SWMU 12 - Coarse Slag Pile

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5.5.12 SWMU 12 – Coarse Slag Pile

The location of Solid Waste Management Unit (SWMU) 12 is shown on Figure 5.5.12-1a and SWMU 12 monitoring stations and sample locations are provided on Figure 5.5.12-1b. SWMU 12, the Coarse Slag Pile, is located east of the Tailings Basin and Water Recirculation System (SWMU 1), west of the Granulated Slag Pile (SWMU 13), and south of the Precipitator Dust Burial Area (SWMU 15). Placement of material in the present location of the Coarse Slag Pile began in the mid 1960's. Before that period, the coarse slag was stored north of German Gulch Road in Parcel 26 and sold for road construction material and also used as building block material. There are no known underground utilities or underground plant process pipes in the SWMU12 area. High voltage overhead power lines are located just south of the slag pile. The nearest monitoring wells are MW-01-1, located approximately 150 feet northeast, and MW097-5, located 350 feet southeast of the SWMU.

Slag is an inert rock-like material formed in the phosphorus production furnace from the minerals in the nodulized phosphate ore, silica and coke feedstocks. Slag (primarily calcium silicate) was drawn off the furnace as a liquid through the flush hole in the furnace. This molten material was cooled (i.e., solidified) via water emersion in the slag pit. The solidified slag was periodically excavated from the slag pits and placed in the Coarse Slag Pile (*see* Figure 5.5.12-1b). The Coarse Slag Pile contains approximately 10 million cubic yards of coarse slag. Furnace dig out materials, including used carbon furnace bricks and blocks, refractory bricks, carbon floor logs, and furnace concrete roofs were buried in the Coarse Slag Pile along with used kiln bricks, and miscellaneous construction debris and garbage. The used furnace carbon and refractory bricks, used carbon blocks, floor logs, concrete roofs and dig out materials were contaminated with elemental phosphorus. However, it is believed that the bricks, carbon blocks, dig out material, and construction debris comprise far less than 1% of the total material in the Coarse Slag Pile.

From the mid-1980's until the end of furnace operations in 1995, approximately 50 percent of the slag was granulated with a high pressure water spray to a sand particle size and stockpiled separately at the Granulated Slag Pile (*see* Section 5.5.13 - SWMU 13). Coarse and granulated slag are composed of the same material and have the same chemical characteristics. Typical total slag production was approximately 200,000 tons/year.

Phosphate ore contains naturally occurring radioactive materials (NORM), which are retained in the slag after the ore is processed. The radioactivity of phosphate ore is almost exclusively due to trace levels of uranium and its decay products (Lloyd, 1983). The uranium-238 decay chain sequence is shown in Table 5.5.12-1.

Phosphate slag typically contains concentrations of certain metals above background/reference area soil concentrations. The Agency for Toxic Substances and Disease Registry (ATSDR) found that the metals concentrations in phosphate slag are not likely to represent a public health hazard (*see* Appendix 5.5.12-A).

5.5.12.1 Prior Investigations

Three studies have been completed that address radioactivity of phosphate slag and other materials at the Silver Bow Plant:

- *Emissions of Naturally Occurring Radioactivity*, Stauffer Elemental Phosphorus Plant by U.S. EPA – Office of Radiation Programs (*see* Appendix 1-H)

- *Evaluation of Radon Sources and Phosphate Slag in Butte, Montana*, by Montana Department of Health and Environmental Sciences (*see* Appendix 1-I)

- *Radiological Assessment, Rhône-Poulenc Silver Bow Plant* by Secor-Trec Inc. (*see* Appendix 1-G)

These studies confirm that slag is not a significant source of radon; however, gamma radiation exposure rates were significant at the slag piles when compared to background exposure rates. Samples of slag showed similar levels of radionuclides compared to the ore, except for a significant reduction in lead-210 and polonium-210 concentrations (Table 5.5.12-2). These data indicate that the lead-210 and polonium-210 were lost during the beneficiation and the thermal reduction processes within the kiln and the furnace (Andrews and Bibb, 1982). The typical concentrations for these radionuclides in slag samples are summarized below:

Radionuclide	Typical Concentration
Pb-210	1 pCi/g
Ra-226	28 pCi/g
Th-230	47 pCi/g
U-234	24 pCi/g
U-238	24 pCi/g

The report entitled *Radiological Assessment, Rhône-Poulenc Silver Bow Plant* included a field gamma radiation survey and analyses of site materials and background/reference samples to evaluate radionuclide concentrations. The average gamma exposure rate for each area evaluated in the field survey is depicted on Figure 5.5.12-2. Gamma exposure rates from the slag pile were highest with an average gamma radiation rate of 145 micro-Roentgens per hour (µR/Hr). Additionally, those areas that contained some slag showed higher average gamma radiation exposure rates than facility soils that did not contain slag. Background/reference samples had typical exposure rates for soil with average measurements of 19 µR/Hr.

OSHA standards (29 CFR 1910.1096) regulate the ionizing (i.e., gamma) radiation exposure of industrial/commercial worker at 3 Roentgen-equivalent-man per quarter (rem/qtr). A worker at the slag pile for the entire quarter (i.e., 40 hours per week, 13 weeks per quarter) would be exposed to 0.045 rem/qtr[1]. This exposure rate is 67 times less than the OSHA limit. However, a site specific risk assessment will be needed to evaluate potential risk associated with exposure to radiation from the Coarse Slag Pile.

Available analytical data for coarse slag samples include:

- Extraction procedure toxicity method (EPTOX) – metals
- General and Site-specific parameters (total and ASTM water leach)
- Metals (total and ASTM water leach)
- Radionuclides (total and ASTM water leach)

Coarse slag data from SWMU 12 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

[1] Note: calculation assumes that 1 µR = 0.6 µrem, See Appendix EE of the CCRA: Review By Senes Consultants Limited.

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).

EPTOX data demonstrates that coarse slag does not leach metals at concentrations that were considered hazardous (*see* Table 5.5.12-3). Fluoride, several metals and certain radionuclides are present in coarse slag at concentrations above the background/reference area soil concentrations (*see* Table 5.5.12-4 through 5.5.12-6 and Figures 5.5.12-3 through 5.5.12-5). Metals and radionuclides were not detected in the ASTM D3987 leach test (*see* Table 5.5.12-7). Fluoride, calcium, potassium and phosphorus were detected in the ASTM leachate.

5.5.12.2 RFI Investigation Activities

The Phase 1 RFI Work Plan concluded that the previous reports and analytical database were sufficient to characterize the nature of the coarse slag material, with the exception of the leaching potential. To further characterize the leaching potential of the coarse slag material, leachate analyses was conducted on two composite coarse slag samples using EPA Method 1312 – Synthetic Precipitation Leaching Procedure (SPLP). Each composite sample was composed of 5 subsamples that were collected as described in the Field Sampling Plan. Sample locations were near the perimeter of the pile (i.e. toe of the slope of the pile) because slag at the center and top of pile was too coarse to sample. The location of each subsample and the centroid of the composite subsample locations are shown on Figure 5.5.12-1b. The resulting leachate from the submitted samples was analyzed for site-specific parameters, general parameters, metals, and radionuclides.

5.5.12.3 RFI Investigation Results

The objective of the RFI work for SWMU 12 was to further characterize the leaching potential of the coarse slag material. Two five-point composite samples of coarse slag (CSP-01 and CSP-02) were analyzed according to the Synthetic Precipitation Leaching Procedure (SPLP) and the leachate was analyzed for elemental phosphorus, fluoride, metals and radionuclides. The analytical results are summarized in Tables 5.5.12-8, 5.5.12-9, and 5.5.12-10 for the general and site-specific parameters, metals and radionuclides, respectively. Fluoride and total phosphorus are the only general and site-specific parameters detected in the leachate (Table 5.5.12-8). Elemental phosphorus was not detected (DL = 0.000023 ug/L) in the leachate. The only constituents detected in the leachate were arsenic, calcium, magnesium, potassium, selenium, and uranium and vanadium (*see* Table 5.5.12-9).

Although radium 226 is present at about 28 pCi/g in the slag, it was not detected in the SPLP leachate. Gross alpha was detected at 3.6 pCi/L in the leachate (*see* Table 5.5.12-10).

5.5.12.4 Conclusions

- Slag is an inert rock-like material formed from the minerals in the nodulized phosphate ore, silica, and coke feedstocks in the phosphorus production furnace. Slag consists primarily of calcium silicate and is generally of cobble size.

- The Coarse Slag Pile contains approximately 10 million cubic yards of slag. Furnace dig out materials, used kiln bricks, miscellaneous construction debris and garbage are buried in the slag pile. The furnace dig out materials, including used furnace carbon bricks and blocks, carbon floor logs, refractory bricks and concrete furnace roofs are contaminated with elemental phosphorus. It is believed that the furnace dig out material, used kiln bricks, construction debris and garbage comprise far less than 1% of the total material in the slag piles.

- Phosphate ore contains naturally occurring radioactive materials (NORM), which are retained in the slag after the ore is processed. The radioactivity of phosphate ore is almost exclusively due to trace levels of uranium and its decay products (Lloyd, 1983). As shown on the U-238 decay chain sequence, the long lasting radionuclides at U-238, U-234, Th-230, Ra-226, and Pb-210. Although these radionuclides are present in the slag above background/reference concentrations, and gamma exposure rates from the slag pile were higher than for facility soils that did not contain slag, exposure rates are estimated to be below the OSHA limit.

- Although certain metals are present in the slag at concentrations above the background/reference area concentrations, the metals concentrations are not likely to represent a public health hazard (*see* Appendix 5.5.12-A).

  Fluoride is the only parameter detected in the SPLP leachate at a concentration above its maximum contaminant level for drinking water.

- 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.

- Rhodia will prepare a technical memorandum that summarizes the investigation activities that have evaluated the potential for downward migration (e.g., leaching) of radionuclides from slag. The technical memorandum will be submitted to EPA on or before May 22, 2013.

5.5.12.5 References

Andrews, V.E., and T. Bibb. November 1982. Emissions of Naturally Occurring Radioactivity, Stauffer Elemental Phosphorus Facility. Office of Radiation Programs-EPA Las Vegas, Nevada Facility.

ATSDR 2009. Public Health Assessment Addendum, Stauffer Chemical Company (Tarpon Springs, Pinellas County, Florida. http://www.atsdr.cdc.gov/hac/pha/PHA.asp?docid=230&pg=1. Page last updated: October 27, 2009.

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.

Tables

Table 5.5.12.1

Uranium-238 Decay Chain

Radioactive Elements	Half-Life
Uranium-238	4.5 x 10^9 years
↓ α	
Thorium-234	24 days
↓ β, γ	
Proactinium-234	6.75 hours
↓ β, γ	
Uranium-234	2.5 x 10^5 years
↓ α, γ	
Thorium-230	8 x 10^4 years
↓ α, γ	
Radium-226	1620 years
↓ α, γ	
Radon-222	3.8 days
↓ α, γ	
Polonium-218	3 minutes
↓ α	
Lead-214	27 minutes
↓ β, γ	
Bismuth-214	19.7 minutes
↓ β, γ	
Polonium-214	1.6 x 10^{-4} seconds
↓ α, γ	
Lead-210	22 years
↓ β, γ	
Bismuth-210	5 days
↓ β	
Polonium-210	138 days
↓ α, γ	
Lead-206	Stable

α - Emission of alpha particle

β - Emission of beta particle

γ - Emission of gamma radiation

Table 5.5.12-2

Site Materials Analytical Data - Radionuclides
Rhodia Silver Bow Plant

Material	U-238 [pCi/g]	U-234 [pCi/g]	Th-230 [pCi/g]	Ra-226 [pCi/g]	Pb-210 [pCi/g]	Po-210 [pCi/g]	Th-232 [pCi/g]	Th-228 [pCi/g]
Raw Materials								
Phosphate Ore	27 ± 2	26 ± 2	39 ± 6	26 ± 5	38 ± 1	36 ± 2	0.26 ± 2	0.52 ± 2
Nodules	26 ± 2	26 ± 2	51 ± 11	21 ± 6	22 ± 2	2.7 ± 3.9	0.06 ± 0.13	0.06 ± 0.13
Coke	0.24 ± 0.10	0.31 ± 0.12	0.31 ± 0.29	0.11 ± 0.03	0.52 ± 0.76	0.3 ± 2.8	0.06 ± 0.13	0.06 ± 0.13
Silica	0.14 ± 0.07	0.24 ± 0.09	0.48 ± 0.31	0.18 ± 0.05	0.55 ± 0.78	-0.3 ± 2.7	0.04 ± 0.09	0.04 ± 0.09
Processed Materials								
Ferrophosphorus	11 ± 2	8.6 ± 1.9	0.51 ± 0.29	0.37 ± 0.08	0.73 ± 0.96	-0.2 ± 1.9	0.08 ± 0.11	0.08 ± 0.11
Fresh Slag	26 ± 2	26 ± 2	50 ± 10	30 ± 6	-0.4 ± 1.0	0.9 ± 2.1	0.93 ± 0.38	0.25 ± 0.13
Aged Slag	24 ± 1	24 ± 1	45 ± 7	27 ± 4	1.8 ± 0.6	2.7 ± 2.3	0.39 ± 0.14	0.62 ± 0.26

Table 5.5.12-3

Coarse Slag Analytical Data - EPTOX Metals
Rhodia Silver Bow Plant

Station ID	Slag		
Sample Date	11/4/1980		
Sample ID	Pit Run Slag		
Lab Name	Ford		
Lab ID	80-001430		
Report	Material Charac		
Arsenic, EPTOX	0.35		mg/L
Barium, EPTOX	58.9		mg/L
Cadmium, EPTOX	0.116		mg/L
Chromium, EPTOX	0.52		mg/L
Lead, EPTOX	0.31		mg/L
Mercury, EPTOX	0.0002	U	mg/L
Selenium, EPTOX	0.02		mg/L
Silver, EPTOX	0.001	U	mg/L

Table 5.5.12-4
Coarse Slag Data - General and Site-Specific Parameters
SWMU 12
Rhodia Silver Bow Plant
[concentrations in mg/kg]

		Chemical Name	Fluoride	Orthophosphate as P	Phosphorus, total
		Background Mean, Exceedances **Bold**	**4.1**		
		Background Maximum, Exceedances Underline	37		
		Background 95% UCL, Exceedances *Italic*	*7.6*		
Location ID	**Sample Date**	**Sample Type**			
ESI-CSP-1	7/21/2003	N	***240***	2.6	12000 J

Table 5.5.12-5
Coarse Slag Data - Metals
SWMU 12
Rhodia Silver Bow Plant
[concentrations in mg/kg]

		Chemical Name	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
		Analysis Location	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	Lab	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	**41**	**59**
Background Maximum, Exceedances Underline				3.9	120	290	1.3	8.9	14000	48	9.5	300	35300	190	5700	1100	0.20	21	5300	0.70	1.7 (1)	620	1.0	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	*43*	*98*
Location ID	Sample Date	Sample Type																							
ESI-CSP-1	7/21/2003	N	16000	***5.2 J***	8.4	129	***2.1***	***28.4***	***279000***	***271***	2.4 J	***66.8***	3290	2.9	3430	88.2	< 0.10	***40.6***	***5550***	***2.7 J***	< 2.0	***2670***	< 4.9	***360***	***355***

Table 5.5.12-6
Coarse Slag Data - Radionuclides
SWMU 12
Rhodia Silver Bow Plant
[concentrations in pCi/g]

		Chemical Name	Bismuth 214	Cesium 137	Gross Alpha (radiation)	Gross Beta (radiation)	Lead 210	Lead 212	Lead 214	Potassium 40	Protactinium-234	Radium 223	Radium 226	Thorium 227	Thorium 232	Thorium 234	Uranium 238
Background Mean, Exceedances **Bold**													**3.6**				**0.78**
Background Maximum, Exceedances Underline													12				2.7
Background 95% UCL, Exceedances *Italic*													*5.0*				*1.6*
Location ID	**Sample Date**	**Sample Type**															
CSL1	01/01/1999	N	--	--	--	--	--	--	--	--	--	--	***40 +/- 0.94***	--	0.92 +/- 0.91	--	***64 +/- 33.00***
CSL2	01/01/1999	N	--	--	--	--	--	--	--	--	--	--	***39 +/- 0.86***	--	< 0.46	--	***22 +/- 32.00***
DS2	01/01/1999	N	--	--	--	--	--	--	--	--	--	--	1.5 +/- 0.57	--	1.8 +/- 1.10	--	***67 +/- 37.00***
DS3	01/01/1999	N	--	--	--	--	--	--	--	--	--	--	3.6 +/- 0.47	--	5 +/- 0.86	--	< 13
ESI-CSP-1	07/21/2003	N	39.9 +/- 3.18	< 0.153	149 +/- 12.0 J	94.2 +/- 8.38 J	5.77 +/- 2.40	0.579 +/- 0.185	42.3 +/- 4.16	5.80 +/- 1.18	39.6 +/- 11.2	8.01 +/- 1.99	***32.1 +/- 1.76***	4.22 +/- 1.78	--	36.9 +/- 4.01	--

Table 5.5.12-7

Slag Analytical Data - ASTM Leachate
Rhodia Silver Bow Plant

Station ID	Slag-1	
Sample Date	10/14/1997	
Sample ID	Slag-1	
Lab Name	Energy	
Lab ID	97-63416	
Report	Voluntary Clean	
Aluminum, ASTM	0.1 U	mg/l
Antimony, ASTM	0.05 U	mg/l
Arsenic, ASTM	0.005 U	mg/l
Barium, ASTM	0.1 U	mg/l
Beryllium, ASTM	0.001 U	mg/l
Cadmium, ASTM	0.001 U	mg/l
Chromium, ASTM	0.01 U	mg/l
Cobalt, ASTM	0.01 U	mg/l
Copper, ASTM	0.01 U	mg/l
Iron, ASTM	0.03 U	mg/l
Lead, ASTM	0.01 U	mg/l
Manganese, ASTM	0.01 U	mg/l
Mercury, ASTM	0.001 U	mg/l
Nickel, ASTM	0.01 U	mg/l
Selenium, ASTM	0.005 U	mg/l
Silver, ASTM	0.005 U	mg/l
Thallium, ASTM	0.1 U	mg/l
Vanadium, ASTM	0.1 U	mg/l
Zinc, ASTM	0.01 U	mg/l
Calcium, ASTM	20	mg/l
Magnesium, ASTM	1 U	mg/l
Sodium, ASTM	1 U	mg/l
Potassium, ASTM	2	mg/l
Chloride, ASTM	1 U	mg/l
Fluoride, ASTM	4.61	mg/l
Phosphorus, ASTM	1.43	mg/l
Sulfate, ASTM	1 U	mg/l
Gross Alpha, ASTM	1 U	pCi/l
Radium-226, ASTM	0.2 U	pCi/l
Radium-228, ASTM	1 U	pCi/l
Uranium, ASTM	0.0003 U	mg/l
Strontium, ASTM	2 U	pCi/l
Alkalinity, Total, ASTM	40	mg/l
Nitrate, ASTM	0.05 U	mg/l
Nitrite, ASTM	0.05 U	mg/l
Total Dissolved Solids, ASTM	113	mg/l

Table 5.5.12-8
Coarse Slag Data - SPLP General and Site-Specific Parameters
SMWU 12
Rhodia Silver Bow Plant
[concentrations in mg/l]

		Chemical Name	Chloride	Fluoride	Phosphorus, elemental (white)	Phosphorus, total	Sodium	Sulfate
Location ID	Sample Date	Sample Type						
Slag-1	10/14/1997	N	< 1	**4.61**	--	**1.43**	< 1	< 1
CSP-01	05/28/2009	N	--	**5.0**	< 0.000023	**0.09**	< 0.52	--
CSP-02	05/28/2009	N	--	**4.5**	< 0.000023	**0.19**	< 0.45	--

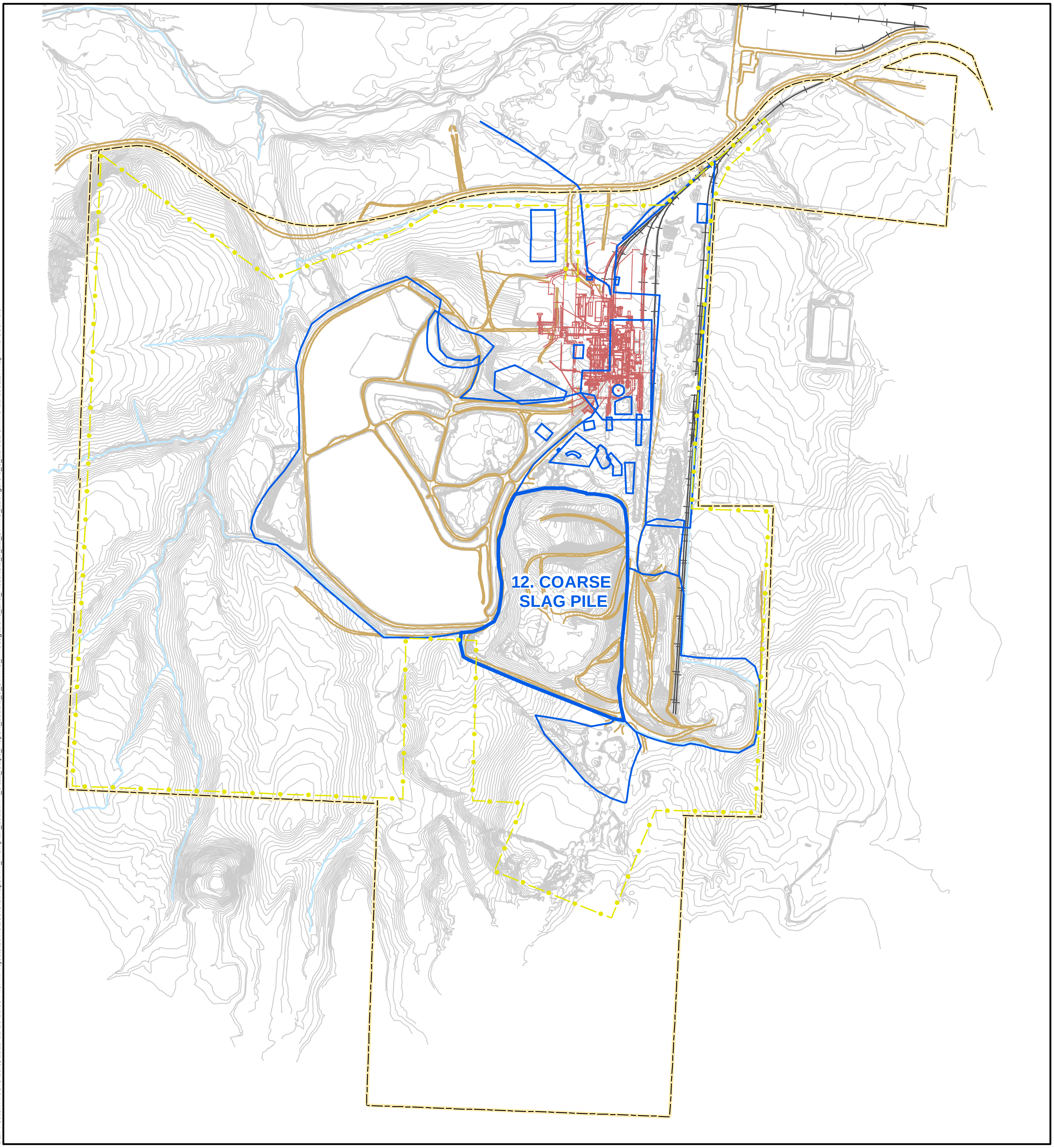
Table 5.5.12-9
Coarse Slag Data - SPLP Metals
SWMU 12
Rhodia Silver Bow Plant
[concentrations in mg/l]

		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	Thallium Lab	Uranium Lab	Vanadium Lab	Zinc Lab
Location ID	Sample Date	Sample Type																						
Slag-1	10/14/1997	N	< 0.05	< 0.005	<0.1	< 0.001	< 0.001	**20**	<0.01	< 0.01	< 0.01	< 0.03	< 0.01	< 1	<0.01	<0.001	< 0.01	**2**	< 0.005	< 0.005	< 0.1	< 0.0003	< 0.1	< 0.01
CSP-01	05/28/2009	N	< 0.010	**0.0012**	< 0.270	< 0.0002	< 0.0005	**18.5**	< 0.002	< 0.0010	< 0.006	< 0.01	< 0.01	**0.315**	**0.0008**	< 0.0010	< 0.002	**0.5**	**0.0010**	< 0.002	< 0.010	**0.00150**	**0.012**	--
CSP-02	05/28/2009	N	< 0.010	**0.0013**	< 0.031	< 0.0002	< 0.0005	**22.4**	< 0.002	< 0.0010	< 0.004	< 0.01	< 0.01	**0.264**	< 0.0006	< 0.0010	< 0.002	**0.30**	**0.0010**	< 0.002	< 0.010	**0.00370**	**0.015**	--

Table 5.5.12-10
Coarse Slag Data - SPLP Radionuclides
SWMU 12
Rhodia Silver Bow Plant
[concentrations in pCi/l]

		Chemical Name	Gross Alpha (radiation)	Gross Beta (radiation)	Radium 226	Radium 228
Location ID	**Sample Date**	**Sample Type**				
Slag-1	10/14/1997	N	< 1	--	< 0.2	< 1
CSP-01	05/28/2009	N	**3.3 +/- 2.1**	< 4	< 1.1	< 3
CSP-02	05/28/2009	N	**3.6 +/- 2.2**	< 4	< 1.1	< 3

Figures



Barr Footer: ArcGIS 10.0, 2012-12-10 16:35 File: I:\Projects\26\46\006\Gis\Maps\RFI_Workplan_2012\RFI_Data_Gaps_Report_2012\5_5_SWMU_Investigations_and_Results\5_5_12_SWMU_12\Figure 5_5_12-01a SWMU 12 Locator Map.mxd User: cls

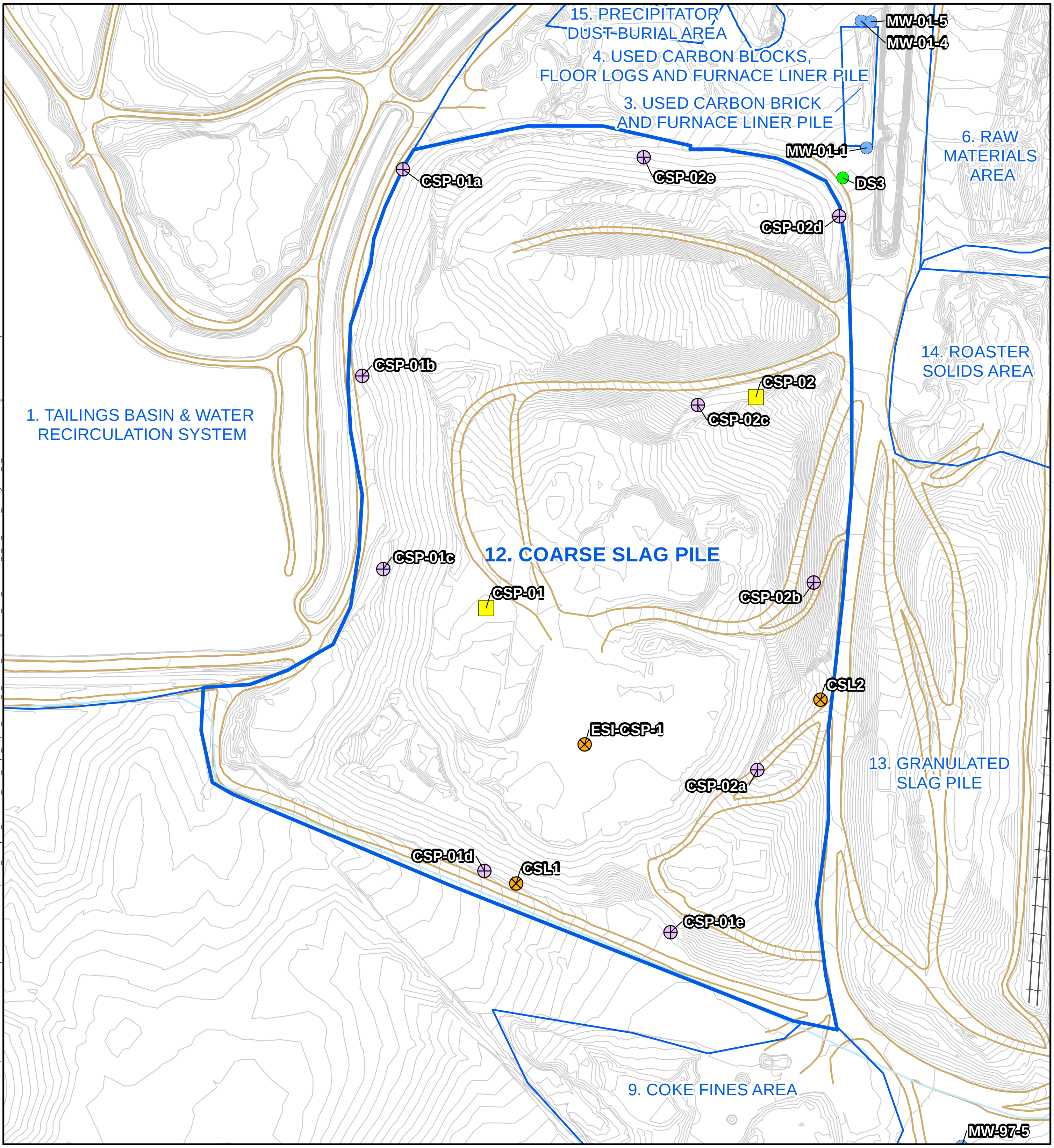
SWMU 12
Other SWMUs
Elevation Contour
Drainage
Railroad
Road
Former Plant Structures
Property Boundary
Fence Line

N

Feet
1,000 0 1,000

Figure 5.5.12-1a

SWMU 12 LOCATION
Rhodia Silver Bow Plant
Montana



Monitoring Well
Soil Sample
Slag Sample
Composite Sample Centroid Location
Slag Subsample (2009)
SWMU 12
Other SWMUs

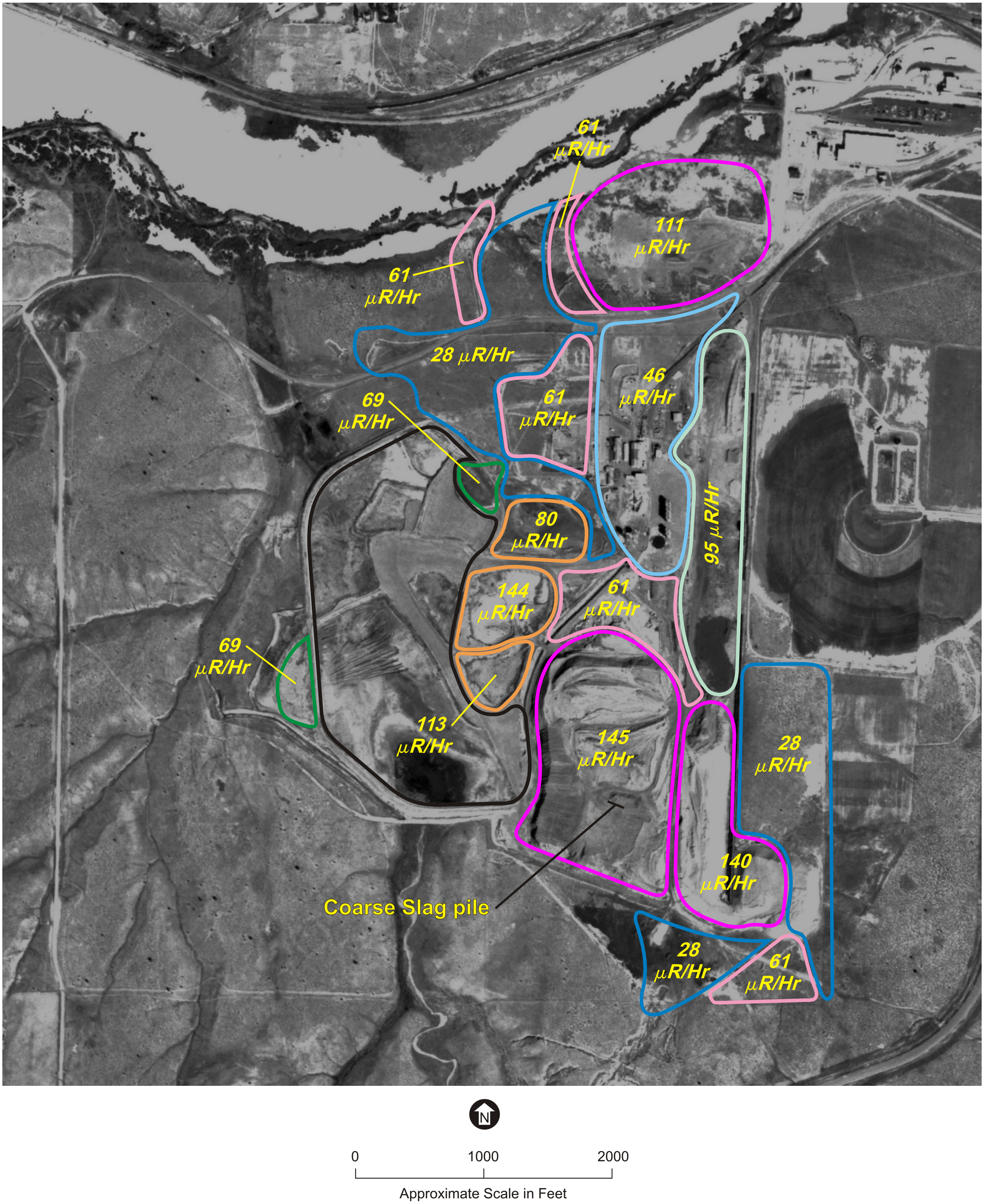
Former Plant Structures
Elevation Contour
Drainage
Railroad
Road

N

Feet
300 0 300

Figure 5.5.12-1b

SWMU 12
MONITORING STATIONS AND SAMPLE LOCATIONS
Rhodia Silver Bow Plant
Montana



P:\Mpls\26 MT46\26\46006\WorkFiles\Figures_Graphics\Gamma radiation Exposure Rates Coarse.CDE RLG 06-18-12

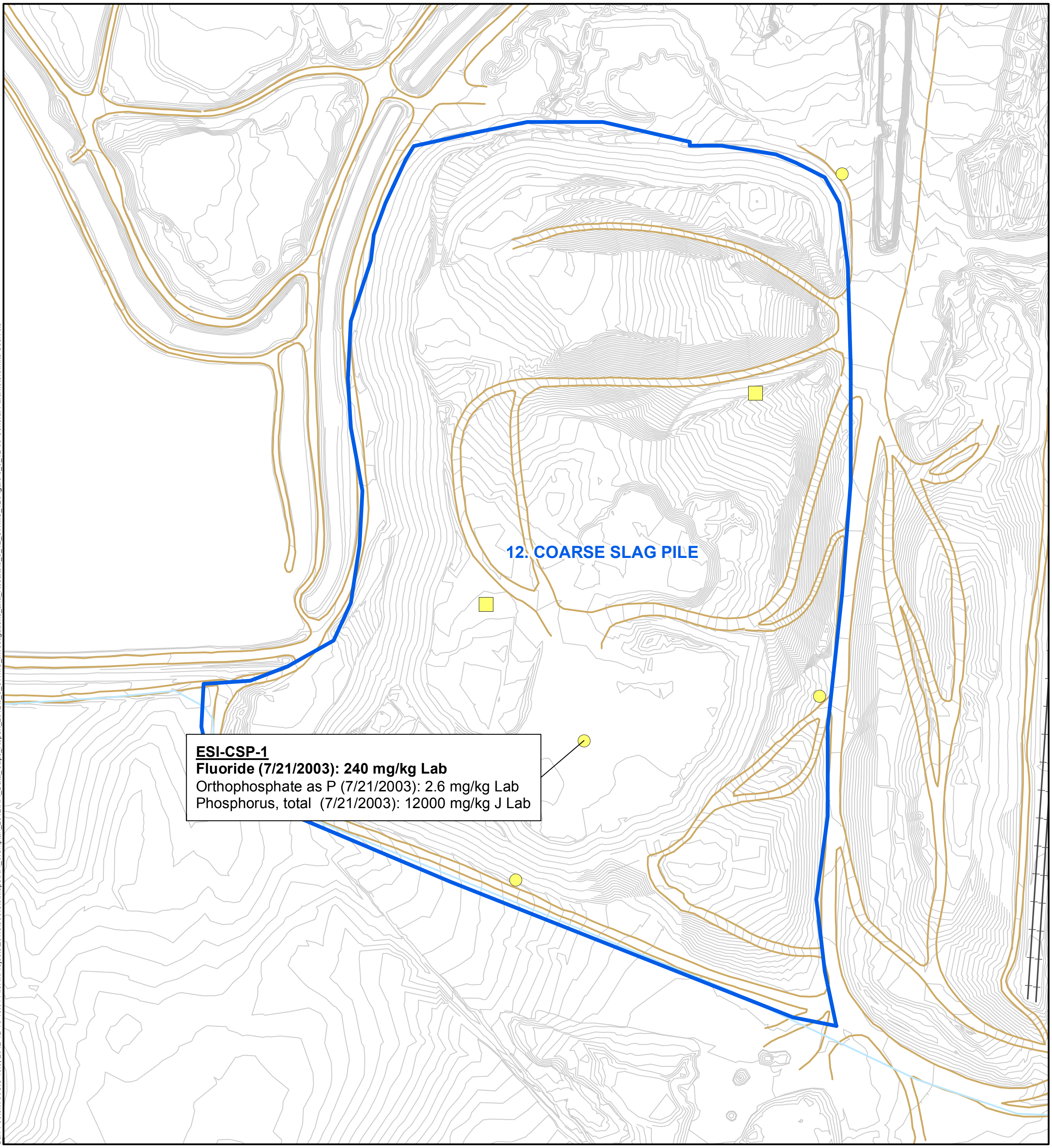
LEGEND

28 μR/Hr — Average Gamma Radiation Exposure Rates (microroentgens per hour) for Survey Area

Background Gamma Radiation Exposure Rates - 19 μR/Hr

Figure 5.5.12-2

GAMMA RADIATION EXPOSURE RATES
Rhodia Silver Bow Plant
Montana



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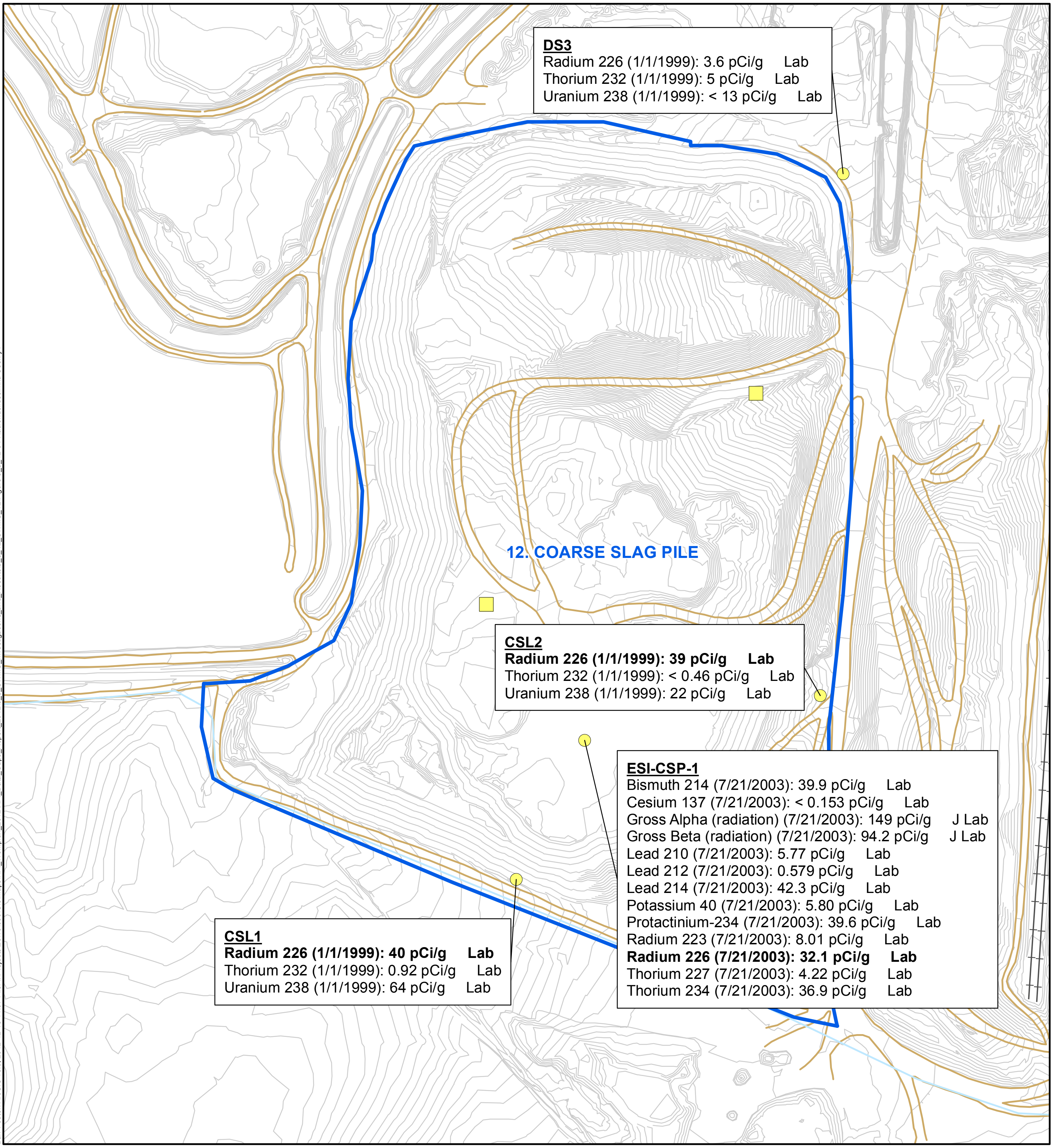
Sample Location
Composite Sample Centroid Location
SWMU 12
Elevation Contour
Drainage
Railroad
Road
Former Plant Structures

Feet
300 0 300

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

Figure 5.5.12-3

SWMU 12
GENERAL PARAMETERS
Rhodia Silver Bow Plant
Montana



Barr Footer: ArcGIS 10.0, 2012-12-18 14:07 File: I:\Projects\26\46\1006\GisMaps\RFI_Workplan_2012\RFI_Data_Gaps_Report_2012\5_5_SWMU_Investigations_and_Results\5_5_12_SWMU_12\Figure 5_5_12-04 Radionuclides.mxd User: jrv

Sample Location
Composite Sample Centroid Location
SWMU 12
Elevation Contour
Drainage
Railroad
Road
Former Plant Structures

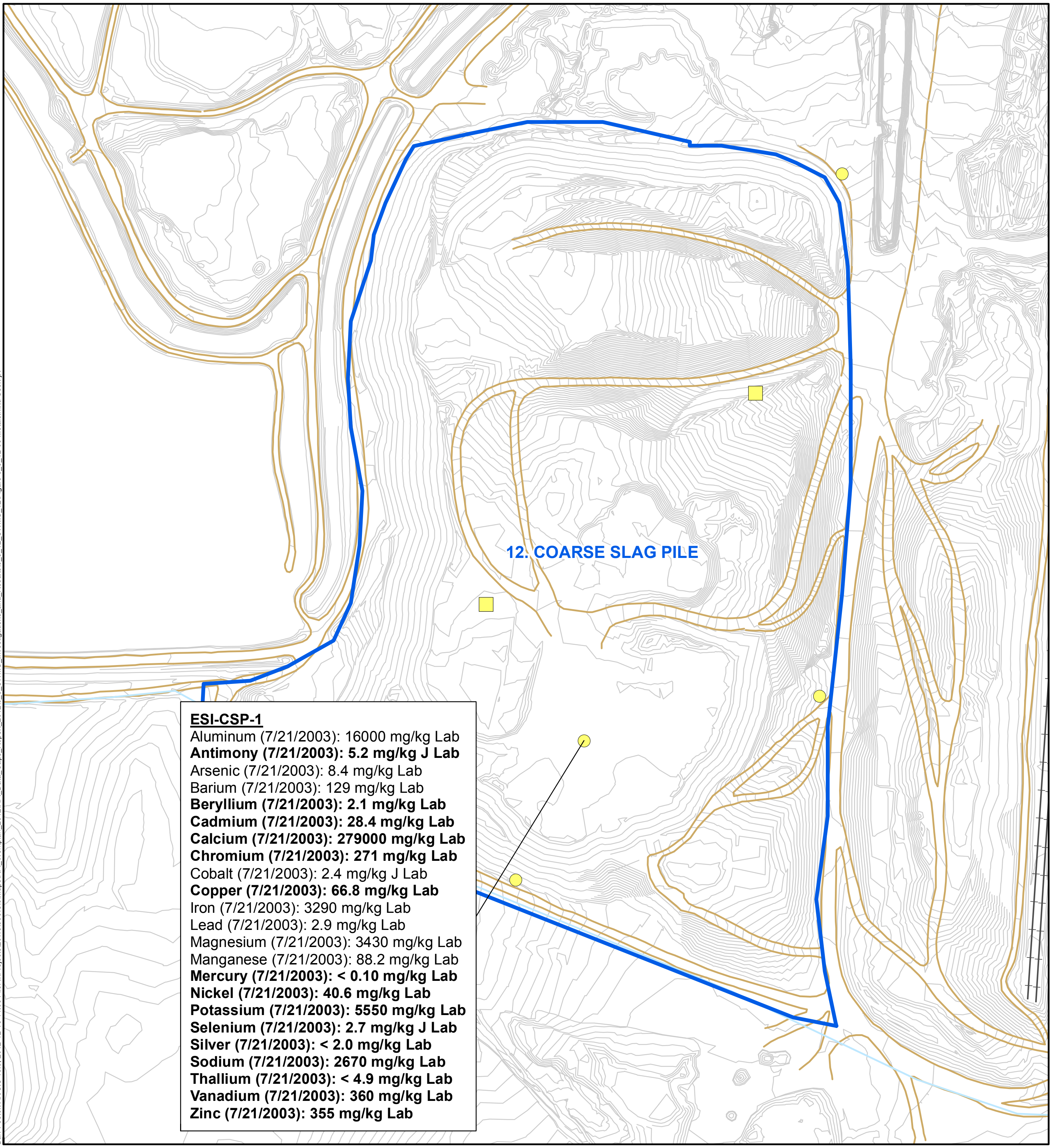
N

Feet
300 0 300

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

Figure 5.5.12-4

SWMU 12
RADIONUCLIDES
Rhodia Silver Bow Plant
Montana



Barr Footer: ArcGIS 10.0, 2012-12-18 14:08 File: I:\Projects\26\46\1006\Gis\Maps\RFI_Workplan_2012\RFI_Data_Gaps_Report_2012\5_5_SWMU_Investigations_and_Results\5_12_SWMU_12\Figure 5_5_12-05 Metals.mxd User: jrv

Sample Location
Composite Sample Centroid Location
SWMU 12
Elevation Contour
Drainage
Railroad
Road
Former Plant Structures

N

Feet
300 0 300

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

Figure 5.5.12-5

SWMU 12
METALS
Rhodia Silver Bow Plant
Montana

Appendix 5.5.12-A

Public Health Assessment Addendum, Stauffer Chemical Company (Tarpon Springs, Florida

Agency for Toxic Substances & Disease Registry Public Health Assessments & Health Consultations

PUBLIC HEALTH ASSESSMENT ADDENDUM

STAUFFER CHEMICAL COMPANY (TARPON SPRINGS)
TARPON SPRINGS, PINELLAS COUNTY, FLORIDA

SUMMARY

From 1947 to 1981, the Stauffer Chemical Company in Tarpon Springs, Florida, made elemental phosphorus from phosphate ore. While the plant was in operation, phosphate slag was transported off-site and used as aggregate in road bedding, road and driveway paving, and in concrete structures. The extent of the distribution could not be determined. Residents in the area expressed concern about possible adverse health effects resulting from exposure to radium and heavy metals leaching from phosphate slag that was used in nearby roads and buildings. Besides radium, other contaminants of concern to residents were arsenic, asbestos, uranium, radon, and ionizing radiation.

There is elevated background radiation from natural radium in phosphate slag and aggregate, but exposures are not expected to result in any adverse health outcomes.

Phosphate slag contains concentrations of metals above background levels. However, based on current epidemiological and medical information the levels are not likely to represent a public health hazard. Combined exposures from roads and driveways are not a health threat. The ATSDR recommends that public health education be provided, to help the public better understand that there is no public health hazard posed by the phosphate slag.

BACKGROUND

In February 1998, the Agency for Toxic Substances and Disease Registry (ATSDR) received a petition from a Tarpon Springs, Florida, resident. The person requested that the agency investigate health problems that might be associated with exposure to slag materials used in residential areas of Tarpon Springs. Since then, the ATSDR has responded to letters from several other residents. The U.S. Environmental Protection Agency (EPA), Region IV also requested that the ATSDR review the sampling data taken at several vicinity properties near the Stauffer Superfund site in Tarpon Springs. The EPA asked the ATSDR to review chemical and radiological sampling data of residential slag, to evaluate exposure scenarios, to provide radiological dose estimates, and to make recommendations for protection of public health.

Since receiving letters from concerned Tarpon Springs residents, ATSDR staff members have begun investigating residents' health concerns and possible associations between those concerns and exposures to hazardous substances.

A. Site Description and History
   From 1947 to 1981, the Stauffer Chemical Company (which operated under different ownership until 1960) made elemental phosphorus from phosphate ore using an arc furnace process. The processed ore was shipped off-site to produce agricultural products, food-grade phosphates, and flame retardants. While the chemical plant

operated, waste products (i.e., slag) were disposed of on the plant property, shipped off -site by rail, and given to local residents to be used as fill and aggregate.

The Stauffer plant was added to the EPA Superfund list in 1994 because of pollution on the site. Superfund is a federal program for finding and cleaning up hazardous waste sites in this country. Since 1994, the EPA has been working to clean up the Stauffer site. The EPA is testing and monitoring the soil, water, and air at the site and at vicinity properties to protect nearby residents against health problems that might result from exposure to hazardous waste.

B. Site Visit

In May 1998, ATSDR staff members visited Tarpon Springs to meet with residents and to gather more information. Staff members addressed residents' questions. ATSDR and EPA Region IV personnel visited several vicinity properties in Tarpon Springs and Holiday, Florida. They saw the Stauffer Chemical Superfund site from the site boundary including the Anclote River. During a boat tour on the Anclote River, the ATSDR and the EPA were shown where slag from the site was used to fill in an inlet on site property.

In August 1998, EPA Region IV personnel and staff from EPA's National Air and Radiation Environmental Laboratory (NAREL) in Montgomery, Alabama, took samples of building materials and roads and performed radiological surveys of several vicinity properties.

C. Demographics, Land Use and Natural Resources

The City of Tarpon Springs is in Pinellas County, Florida. The community is near the Anclote River, about 1.6 miles east of the Gulf of Mexico. Gulfside Elementary School is directly across the street from the Stauffer site and Tarpon Springs Middle and High Schools are also in close proximity.

According to 1990 census data (1), 9,231 people live within a one-mile radius of the site. About 97% of the population is white and 2.2% are black, with most being middle income level. A hospital, a nursing home, and a children's group home are within one mile of the site. There are about 100 private wells within this same area. The color maps on the following page give a graphical representation of the demographic data (see figure 1).

D. Health Outcome Data

Evaluation of available health outcome data did not find any elevated mortality rates for leukemia, bone cancer, or respiratory diseases. Rates for Pasco and Pinellas Counties were below the state averages for both respiratory disease and childhood leukemia and bone cancers.

Mortality data were analyzed for various respiratory diseases (ICD Codes 460 to 519.9) and for childhood radiogenic cancers (ICD Codes 204 to 204.9) in Florida counties surrounding the Stauffer site. Respiratory diseases were looked at, because of the dusts emitted from Stauffer Chemical when it was operating. The ATSDR used the *Wide-ranging ONline Data for Epidemiologic Research* (*WONDER)* system, which is a computer database designed by the Information Resources Management Office, Centers for Disease Control and Prevention (CDC), Public Health Service. The mortality section of the database provided information for comparing the rates of the county with rates for the state and the rest of the country.

Figure 1. Map of Tarpon Springs, Florida with Demographics and Site

COMMUNITY HEALTH CONCERNS

Residents from Tarpon Springs, and Holiday, Florida expressed concern about adverse health effects resulting from exposure to radium and heavy metals leaching from phosphate slag that was used in nearby roads and buildings. Besides radium, other contaminants of concern to residents were arsenic, beryllium, uranium, radon, and ionizing radiation.

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