU data exceed both of the mean and maximum background/reference area values. All data will be retained for evaluation in the human health and ecological risk assessments. The definitive background comparison will be conducted in the risk assessment using a statistical approach consistent with EPA guidance (U.S. EPA, 2002).

5.5.16.2.1 General and Site Specific Parameters

The distribution of general chemistry parameters are summarized in Table 5.5.16-1 and are shown on Figure 5.5.16-3.

Fluoride concentrations ranged from 101 mg/kg in the 3.5-4 foot interval at BPDP-1 to 154 mg/kg in the field duplicate sample from the 4-4.5 foot interval at BPDP-2. Fluoride concentrations in the soils samples are considered above background.

Elemental phosphorus data was rejected due to low recoveries for the matrix spike/matrix spike duplicate (MS/MSD) samples related to these samples. Elemental phosphorus is likely present in SWMU 16 based on the presence of smoking soils during trenching activities.

Total phosphorus concentrations at SWMU 16 ranged from 96,000 mg/kg in the 3.5-4 foot interval at BPDP-1 to 115,000 mg/kg in the field duplicate sample from the 4-4.5 foot interval in BPDP-2. The mean total phosphorus concentration in Silver Bow County is 880 mg/kg (USGS, 2012).

5.5.16.2.2 Metals

Certain metals are present at concentrations above the background concentrations as detailed below. The metals data are presented in Table 5.5.16-2.

5.5.16.2.2.1 Metals - Group A

The metals included in Group A are arsenic, cadmium, chromium and copper. The distribution of each metal in test trench samples is shown on Figure 5.5.16-4. Arsenic and copper concentrations are consistent with background data set concentrations. Cadmium and chromium concentrations in SWMU 16 samples exceed their respective mean and maximum background data set concentrations and are considered above background.

5.5.16.2.2.2 Metals - Group B

The metals included in Group B are iron, lead, manganese and nickel. The distribution of each metal in test trench samples is shown on Figure 5.5.16-5. Iron and manganese concentrations are consistent with background data set concentrations. Lead and nickel concentrations in SWMU 16 samples exceed their respective mean and maximum background data set concentrations and are considered above background.

5.5.16.2.2.3 Metals - Group C

The metals included in Group C are selenium, silver, uranium, vanadium and zinc. The distribution of these metal constituents in test trench samples are shown on Figure 5.5.16-6. Group C metals concentrations exceed their respective mean and maximum background data set concentrations and are considered above background.

5.5.16.2.2.4 Metals - Group D

The metals included in Group D are barium, beryllium, cobalt, mercury and thallium. The distribution of these metal constituents in test trench samples is shown on Figure 5.5.16-7. Barium, cobalt and mercury concentrations are consistent with background data set concentrations. Beryllium and thallium concentrations in SWMU 16 samples exceed their respective mean and maximum background data set concentrations and are considered above background.

5.5.16.2.2.5 Metals - Group E

The metals included in Group E are antimony, calcium, magnesium, potassium, and sodium. The distribution of these metal constituents in test trench samples is shown on Figure 5.5.16-8. Magnesium concentrations are consistent with background data set concentrations. Calcium, potassium, sodium and antimony concentrations in SWMU 16 samples exceed their respective mean and maximum background data set concentrations and are considered above background.

5.5.16.2.3 Radionuclides

Naturally-occurring radioactive materials (NORM) consisting of U-238 and its decay chain constituents are present in the samples collected from SWMU 16. The radionuclide data are presented in Table 5.5.16-3 and shown in Figure 5.5.16-9. Lead-210, radium-226, thorium-230, uranium-234 and uranium-238 concentrations are considered above background. Uranium-235 was not detected in the SWMU 16 samples.

5.5.16.3 Conclusions

The geophysical surveys did not identify any large anomalies in the area designated as SWMU 16. The anomalies were determined to be either non-ferrous or too small to be a response from a metallic object the size of a precipitator dust pan.

Elemental phosphorus is present in SWMU 16 materials based on the observation of smoking soils during trenching activities. The elemental phosphorus concentration in the smoking soils may be on the order of 1,000 mg/kg (U.S. EPA, 2001).

The following parameters were identified as above background based on comparison to the background/reference area values: fluoride, antimony, beryllium, cadmium, calcium, chromium, lead, nickel, potassium, selenium, silver, sodium, thallium, uranium, vanadium and zinc. Radionuclide concentrations of lead-210, radium-226, thorium-230, uranium-234 and uranium-238 are considered above background. Uranium-235 was not detected in the SWMU-16 samples.

There is sufficient information to conduct the risk assessment for this SWMU. The risk assessment will identify which parameters, if any, are present at concentrations that warrant corrective measures. The dataset would be reviewed at that time and additional sampling may be necessary to inform the corrective measures study or later during the corrective measures design phase.

5.5.16.4 References

Lloyd, L.L. June 1983. Evaluation of Radon Sources and Phosphate Slag in Butte, Montana. Occupational Health Bureau, Montana Department of Health and Environmental Sciences.

U.S. EPA. 2002. Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites. U.S. Environmental Protection Agency. EPA 540-R-01-003. OSWER 9285.7-41. September 2002.

U.S. EPA. 2003. Treatment Technologies for Historical Ponds Containing Elemental Phosphorus - Summary and Evaluation, Final Report. U.S. Environmental Protection Agency. EPA 542-R-03-013 August 2003.

U.S. Geological Survey, 2012. Average concentrations of elements in Silver Bow County, Montana. Open-File Report 2004-1001. Accessed December 11, 2012, at http://mrdata.usgs.gov/geochem/county.php?place=f30093&el=P&rf=northwestern

Tables

Table 5.5.16-1
Soil Data - General and Site Specific Parameters
SWMU 16
Rhodia Silver Bow Plant
[concentrations in mg/kg]

			Chemical Name	Fluoride	Phosphorus, elemental (white)	Phosphorus, total
			Background Mean, Exceedances **Bold**	**4.1**		
			Background Maximum, Exceedances <u>Underline</u>	<u>37</u>		
			Background 95% UCL, Exceedances *Italic*	*7.6*		
Location ID	**Sample Date**	**Depth**	**Sample Type**			
BPDP-1	10/03/2012	3.5 - 4 ft	N	<u>***101***</u>	< 0.000015 R	96000
BPDP-2	10/03/2012	4 - 4.5 ft	N	<u>***135***</u>	< 0.000015 R	104000
			FD	<u>***154***</u>	< 0.000015 R	115000
BPDP-3	10/03/2012	3 - 4 ft	N	<u>***111***</u>	< 0.000015 R	113000

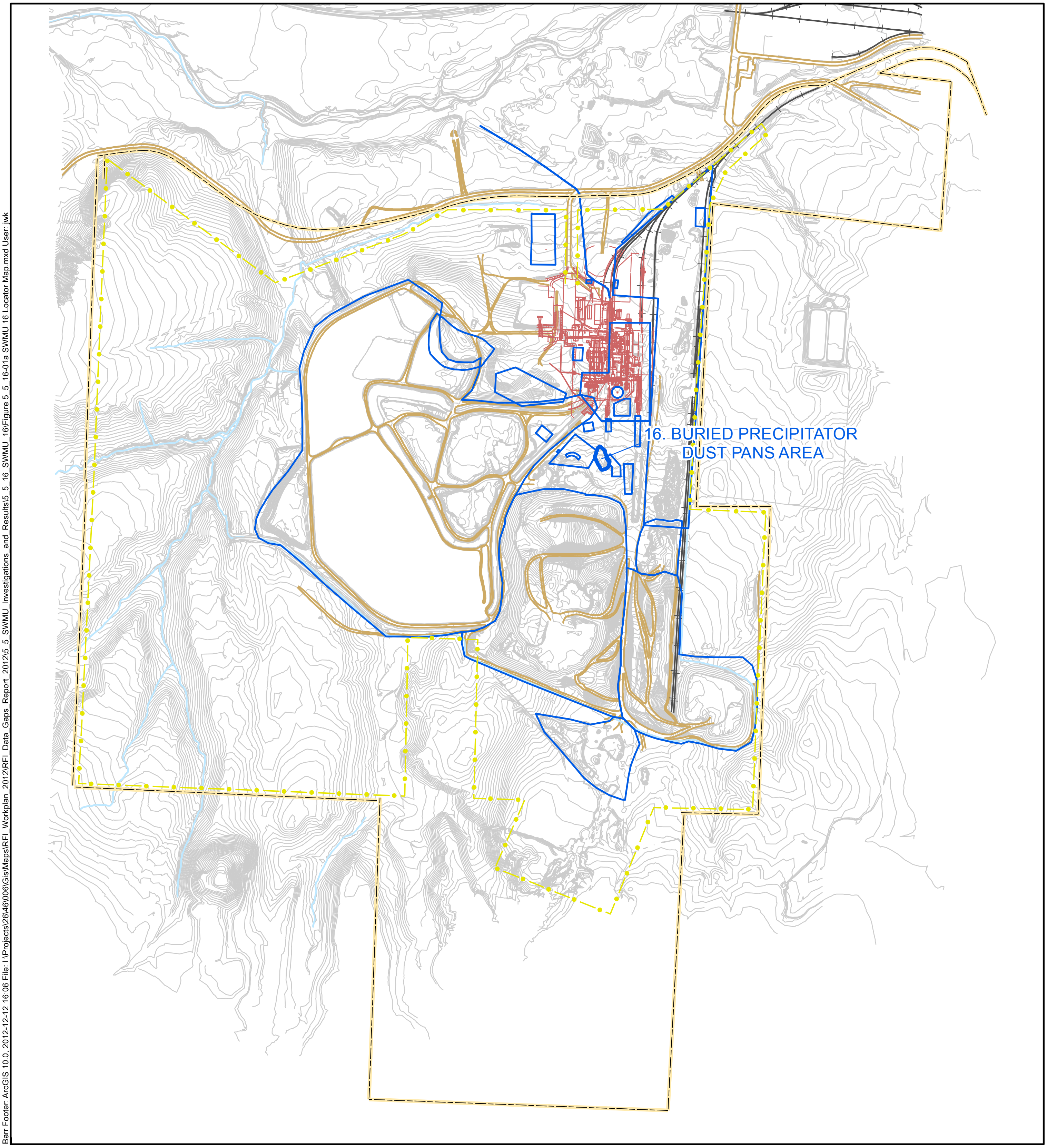
Table 5.5.16-2
Soil Data - Metals
SWMU 16
Rhodia Silver Bow Plant
[concentrations in mg/kg]

Chemical Name / Analysis Location				Antimony Lab	Arsenic Lab	Barium Lab	Beryllium Lab	Cadmium Lab	Calcium Lab	Chromium Lab	Cobalt Lab	Copper Lab	Iron Lab	Lead Lab	Magnesium Lab	Manganese Lab	Mercury Lab	Nickel Lab	Potassium Lab	Selenium Lab	Silver Lab	Sodium Lab	Thallium Lab	Uranium Lab	Vanadium Lab	Zinc Lab
Background Mean, Exceedances **Bold**				**0.50**	23	150	**0.51**	**1.6**	**3900**	**11**	5.9	**35**	19600	**17**	**3500**	540	**0.021**	**5.3**	**3000**	**0.41**	**0.73 (1)**	**140**	**0.35**	**1.8**	**41**	**59**
Background Maximum, Exceedances Underline				3.9	120	290	1.3	8.9	14000	48	9.5	301	35300	190	5700	1100	0.20	21	5300	0.70	1.7 (1)	620	1.0	4.1	83	380
Background 95% UCL, Exceedances *Italic*				*1.0*	40	170	*0.55*	*1.1*	*4500*	*12*	6.1	*64*	20600	*35*	*3700*	570	0.038	*6.0*	*3200*	*0.47*	*0.35 (1)*	*220*	*0.46*	*2.0*	*43*	*98*
Location ID	**Sample Date**	**Depth**	**Sample Type**																							
BPDP-1	10/03/2012	3.5 - 4 ft	N	***37.4***	5.19	118	***1.34 J***	***161***	***90600***	***179***	2.05 J	***85.9***	5950	***497***	***5190***	209	**0.022**	***31.4***	***56000***	***6.5***	***471***	***5320***	***50.7 J***	***28.6***	***156***	***89200***
BPDP-2	10/03/2012	4 - 4.5 ft	N	***45.8***	3.74	87.3	***1.34 J***	***164***	***102000***	***175***	< 1.19	***79.2***	2470	***464***	***5130***	141	0.010 J	***27.6***	***64000***	***10.4***	***480***	***6160***	***64.9***	***28.8***	***153***	***99300***
			FD	***44.0***	3.76	89.9	***1.40 J***	***115***	***151000***	***188***	< 1.11	***82.8***	2550	***412***	***4870***	118	0.010 J	***26.1***	***57300***	***10.3***	***375***	***5650***	***57.4***	***38.1***	***214***	***87800***
BPDP-3	10/03/2012	3 - 4 ft	N	***46.4***	3.49	111	***1.65 J***	***192***	***113000***	***203***	< 1.15	***123***	3830	***714***	***4110***	157	**0.025**	***32.9***	***61800***	***8.4***	***411***	***4530***	***70.7***	***27.3***	***179***	***73200***

Table 5.5.16-3
Soil Data - Radionuclides
SWMU 16
Rhodia Silver Bow Plant
[concentrations in pCi/g]

			Chemical Name	**Lead 210**	**Radium 226**	**Thorium 230**	**Uranium 234**	**Uranium 235**	**Uranium 238**
Background Mean, Exceedances **Bold**					**3.6**	**0.96**	**0.73**		**0.78**
Background Maximum, Exceedances Underline					12	3.4	2.8		2.7
Background 95% UCL, Exceedances *Italic*					*5.0*	*1.7*	*1.6*		*1.6*
Location ID	**Sample Date**	**Depth**	**Sample Type**						
BPDP-1	10/03/2012	3.5 - 4 ft	N	410 +/- 13	***18 +/- 1.4***	***9.1 +/- 1.5***	***7.7 +/- 1.2***	< 0.35	***8.33 +/- 1.3***
BPDP-2	10/03/2012	4 - 4.5 ft	N	410 +/- 13	***22 +/- 1.5***	***10 +/- 1.6***	***4.8 +/- 1.2***	< 0.41	***5.55 +/- 1.3***
			FD	380 +/- 14	***24 +/- 1.6***	***8.8 +/- 1.3***	***6 +/- 1.6***	< 0.59	***6.72 +/- 1.6***
BPDP-3	10/03/2012	3 - 4 ft	N	320 +/- 12	***23 +/- 1.6***	***8.3 +/- 1.4***	***6.1 +/- 1.5***	< 0.51	***4.86 +/- 1.3***

Figures

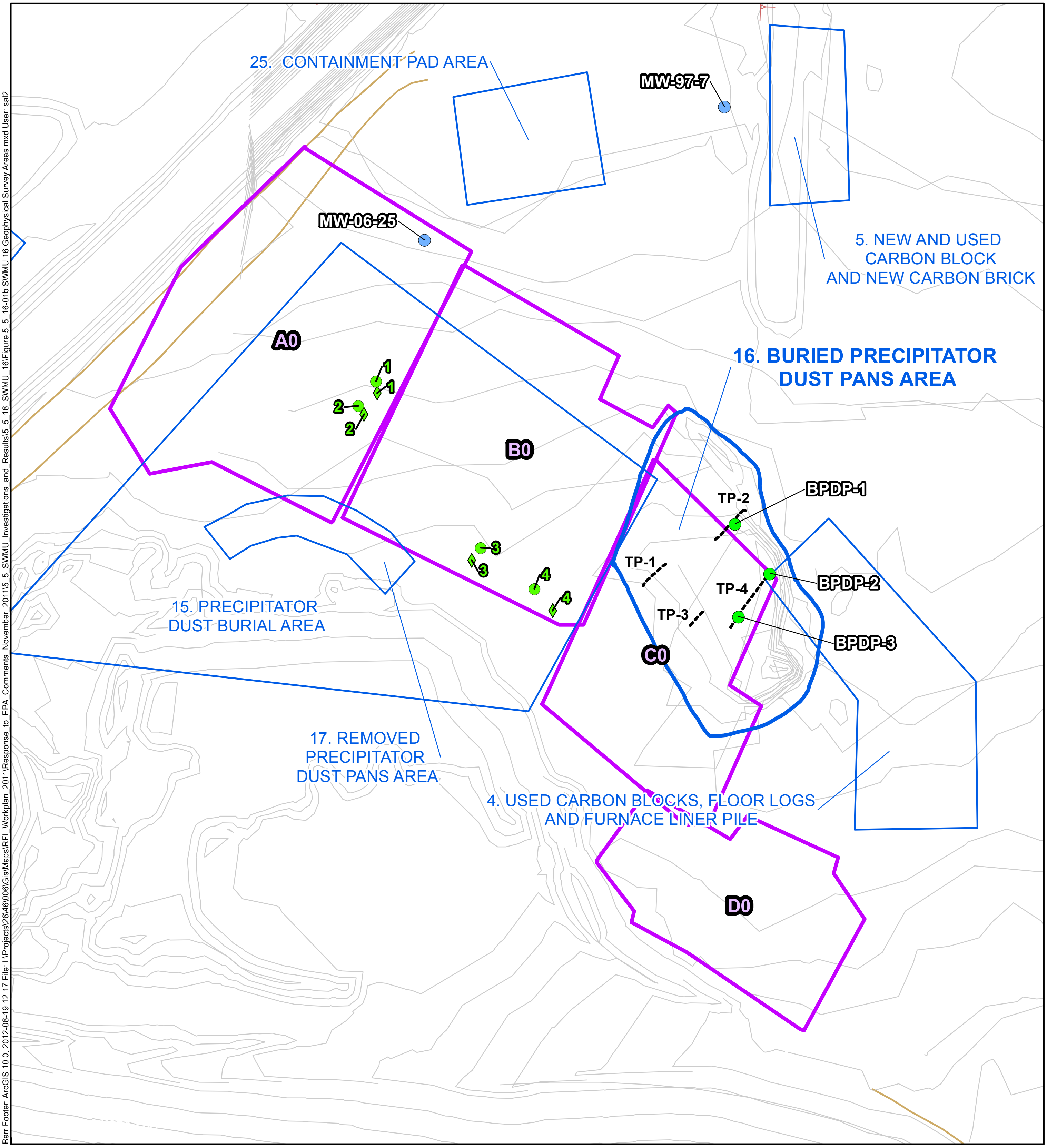


SWMU 16
Other SWMUs
Elevation Contour
Drainage
Railroad
Road
Former Plant Structures
Property Boundary
Fence Line

N
Feet
1,000 0 1,000

Figure 5.5.16-1a

SWMU 16 LOCATION
Rhodia Silver Bow Plant
Montana



Electromagnetic Target Location
Magnetic Target Location
Monitoring Well
Soil Sample
SWMU 16
Other SWMUs
Geolex Geophysical Survey Area
Test Trench Locations
Elevation Contour
Drainage
Railroad
Road
Former Plant Structures

N

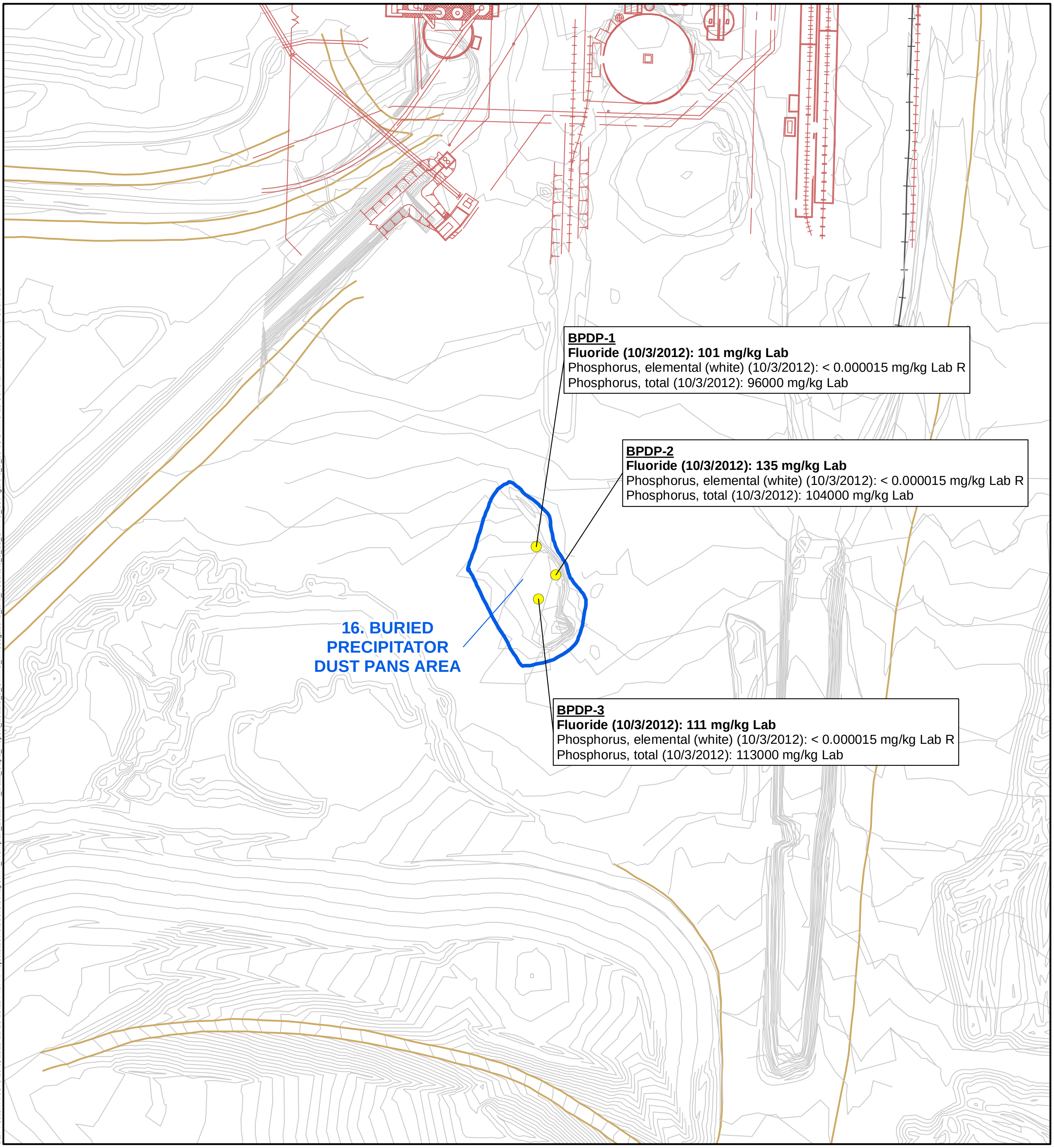
Feet
75 0 75

Figure 5.5.16-1b

SWMU 16
MONITORING STATIONS
AND SAMPLE LOCATIONS
Rhodia Silver Bow Plant
Montana

Figure 5.5.16-2

Photograph of Precipitator Dust Pan
Rhodia Silver Bow Plant



- Sample Location
- SWMU 16
- Elevation Contour
- Drainage
- Railroad
- Road
- Former Plant Structures

Bold font indicates that sample concentration is greater than the 95% UCL of mean Reference Area Concentration.

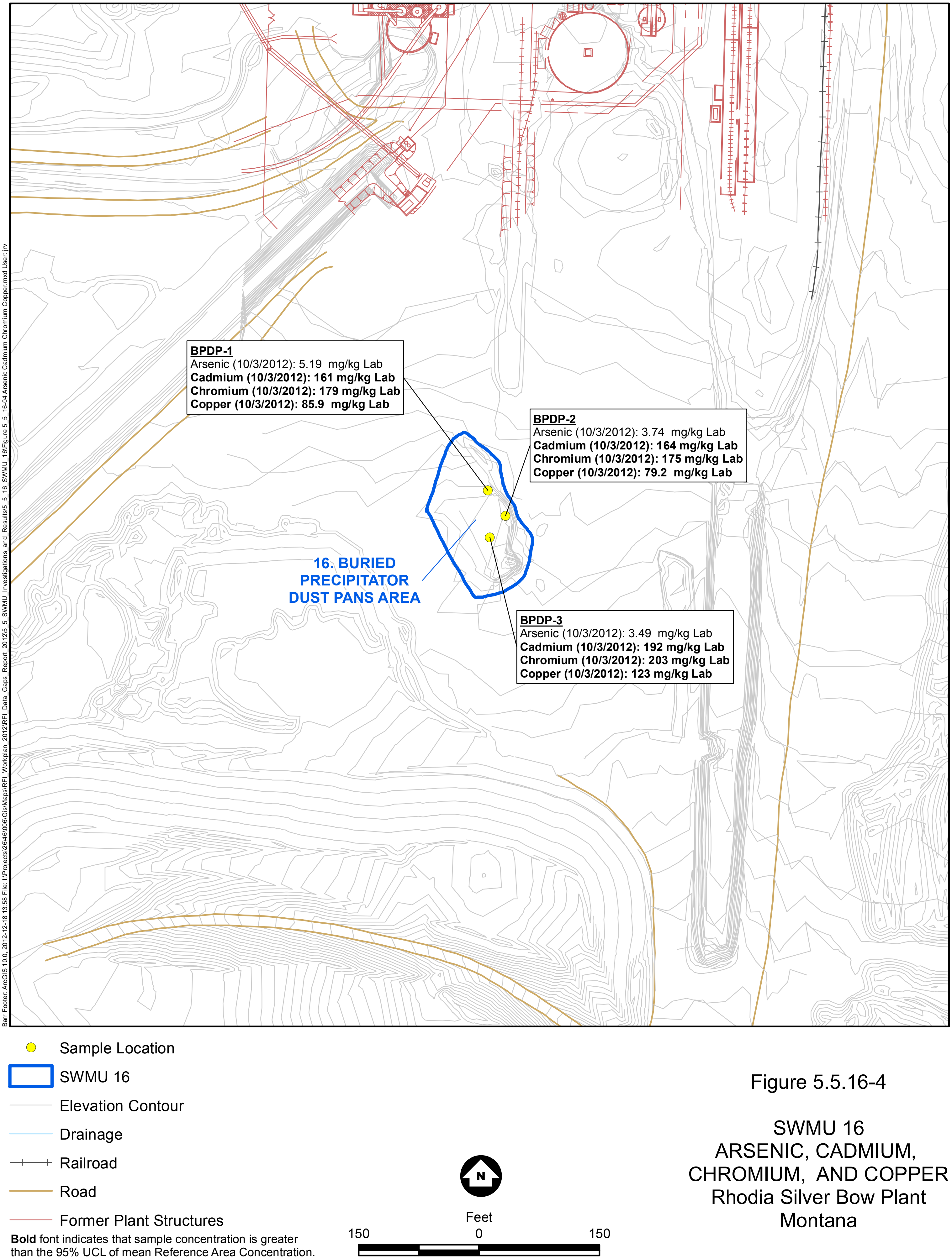
N

Feet

150 0 150

Figure 5.5.16-3

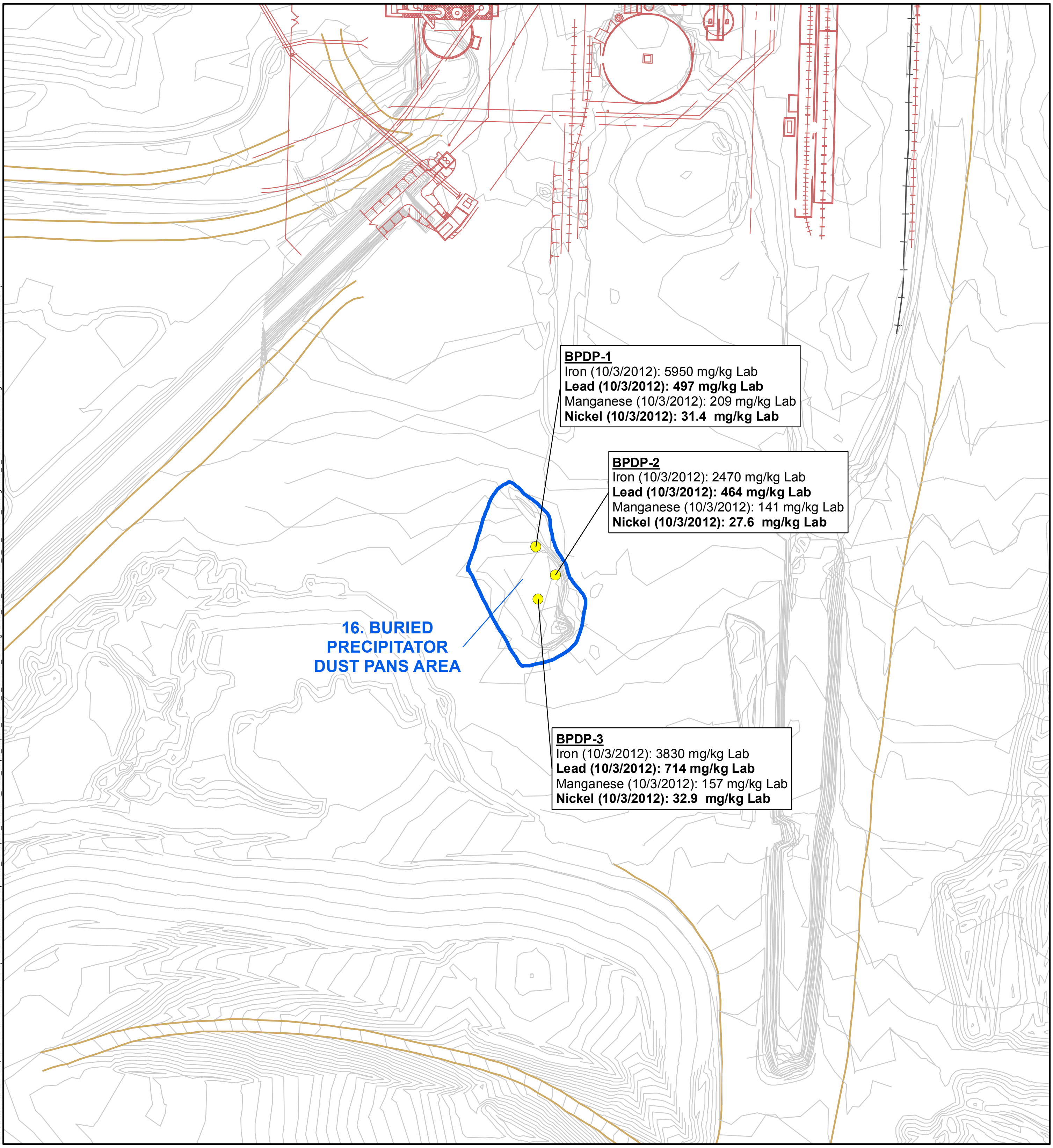
SWMU 16
GENERAL PARAMETERS
Rhodia Silver Bow Plant
Montana



Bold font indicates that sample concentration is greater than the 95% UCL of mean Reference Area Concentration.

Figure 5.5.16-4

SWMU 16
ARSENIC, CADMIUM, CHROMIUM, AND COPPER
Rhodia Silver Bow Plant
Montana



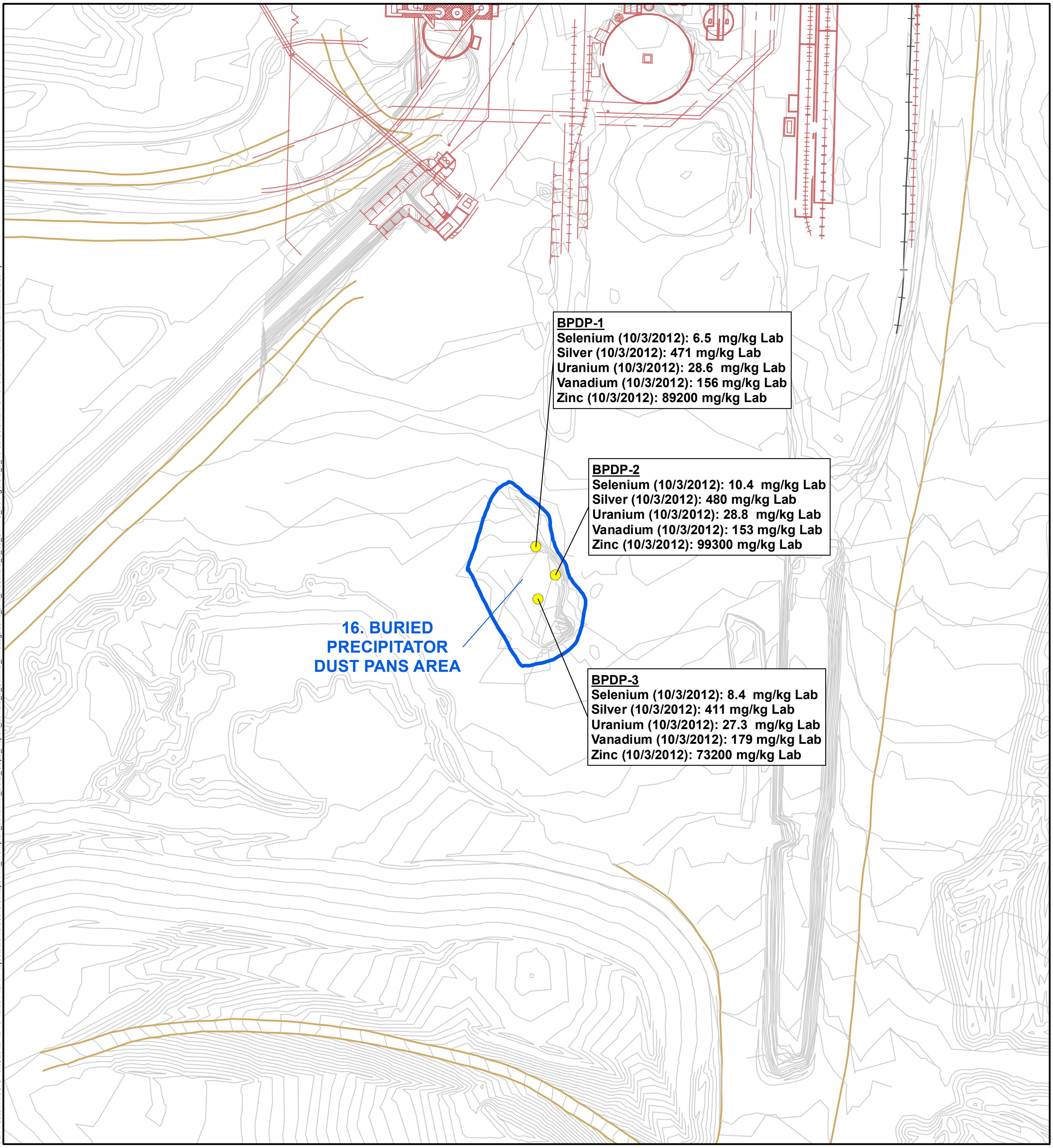
Sample Location
SWMU 16
Elevation Contour
Drainage
Railroad
Road
Former Plant Structures

Feet
150 0 150

Figure 5.5.16-5

SWMU 16
IRON, MANGANESE, NICKEL,AND LEAD
Rhodia Silver Bow Plant
Montana

Bold font indicates that sample concentration is greater than the 95% UCL of mean Reference Area Concentration.



Barr Footer: ArcGIS 10.0, 2012-12-18 13:59 File: I:\Projects\26\46\006\Gis\Maps\RFI_Workplan_2012\RFI_Data_Gaps_Report_2012\5_5_SWMU_Investigations_and_Results\5_5_16_SWMU_16\Figure 5_5_16-06 Selenium Silver Uranium Vanadium Zinc.mxd User: jrv

Sample Location
SWMU 16
Elevation Contour
Drainage
Railroad
Road
Former Plant Structures

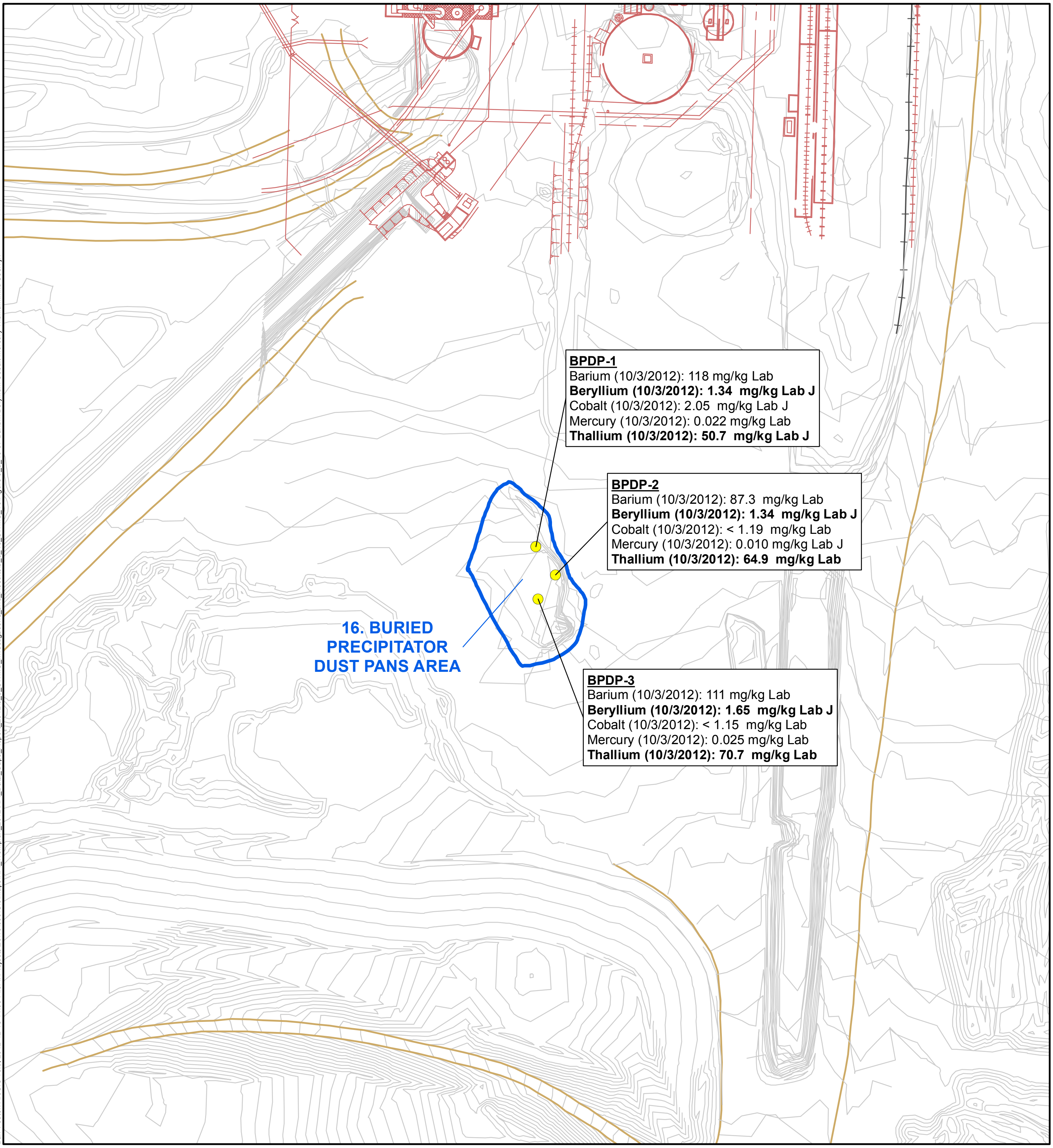
Bold font indicates that sample concentration is greater than the 95% UCL of mean Reference Area Concentration.

N

Feet
150 0 150

Figure 5.5.16-6

SWMU 16
SELENIUM, SILVER, URANIUM, VANADIUM, AND ZINC
Rhodia Silver Bow Plant
Montana



Sample Location
SWMU 16
Elevation Contour
Drainage
Railroad
Road
Former Plant Structures

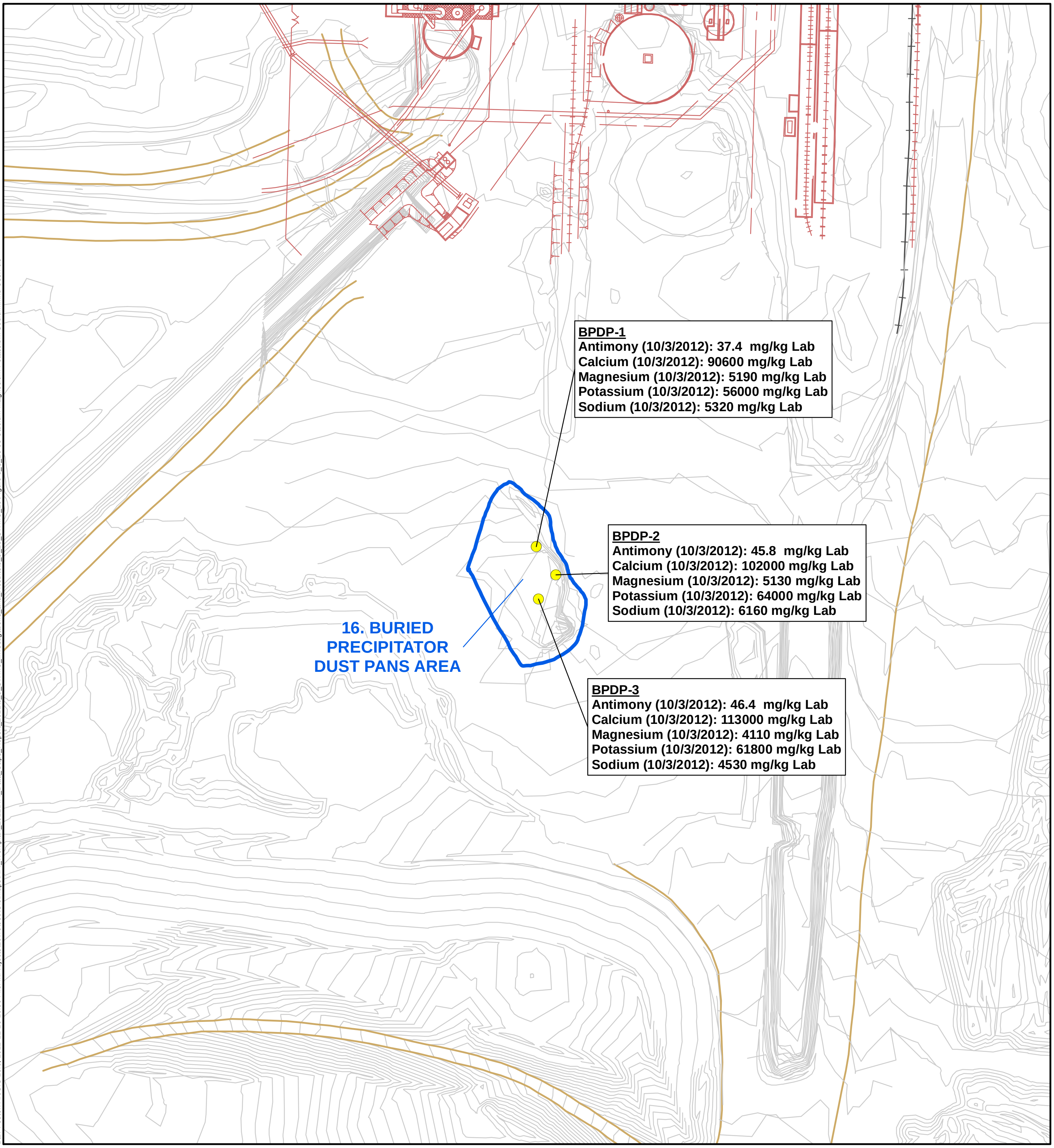
Bold font indicates that sample concentration is greater than the 95% UCL of mean Reference Area Concentration.

N

Feet
150 0 150

Figure 5.5.16-7

SWMU 16
BARIUM, BERYLLIUM, COBALT, MERCURY, AND THALLIUM
Rhodia Silver Bow Plant
Montana



Sample Location

SWMU 16

Elevation Contour

Drainage

Railroad

Road

Former Plant Structures

Bold font indicates that sample concentration is greater than the 95% UCL of mean Reference Area Concentration.

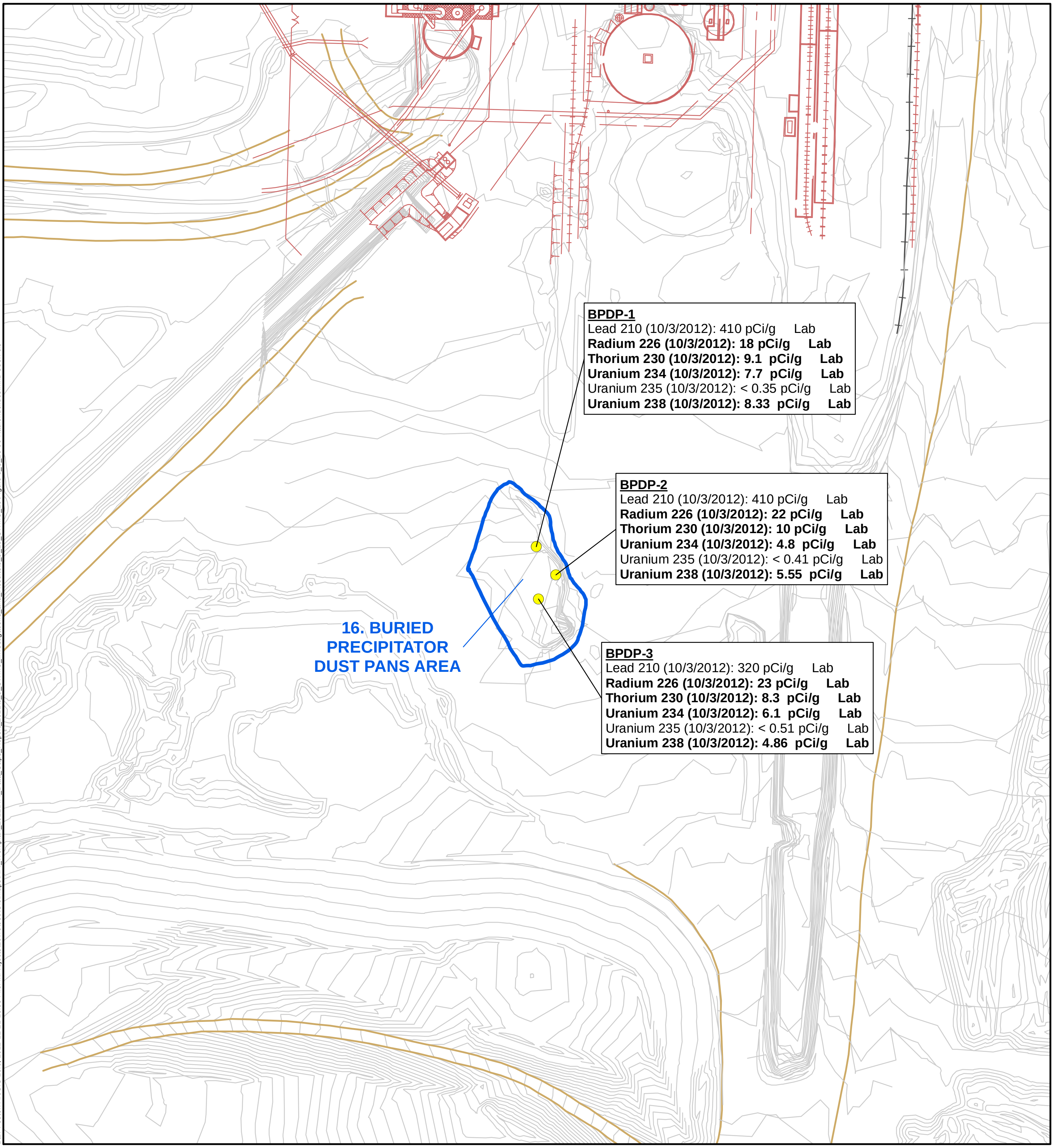
N

Feet

150 0 150

Figure 5.5.16-8

SWMU 16
ANTIMONY, CALCIUM, MAGNESIUM, POTASSIUM, AND SODIUM
Rhodia Silver Bow Plant
Montana



Sample Location
SWMU 16
Elevation Contour
Drainage
Railroad
Road
Former Plant Structures

Bold font indicates that sample concentration is greater than the 95% UCL of mean Reference Area Concentration.

N

Feet
150 0 150

Figure 5.5.16-9

SWMU 16
RADIONUCLIDES
Rhodia Silver Bow Plant
Montana

Appendices

Appendix 5.5.16-A

Geolex, Inc Geophysical Investigation Report

Geophysical Investigation for Buried Steel Precipitator Pans at Rhodia, Inc.

On 13 July 2010, Geolex Inc. conducted a total field magnetometer survey and an electromagnetic survey for the purpose of locating the precipitator dust pans at the Rhodia Silver Bow Site. Precipitator dust pans are steel objects greater than 1 cubic meter in size. Both the magnetic and electromagnetic surveys were conducted in accessible areas north of the coarse slag pile, west of SWMU3, south of MW-97-7, and east of the tailing basin water return channel. The magnetometer ("Mag") survey was accomplished using a Geolex array of four Geometrics 823A cesium-vapor sensors combined with a Trimble PRO XT GPS mapping receiver for submeter positioning. The electromagnetic ("EM") survey was accomplished using a Geonics EM61 MKII with the Trimble receiver.

The Mag and EM surveys used the Trimble NMEA GGA output string for real-time coupling with the total magnetic field and EM decay channel readings. The GPS provides approximately 50cm accuracy with lat/long coordinates converted to the local UTM (NAD 83) grid system for use with a GIS database.

The geophysical surveys were completed in accessible terrain that was determined by Rhodia to be the most likely dust pan burial area. Barr Engineering provided grid control points at roughly 25 meter (M) intervals in the flat area north of the coarse slag pile. Geolex surveyed four grids – A0, B0, C0, and D0 – that were each approximately 50M x 50M in size. The southwest corner of each grid was clearly staked and labeled for future reference. The geophysical surveys were conducted using 1 to 2 meter transect spacing, controlled by using fiberglass measuring tapes and traffic cones for visual sighting, and recorded with GPS. Specifically, the Mag survey used 2M spacing with 100 percent ground coverage for all four grids. The EM survey used 1M spacing with 100 percent coverage for grid C0, and 2M spacing with 50 percent coverage for grids A0 and B0. Both the 1M and 2M transect spacing methods were determined to be sufficient to detect large buried metallic objects to depths of approximately 2 to 4 meters below ground surface (bgs). No EM data was collected in grid D0.

As with any geophysical survey, metal objects at the surface such as chain-link and barbed wire fences or metallic surface debris will negatively affect the signal-noise ratio and render the data immediately surrounding such features unusable. Since the primary objective of the geophysical work was to detect subsurface objects, a practical attempt was made to remove surface debris that could be easily picked up by hand prior to the geophysical survey in grids A0, B0, and C0. Also, due to the hundreds of pieces of steel debris in grid D0, no attempt was made to remove surface debris in this area.

Geophysical anomaly contour maps for all grid areas were compiled to identify possible Mag/EM targets and are discussed below. In general, the large amount of steel debris at and immediately below the surface made definition of the anomalies identified as potential dust pans difficult, and it is possible that the survey area may not have covered any historic dust pan burial areas.

Magnetometer Survey

The Mag survey was conducted to locate ferrous items only, in this case the buried steel dust pans. Magnetometers are passive instruments that directly measure the Earth's magnetic field in units of nano-Tesla. They are not sensitive to other metallic items (non-ferrous aluminum, brass, copper, etc.); however, they are affected by remnant magnetism of naturally occurring iron oxides (hematite and magnetite) in soil and bedrock, and by induced magnetism of iron-bearing compounds (e.g., waste rock or tailings containing iron). In general, small iron or steel objects of one to two decimeters in size can be detected at depths of 40 cm to 80 cm. Larger objects of 25 cm to 50 cm or more in size can often be detected at depths of 1 to 3 meters.

Four Geometrics 823-A cesium vapor magnetometers were used for the total field magnetic survey on 13 July 2010. The sensors were spaced at 0.5 meter and carried over the ground at a height of 0.5 meter. Transect spacing was 2 meters for all grids in grids A0, B0, C0, and D0. The magnetometer array is sensitive to ferrous materials which disrupt the Earth's magnetic field. The depth of detection is relative to the size of the buried object and the strength of an object's magnetic signature (signal attenuation for total field magnetometry varies as a function of the inverse cube root of the vertical distance between the target item and sensors). Magnetic anomalies that correspond to buried ferrous objects are dipolar, which means the anomalies have a positive pole and a corresponding negative pole.

Electromagnetic (EM) Survey

The EM survey was conducted to locate all metallic debris. EM instruments actively charge the near surface with current; if a metallic object is present, a temporary electromagnetic field is induced around the object, and the rate of decay of the field is measured in millivolts from four separate time intervals. The main advantage in using EM is to locate metallic objects in areas where high iron concentration in surface soils would otherwise overwhelm or "mask" the ability of a magnetometer to passively detect ferrous or other metallic objects at depth. Near surface detection of small metallic items is generally somewhat better using EM, whereas deeper detection of larger items tends to be better using Mag.

A Geonics EM61-MKII was used for the electromagnetic survey, with a 0.5 meter survey height above ground surface. (Transect spacing was 1 meter for grid C0, the grid considered most likely to contain the buried dust pans. Grids A0 and B0 were surveyed using 2 meter transect spacing. Grid D0 was not surveyed.) The EM61-MK2 is sensitive to electrically conductive material. The depth of detection is relative to the size of the object, its conductivity, and the rate at which its induced electromagnetic field decays. Electromagnetic anomalies that correspond to buried electrically conductive material are displayed as positive monopoles.

Voided Area

Data coverage included the entire survey area as staked by Barr Engineering, except for a small approximately 6 meter diameter mound shown in figure 1. The area was not surveyed due to debris located in the mound and the general size of the mound which would hinder detection depth.

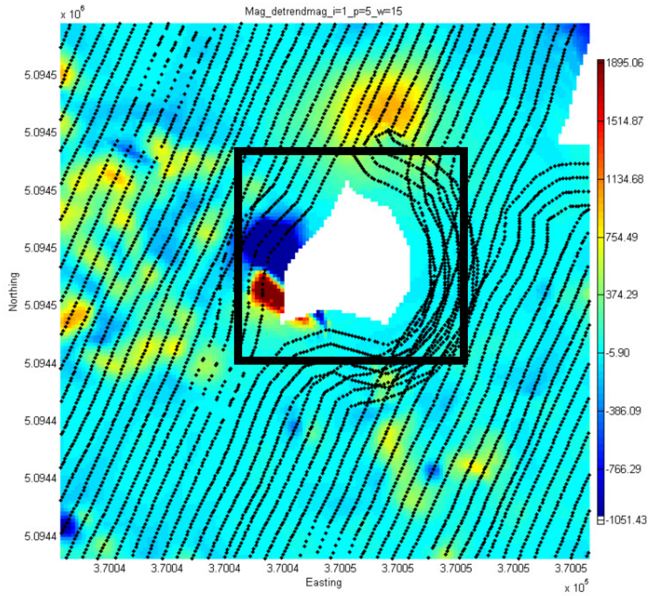


Figure 1: Location of area not surveyed is outlined by black box.

Comparison and Discussion of Results

The survey area contained electrically conductive and magnetic metallic debris that interfered with the detection of buried materials for both instruments. This limitation is due to anomalies from near surface debris potentially masking anomalies from deeper buried objects. Debris anomalies are numerous throughout the survey with high concentration in the southern area. This is more apparent in the magnetic data. High concentrations of debris appear as smaller individual dipole anomalies in the magnetic data, but the close proximity of individual debris items results in a single large monopole in the electromagnetic data. Anomalies that appear only on the electromagnetic contour map are non-magnetic, but still electrically conductive. These anomalies are not pertinent because the steel dust bins of interest are iron/steel and thus magnetic.

There are four large anomalies of approximately one to two meters in size that correlate well between the electromagnetic monopoles and magnetic dipoles. All remaining anomalies appear to be too small to be a response from a large (greater than one cubic meter) metallic object. Magnetic instruments typically can detect items buried much deeper (1.5x) than an electromagnetic instrument. The magnitudes of the electromagnetic anomalies when compared to the magnetic anomalies are much smaller and are attributed to the detection limits of the EM61. The magnetic dipolar responses and electromagnetic monopole responses of Targets 1, 2, and 4 correlate well. The single magnetic dipolar response of Target 3 correlates to the three low magnitude electromagnetic monopole responses. Predicted depths of the four major anomalies are between 1.1 to 1.7 meters or deeper. UTM locations for the four targets are provided in Table 1.

Electromagnetic UTM Target Locations			Magnetic UTM Target Locations		
EASTING	NORTHING	TARGET	EASTING	NORTHING	TARGET
370010.0791	5094455.951	1	370009.8109	5094458.197	1
370007.667	5094451.836	2	370006.511	5094453.45	2
370028.8078	5094424.31	3	370030.5077	5094426.739	3
370044.557	5094414.946	4	370040.9349	5094419.026	4

Table 1: UTM locations for the four targets for their respective electromagnetic and magnetic contour maps.

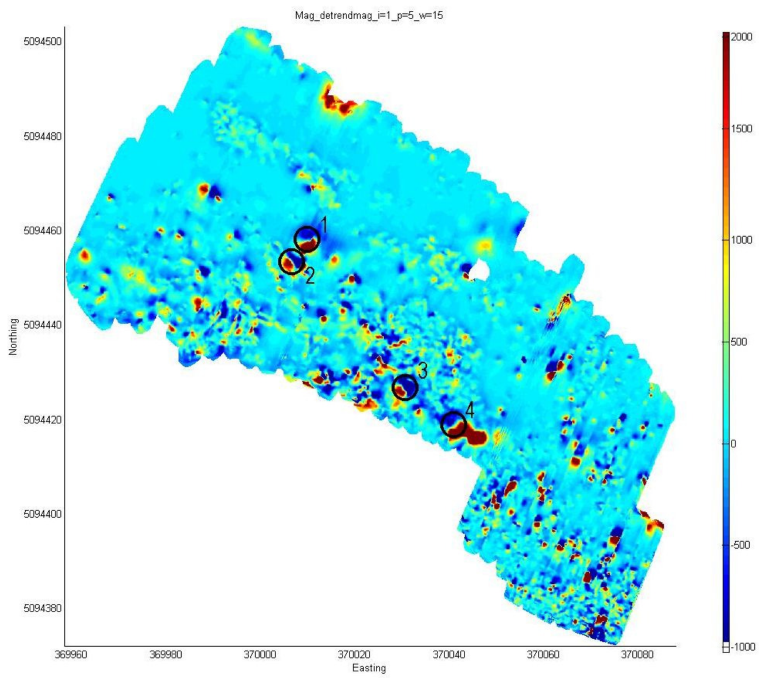


Figure 2: Magnetic contour map of combined survey area A0 B0 C0 with target locations. Units are in nT.

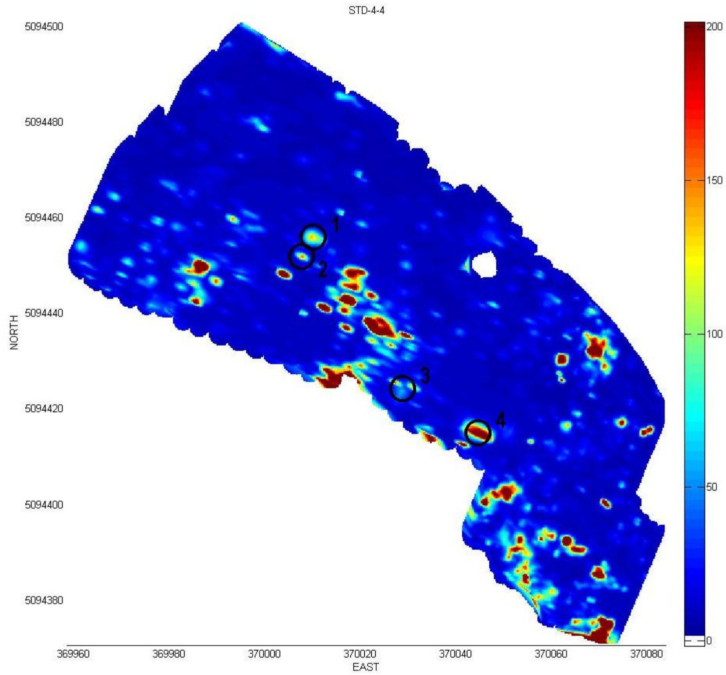


Figure 3: Electromagnetic contour map of combined survey area A0 B0 C0 with target locations. Units are in mV.

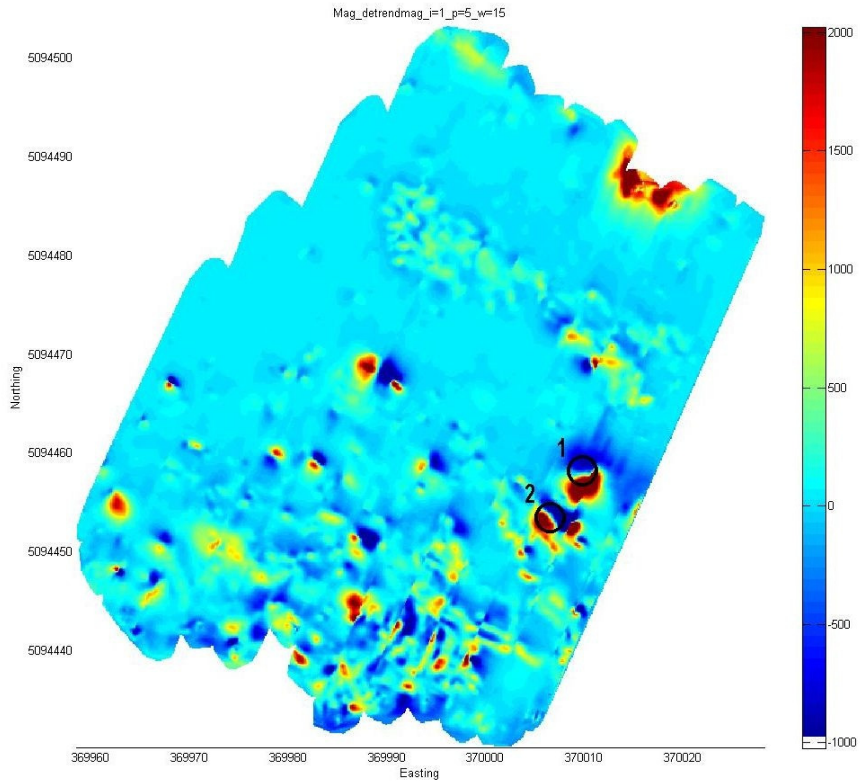


Figure 4: Magnetic contour map of survey grid A0. Units are in nT.

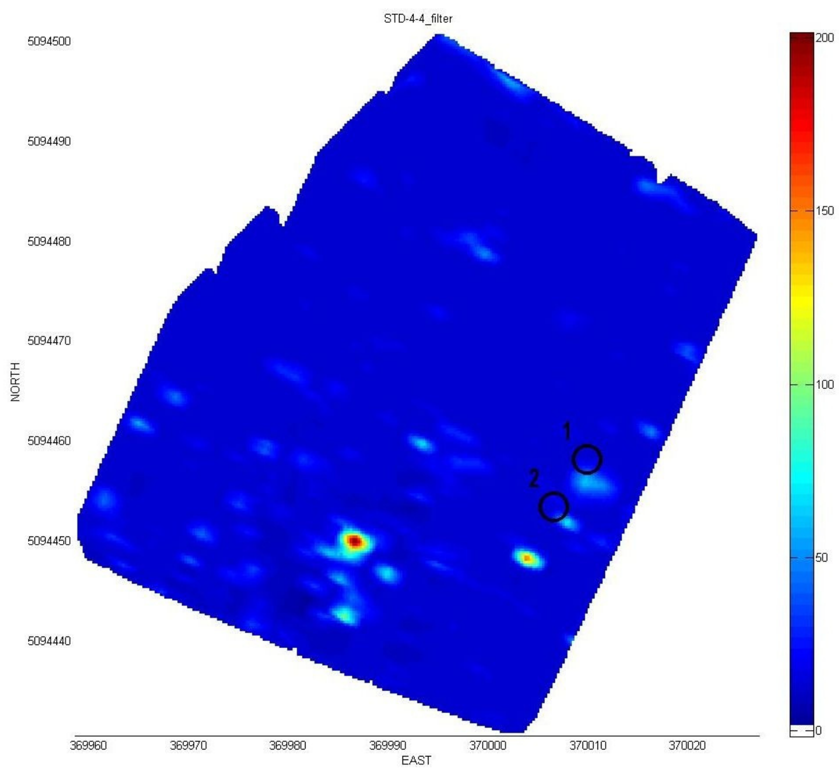


Figure 5: Electromagnetic contour map of survey grid A0. Units are in mV.

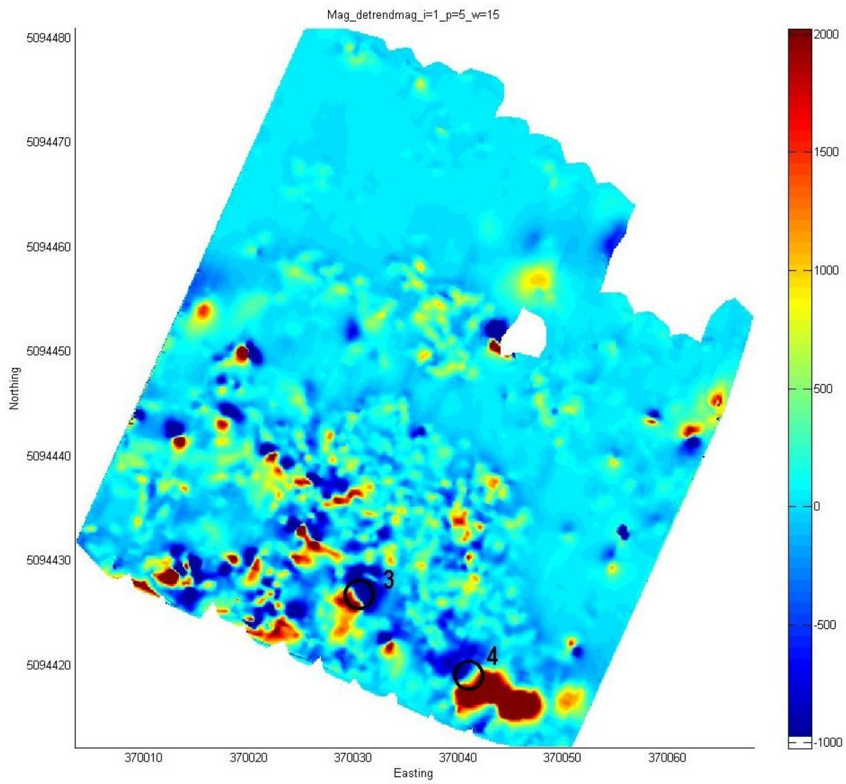


Figure 6: Magnetic contour map of survey grid B0. Units are in nT.

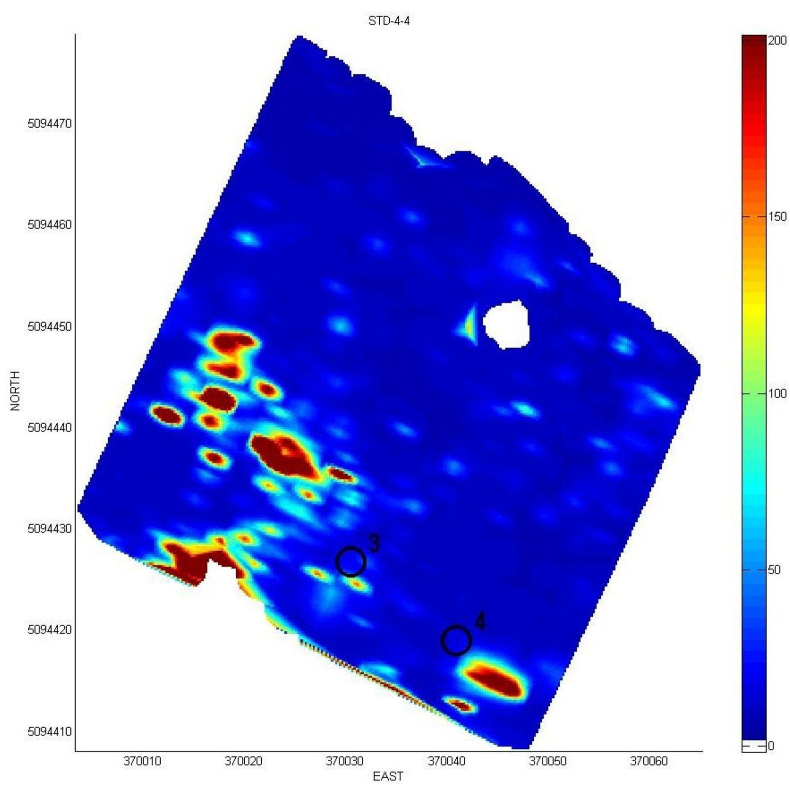


Figure 7: Electromagnetic contour map of survey grid B0. Units are in mV.

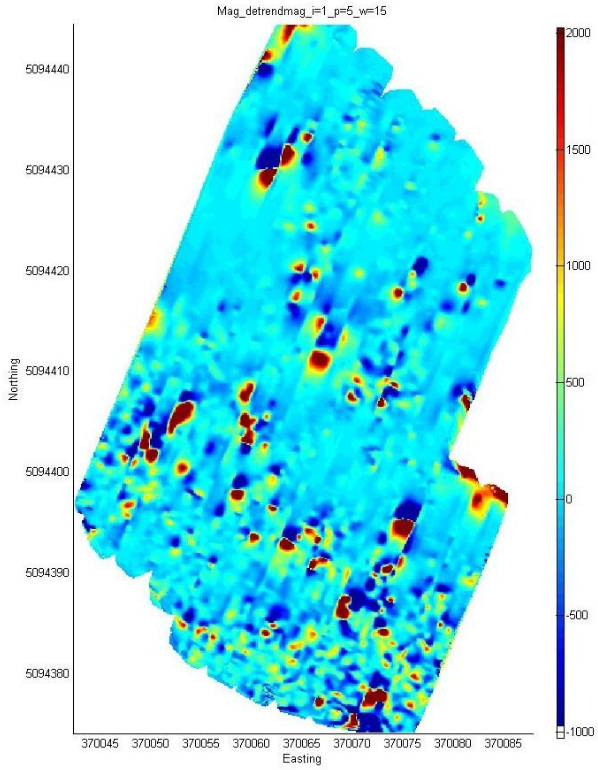


Figure 8: Magnetic contour map of survey grid C0. Units are in nT.

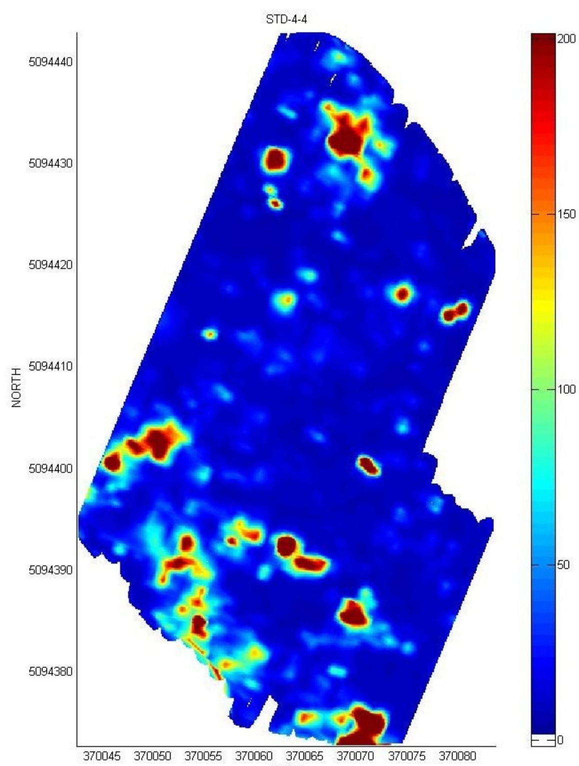


Figure 9: Electromagnetic contour map of survey grid C0. Units are in mV.

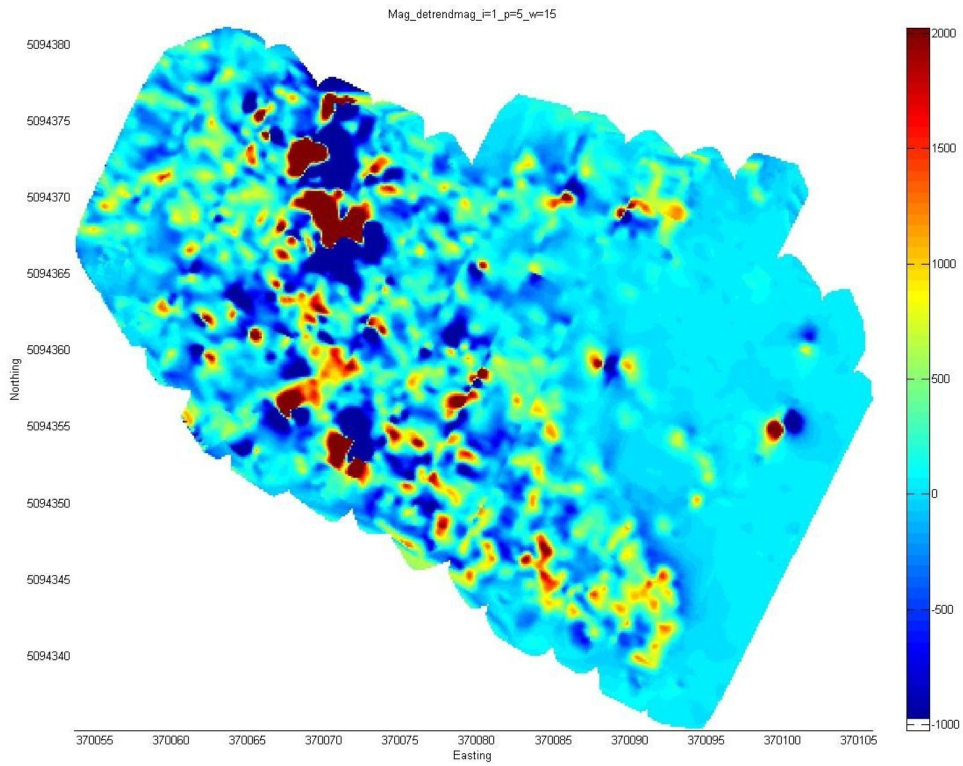


Figure 10: Magnetic contour map of survey grid D0 (no EM data collected). Units are in nT.

Summary

The EM and Mag surveys were sufficient to detect objects with the dimensions of a precipitator dust pan (a steel object greater than 1 cubic meter in size) to a depth of at least 3 to 4 meters bgs. Based on the results of these surveys, there are most likely only four anomaly locations within the area surveyed where a buried precipitator pan might be present. These four anomalies are predicted to be present at depths of at least 1 to 2 meters bgs at locations #1 through #4 identified in Figures 2 and 3 and Table 1.

Appendix 5.5.16-B

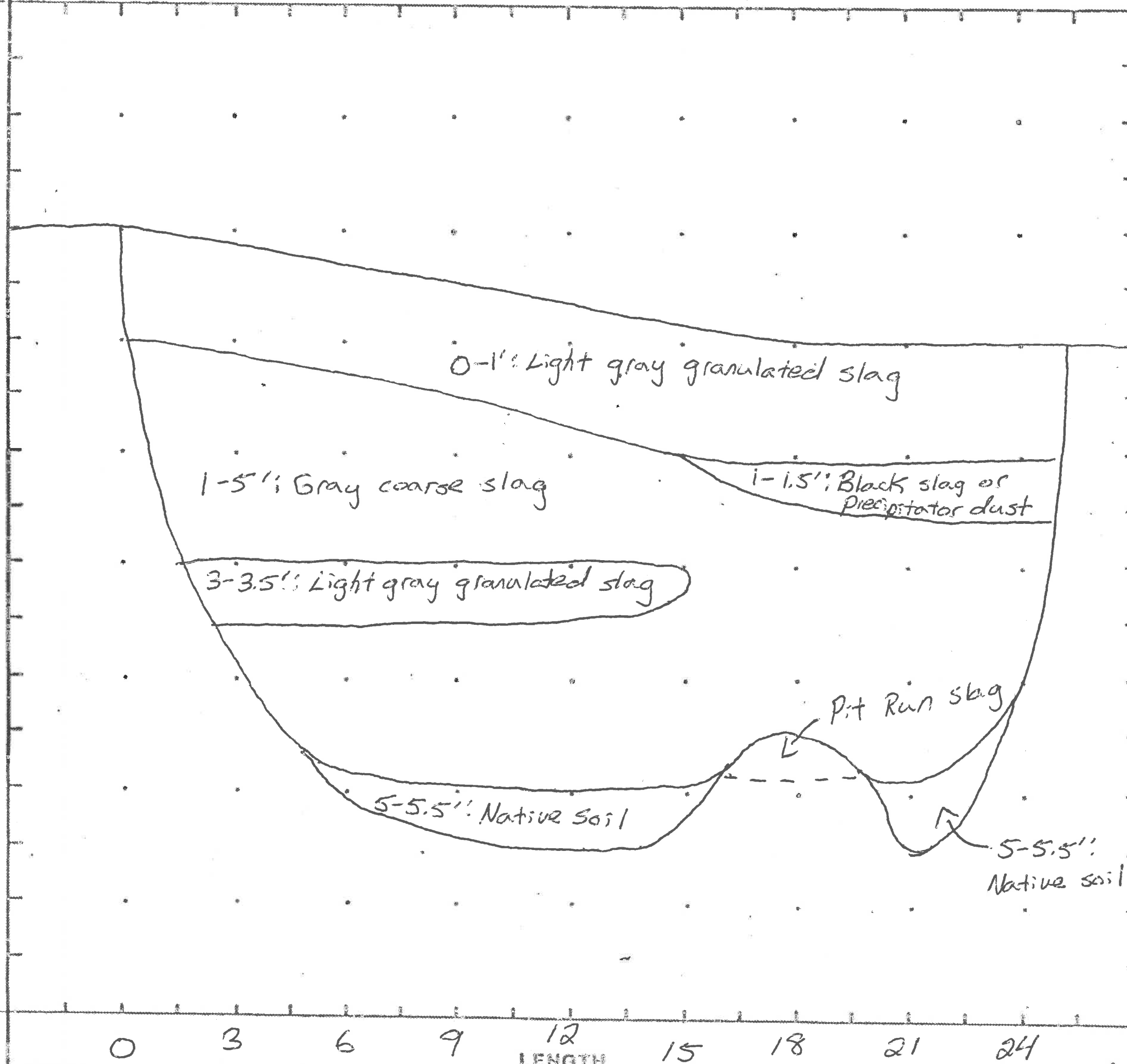
Test Pit Logs

TEST PIT WALL LOG

PROJECT NO. 26460006
TEST PIT NO. SWMU-16 TP-1 SHEET 1 OF 1

PROJECT Rhodia RFI
LOCATION SWMU-16 Precipitator Dust Pens
MAP OF SE WALL OF PIT
ELEVATION N/A
CONTRACTOR MT Reclamation & Landscaping
DATE EXCAVATED 10/3/12
WATER LEVEL AND DATE N/A - Dry
EXCAVATION METHOD Backhoe
LOGGER KAM
APPROXIMATE DIMENSIONS LENGTH 25' WIDTH 3' DEPTH 5-5.5' REMARKS

ELEVATION	DEPTH BELOW SURFACE ( )	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER
	0		
	1		
	2		
	3		
	4		
	5		
	6		



COMMENTS

Soil gas monitoring point is ~2 feet west of south end of the trench.

Black slag is in a black silty sand matrix.

Native soil is yellowish brown sandy silt w/ abundant small roots and very fine-grained sand.

TEST PIT WALL LOG

PROJECT NO. 26460006

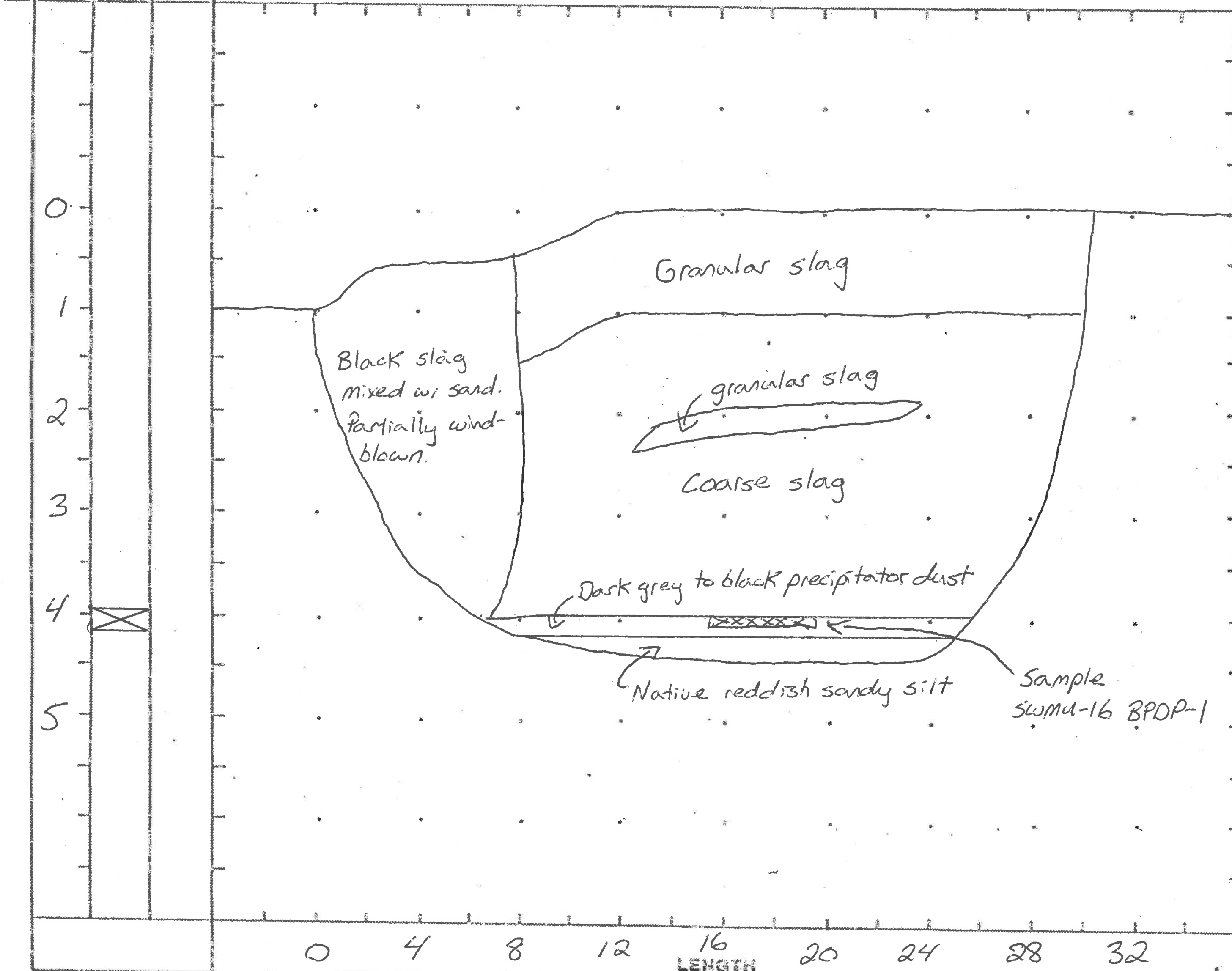
TEST PIT NO. SWMU-16 TP-2 SHEET 1 OF 1

PROJECT Rhodia RFI LOCATION SWMU-16 Precipitator Dust Pans MAP OF SE WALL OF PIT

ELEVATION N/A CONTRACTOR MT Reclamation & Landscaping DATE EXCAVATED 10/3/12

WATER LEVEL AND DATE N/A - Dry EXCAVATION METHOD Backhoe LOGGER KAM

APPROXIMATE DIMENSIONS LENGTH 31 WIDTH 2.5 DEPTH 4.5 REMARKS



COMMENTS

Sample collected at 1310 SWMU-16 BPDP-1 from 3.5 to 4 feet.

PROJECT NO. 26460006

TEST PIT NO. SWMU-16 TP-3 SHEET 1 OF 1

TEST PIT WALL LOG

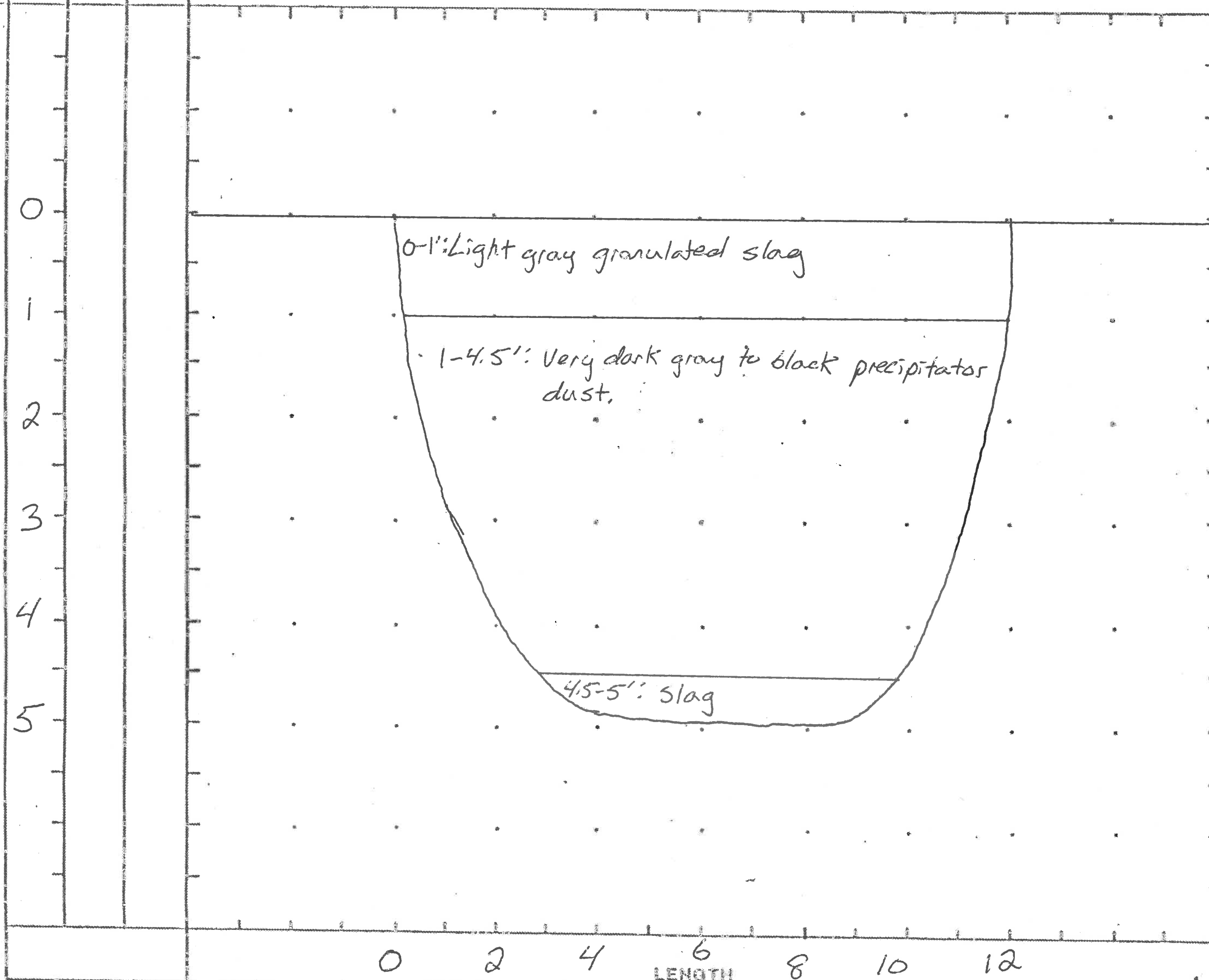
PROJECT Rhodia RFI LOCATION SWMU-16 Precipitator Dust Pons MAP OF SE WALL OF PIT

ELEVATION N/A CONTRACTOR MT Reclamation + Landscaping DATE EXCAVATED 10/3/12

WATER LEVEL AND DATE N/A - Dry EXCAVATION METHOD Backhoe LOGGER KAM

APPROXIMATE DIMENSIONS LENGTH 12' WIDTH 2.5' DEPTH 5' REMARKS

ELEVATION | DEPTH BELOW SURFACE ( ) | SAMPLE: INTERVAL | TYPE AND NUMBER



COMMENTS

Precipitator dust smoked and ignited. Trench was immediately backfilled.

TEST PIT WALL LOG

PROJECT NO. 26460006

TEST PIT NO. SWMU-16 TP-4 SHEET 1 OF 1

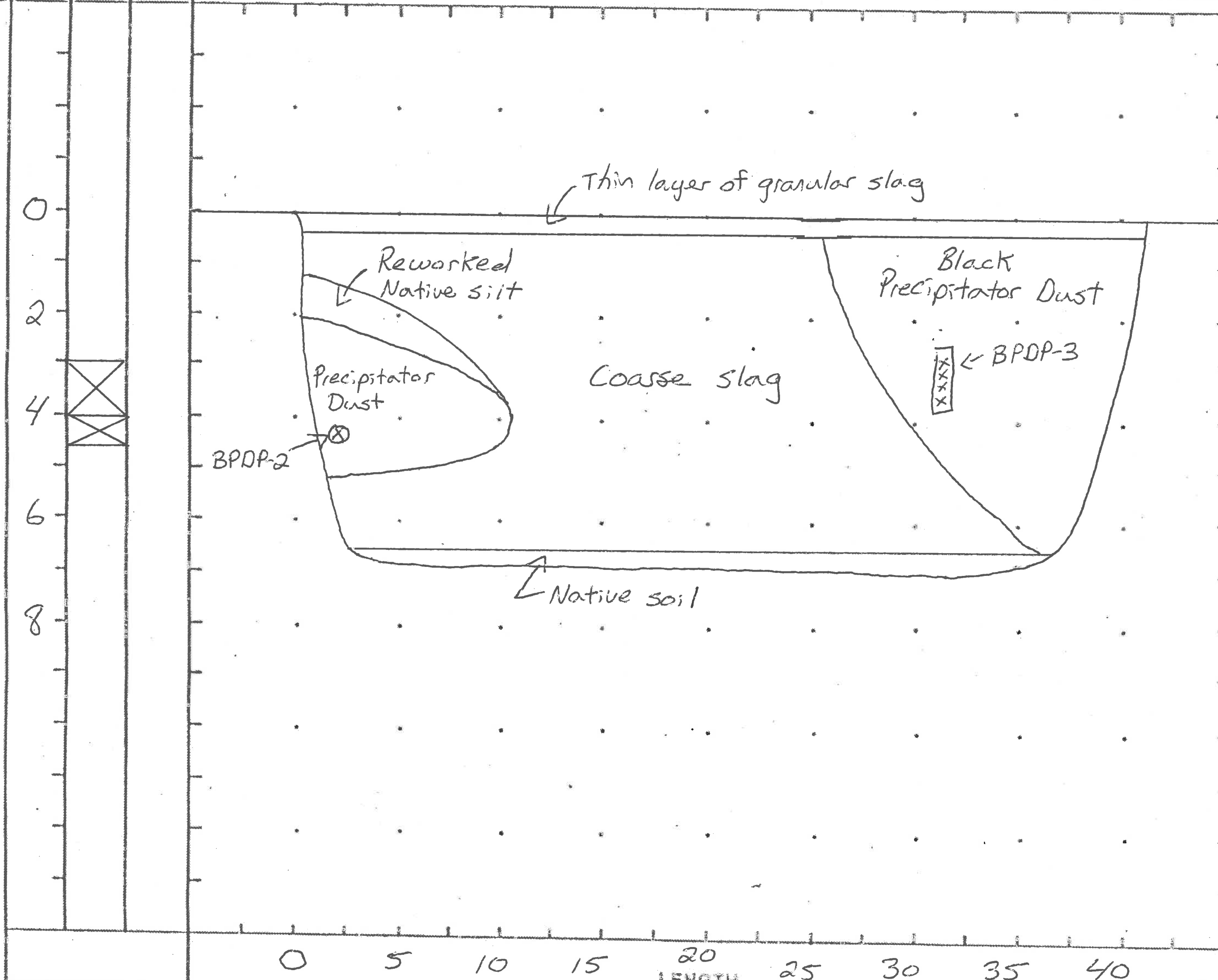
PROJECT Rhodia RFI LOCATION SWMU-16 Precipitator Dust Pans MAP OF SE WALL OF PIT

ELEVATION N/A CONTRACTOR MT Reclamation & Landscaping DATE EXCAVATED 10/3/12

WATER LEVEL AND DATE N/A- Dry EXCAVATION METHOD Backhoe LOGGER KAM

APPROXIMATE DIMENSIONS LENGTH 41' WIDTH 2.5' DEPTH 7' REMARKS

ELEVATION | DEPTH BELOW SURFACE ( ) | SAMPLE: INTERVAL | TYPE AND NUMBER



COMMENTS

No smoking soil noted.

Collected sample at 1350 BPDP-2 (4-4.5)

Collected sample BPDP-100 (4-4.5) for field duplicate

Collected sample at 1445 BPDP-3 (3-4)

Collected sample at 1500 BPDP-120 for field blank