ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

August 30, 2007

Mr. James Webb
Division of Decommissioning/Waste Management
U.S. Nuclear Regulatory Commission
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SUBJECT: REVISION–RADIOLOGICAL SURVEY RESULTS FOR AREAS A1 NORTH, A5A, A6, A1 SOUTH AND A1A AT THE MOLYCORP WASHINGTON REMEDIATION PROJECT, WASHINGTON, PENNSYLVANIA (DOCKET NO. 040-08778; TAC NO. L52062; RFTA NO. 06-007)

Dear Mr. Webb:

The Oak Ridge Institute for Science and Education (ORISE) performed radiological survey and ORISE procedural training activities at the Molycorp Washington Remediation Project (MWRP) in Washington, Pennsylvania during the period of November 28 and 29, 2006. ORISE personnel provided limited training of ORISE survey procedures to include: gamma surface scans, soil sample collection, sample labeling, and chain-of-custody to Pennsylvania Department of Environmental Protection (PADEP) personnel. In addition, ORISE performed radiological survey activities that were approved by the U.S. Nuclear Regulatory Commission (NRC). Enclosed are the radiological survey results documenting the survey activities which included gamma surface scans and the collection of soil samples from Area A1 North and the collection of background soil samples from locations surrounding the MWRP facility. Also enclosed are radiological data pertaining to the transfer of soil samples collected from Areas A5A, A6, A1 South and A1A by PADEP personnel to ORISE for radiological analyses, and interlaboratory comparison analyses of soil samples collected by MWRP personnel from the A1 soil stockpiles.

The letter report submitted on March 13, 2007 incorrectly reported the Ra-226 results and incorrectly stated that ORISE had analyzed PADEP-collected soil samples from Areas A2 and B2. This revision corrects the Ra-226 results and correctly identifies the soil samples from Areas A1 South and A1A. If you have any questions or comments, please direct them to me at 865.576.0065 or Sarah Roberts at 865.241.8893.

Sincerely,

Wade C. Adams
Health Physicist/Project Leader
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RADIOLOGICAL SURVEY RESULTS FOR AREAS A1 NORTH, A5A, A6, A1 SOUTH AND A1A AT THE MOLYCORP WASHINGTON REMEDIATION PROJECT WASHINGTON, PENNSYLVANIA

INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) requested the Oak Ridge Institute for Science and Education (ORISE) to provide limited training pertaining to ORISE radiological soil scanning and sampling procedures to the Pennsylvania Department of Environmental Protection (PADEP) personnel. In addition, the NRC also requested that ORISE perform radiological surveys of the Molycorp Washington Remediation Project (MWRP) facility in Washington, Pennsylvania (Figure 1).

ORISE has and will continue to interface with PADEP personnel in a joint effort to perform confirmatory radiological surveys, consisting of gamma scans and soil sampling, at the MWRP facility. PADEP personnel will continue to submit soil samples that they collect to ORISE for analyses. PADEP sample results, along with ORISE results, will be provided to the NRC and PADEP so that decisions regarding the radiological status of the surveyed areas can be determined.

ORISE performed radiological surveys during the period of November 28 and 29, 2006. The survey unit (SU) available for ORISE radiological survey activities was Area A1 North. The MWRP final status survey (FSS) results for Area A1 North were reviewed prior to these survey activities. Prior to ORISE's survey activities, PADEP personnel had performed radiological surveys and collected soil samples from SU Areas A5A and A6. These samples were provided to ORISE for analyses while on site. After the ORISE radiological surveys, PADEP personnel collected soil samples from SU Areas A1 South and A1A and these samples were shipped to ORISE for analyses in January 2007. Figure 2 depicts the MWRP Areas A through D; ORISE and PADEP personnel performed survey activities in portions of Areas A and B.

For interlaboratory comparison analyses with MWRP's site contractor, Malcolm Pirnie (MP), ORISE requested soil samples from the Area A1 soil stockpiles. In addition, ORISE also collected background soil samples from areas adjacent to or in the vicinity surrounding the MWRP facility.

PROCEDURES

Radiological surveys conducted by ORISE, in Area A1 North, were performed in accordance with a site-specific survey plan that was submitted to and approved by the NRC (ORISE 2006a). The site-specific survey plan follows the guidance provided in the ORISE Survey Procedures and Quality Assurance Manuals (ORISE 2006b and 2005).

SURFACE SCANS

Survey Unit Area A1 North

Gamma surface scans were performed on approximately 75% of accessible land areas within the Area A1 North SU using sodium iodide (NaI) scintillation detectors coupled to ratemeters with audible indicators. Due to the elevated gamma radiation levels associated with slag materials near the

southeast section of the SU, this area was segregated from the Area A1 North area. MP personnel were to survey this area at a later date.

SOIL SAMPLING

Background Soil Samples

Background surface (0 to 0.5 ft) soil samples were collected at six judgmental locations in the immediate vicinity of the MWRP facility (Figure 3). Background samples were collected since the soil concentration limits for the site are intended to be applied after correcting for natural background radioactivity in soil (MP 2005).

Survey Unit Area A1 North

ORISE collected three judgmental soil samples from Area A1 North based on elevated gamma radiation levels determined by the surface scan results. ORISE also selected four grid blocks for grid block averaging based on MP radiological gamma scan results (Figure 4). In order to directly compare soil sample concentrations with MWRP guidelines, ORISE collected a two-foot core sample from each sampling location as specified in the approved technical basis document (TBD) for sampling lifts (MP 2005).

Survey Unit Areas A5A, A6, A1 South and A1A

PADEP personnel collected five soil samples from SU Area A5A (Figure 5), and four soil samples from SU Area A6 (Figure 6). These judgmental samples were transferred to ORISE for analyses while on site. After ORISE's radiological survey activities, PADEP personnel collected four soil samples from SU Area A1 South and five soil samples from SU Area A1A. These judgmental soil samples were shipped to ORISE for analyses. Figures documenting these sample locations were not provided to ORISE.

Interlaboratory Samples from Area A1

ORISE requested and received seven Area A1 soil stockpile samples previously analyzed by MP's contractor laboratory for interlaboratory comparison. Three of these samples were collected from Overburden Stockpiles 1 and 3, two samples were collected from the Intermediate Stockpile, and two samples were collected from the Disposal Stockpile.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Radiological data and sample media were returned to the ORISE laboratory in Oak Ridge, TN for analysis and interpretation. Radioanalyses were performed in accordance with the ORISE Laboratory Procedures Manual (ORISE 2006c). The soil samples were analyzed by gamma spectroscopy for the primary radionuclides-of-concern [ROC (i.e., Ra-226, thorium and uranium)]. However, spectra were also reviewed for other identifiable total absorption peaks. The soil sample radionuclide concentrations were reported in units of picocuries per gram (pCi/g).

FINDINGS AND RESULTS

PADEP PERSONNEL TRAINING

ORISE personnel provided limited training to PADEP personnel regarding ORISE gamma surface scanning and soil sampling procedures. ORISE also provided PADEP personnel with copies of the NRC-approved ORISE survey plan and specific ORISE survey procedures for gamma scans, soil sampling, sample labeling, and maintaining chain-of-custody (ORISE 2006a and b).

SURFACE SCANS

Gamma surface scans identified several locations of elevated direct gamma radiation on the excavated soil surface in SU Area A1 North. Additional investigation determined that the elevated gamma radiation detected was due to slag materials that remained within the excavation. MP personnel removed several pieces of slag and disposed of them as radiological waste.

SOIL SAMPLING

Background Soil Samples

Background surface soil concentration ranges and average concentrations are listed in the table below. A complete listing of the radionuclide concentrations for the background soil samples is provided in Table 1.

Range *(and Average)* of Radionuclide Concentrations in Background Soil Samples (pCi/g)		
Ra-226	**Total Thorium**	**Total Uranium**
0.74 to 1.04 *(0.89)*	1.33 to 3.05 *(2.57)*	1.96 to 4.3 *(3.0)*

Survey Unit Area A1 North

ORISE collected soil samples from three of these locations after the slag was removed. The radionuclide concentration ranges for these judgmental samples were as follows:

Range of Radionuclide Concentrations in Judgmental Soil Samples from Area A1 North (pCi/g)[a]		
Ra-226	**Total Thorium**	**Total Uranium**
2.54 to 7.10	38.0 to 51.5	12.8 to 19.1

[a]Average backgrounds subtracted.

The radionuclide concentration ranges for the grid block samples were as follows:

Range *(and Average)* Radionuclide Concentrations in Grid Block Soil Samples from Area A1 North (pCi/g)[a]		
Ra-226	**Total Thorium**	**Total Uranium**
0.27 to 0.62 *(0.42)*	1.47 to 3.30 *(2.7)*	-0.6 to 1.9 *(0.5)*

[a]Average backgrounds subtracted.

A complete listing of the Area A1 North soil sample radionuclide concentrations is provided in Table 1.

Survey Unit Areas A5A, A6, A1 South and A1A

The radionuclide concentration ranges (backgrounds not subtracted) for the Area A5A, Area A6, Area A1 South and Area A1A soil samples collected by PADEP were as follows:

Range of Radionuclide Concentrations in PADEP-Collected Soil Samples from Areas A5A, A6, A1 South and A1A (pCi/g)[a]			
Survey Unit	**Ra-226**	**Total Thorium**	**Total Uranium**
Area A5A	0.12 to 0.85	0.25 to 0.59	-0.2 to 2.7
Area A6	-0.23 to 1.87	-1.20 to 14.4	-1.8 to 6.8
Area A1 South	0.02 to 0.38	-0.13 to 3.01	-1.1 to 0.4
Area A1A	0.14 to 1.35	-0.20 to 6.18	-0.4 to 4.8

[a]Average backgrounds subtracted.

A complete listing of the Areas A5A, A6, A1 South and A1A soil sample radionuclide concentrations is provided in Table 2.

Interlaboratory Sample Analyses

ORISE obtained seven MWRP stockpiles soil samples from Area A1 for analytical comparison with MP's contractor laboratory (Table 3). With one exception, most of the interlaboratory comparison analyses for these samples demonstrate general agreement between the two data sets and indicate that MWRP contractor laboratory data, within the parameters of sample preparation and analytical procedures, were comparable with ORISE's analytical results. The exception was with sample 29 (A1-I-S1-18) where the analytical results were off by a factor of seven (or greater) for each of the ROCs. Further review of the sample data indicated that ORISE was not provided with the same samples, but instead was provided with split samples from the requested sample locations. A review of MWRP and ORISE laboratory results indicates that MWRP samples contained approximately 1 kilogram (kg) of sample and the ORISE samples contained approximately 0.5 kg of material.

SUBSURFACE SOIL GUIDELINES COMPARISON

Table 4-2 of MP's TBD, which contains the subsurface soil guidelines, is presented as Table 4 in this report. The confirmatory soil sample results from Areas A5A, A6, A1 South and A1A indicated that the soil concentrations are well within the guideline levels. However, the radiological soil sample results from Area A1 North indicated several judgmental soil samples that approached, but did not exceed, the average guideline level of 44.8 and 53.0 pCi/g total thorium at the 6 to 10 and 8 to 10 foot layers, respectively (locations 7 and 9). The other judgmental sample and the grid block average samples were well below the applicable soil averaging limits.

SUMMARY

During the period of November 28 and 29, 2007, the Oak Ridge Institute for Science and Education (ORISE) provided limited training to Pennsylvania Department of Environmental Protection (PADEP) personnel regarding ORISE soil sampling procedures to include: gamma surface scans, soil sample collection, sample labeling, and chain-of-custody procedures. In addition, ORISE performed radiological survey activities which included gamma surface scans within Area A1 North, the collection of soil samples from Area A1 North and the collection of background soil samples from locations surrounding the Molycorp Washington Remediation Project (MWRP) facility. ORISE also received custody of 18 soil samples collected from Areas A5A, A6, A1 South and A1A by PADEP personnel for radiological analyses. In addition, Malcolm Pirnie (MP) personnel shipped seven Area A1 soil stockpile samples to ORISE for interlaboratory comparison analyses.

Gamma surface scans identified several locations of elevated direct gamma radiation within SU Area A1 North. Additional investigation of these locations indicated that the elevated radiation levels were attributable to slag material that remained within the A1 North excavation. Several pieces of slag material were removed by MWRP personnel and ORISE collected soil samples from three of these locations. The soil sample results from these three locations indicated residual radium, thorium and uranium concentrations above background levels but did not exceed the site-specific subsurface averaging criteria. ORISE also collected four samples from Area A1 North in adjacent grid blocks for a grid block averaging determination. These results were well below the site criteria. Samples collected by PADEP personnel from Areas A5A, A6, A1 South and A1A were also analyzed and were well below the subsurface averaging criteria.

The interlaboratory comparison analyses indicated that MP did not provide the exact same samples that were analyzed by their contractor laboratory; instead ORISE received split samples from the requested soil sample locations. Although, in general, the sample results were in agreement, one sample was off by a factor of seven for each of the radionuclides-of-concern. ORISE recommends that the same samples be analyzed by ORISE for future interlaboratory comparison analyses.

FIGURES

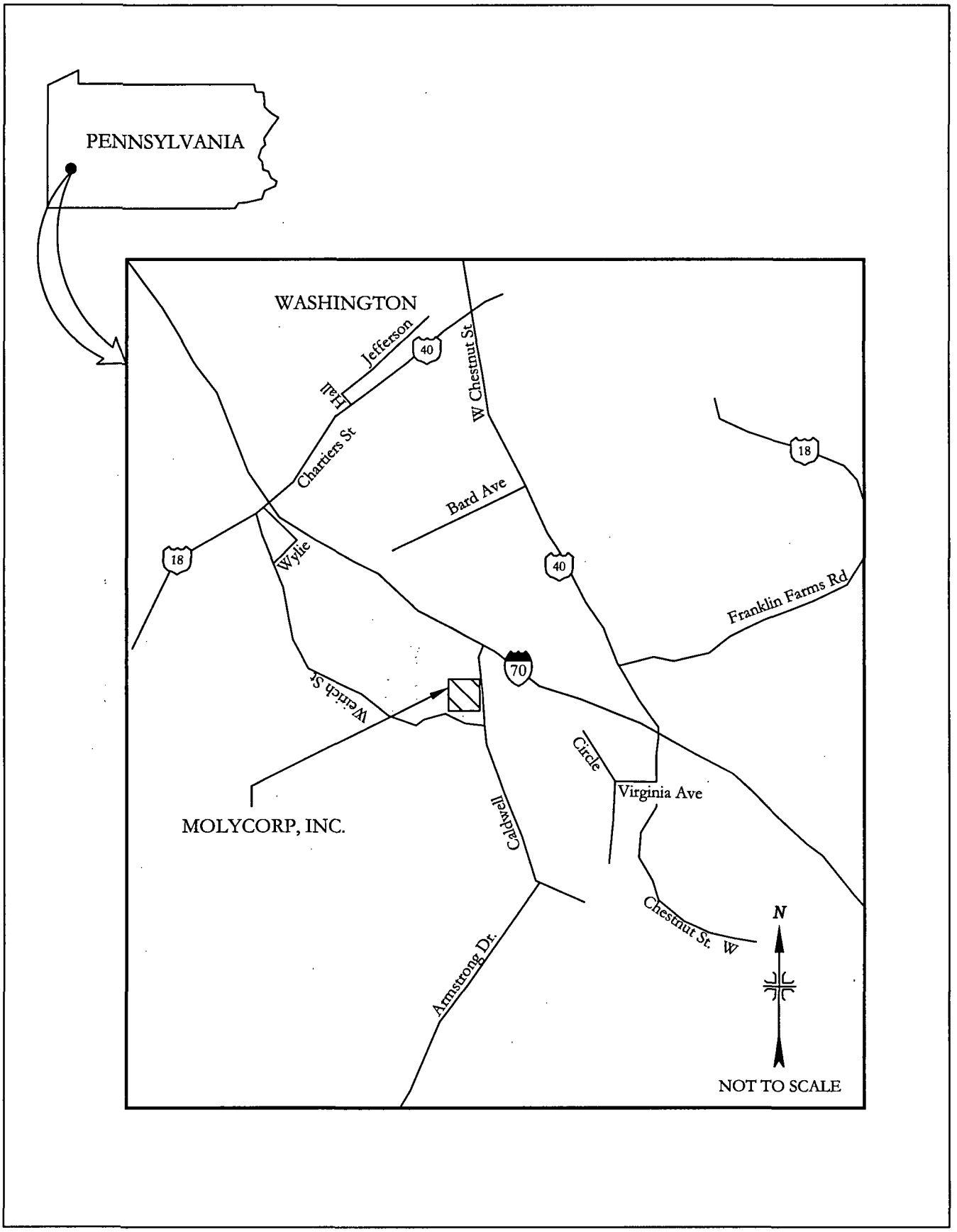


FIGURE 1: Location of Molycorp Washington Remediation Project - Washington, Pennsylvania

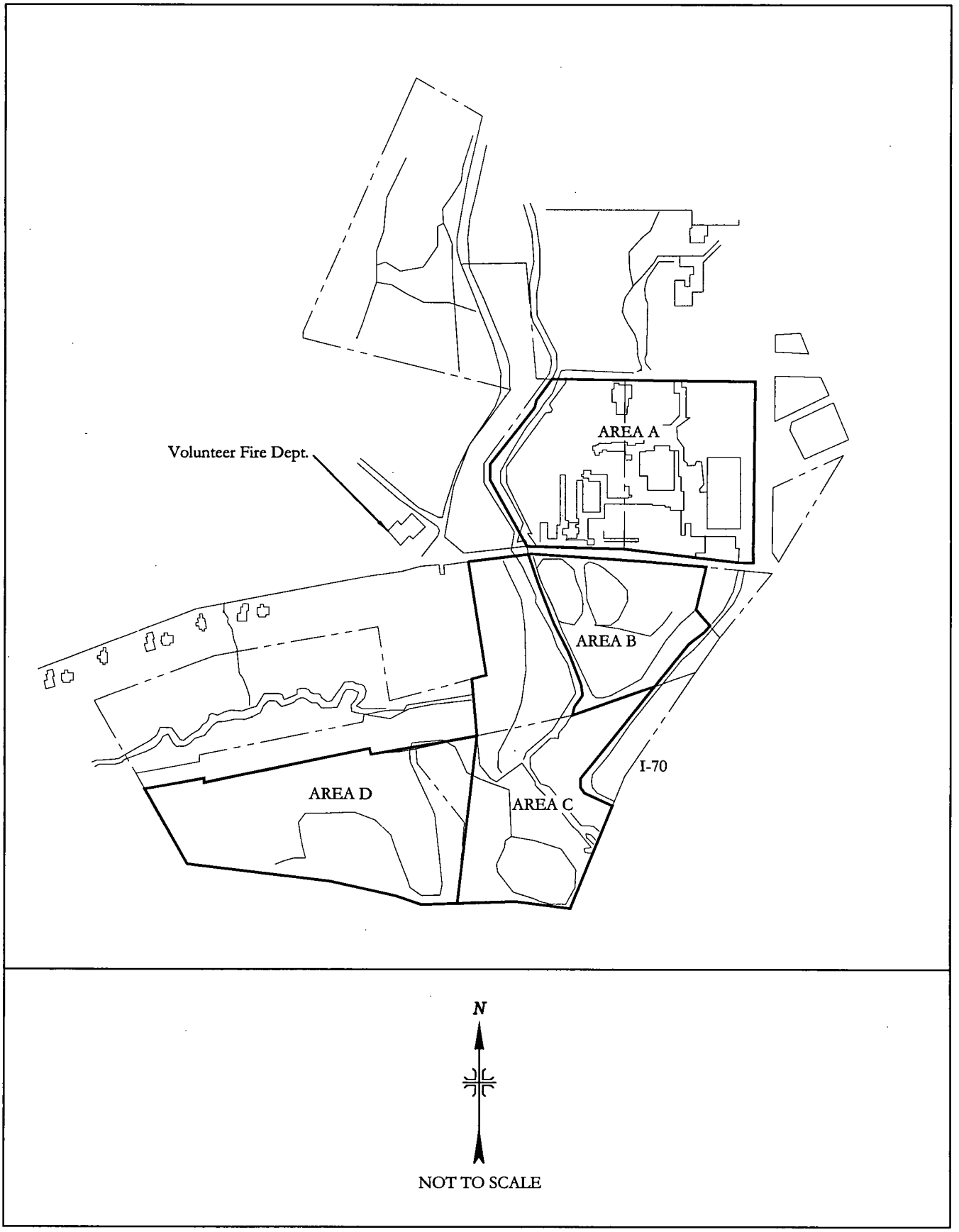


FIGURE 2: Molycorp Washington Remediation Project - Plot Plan

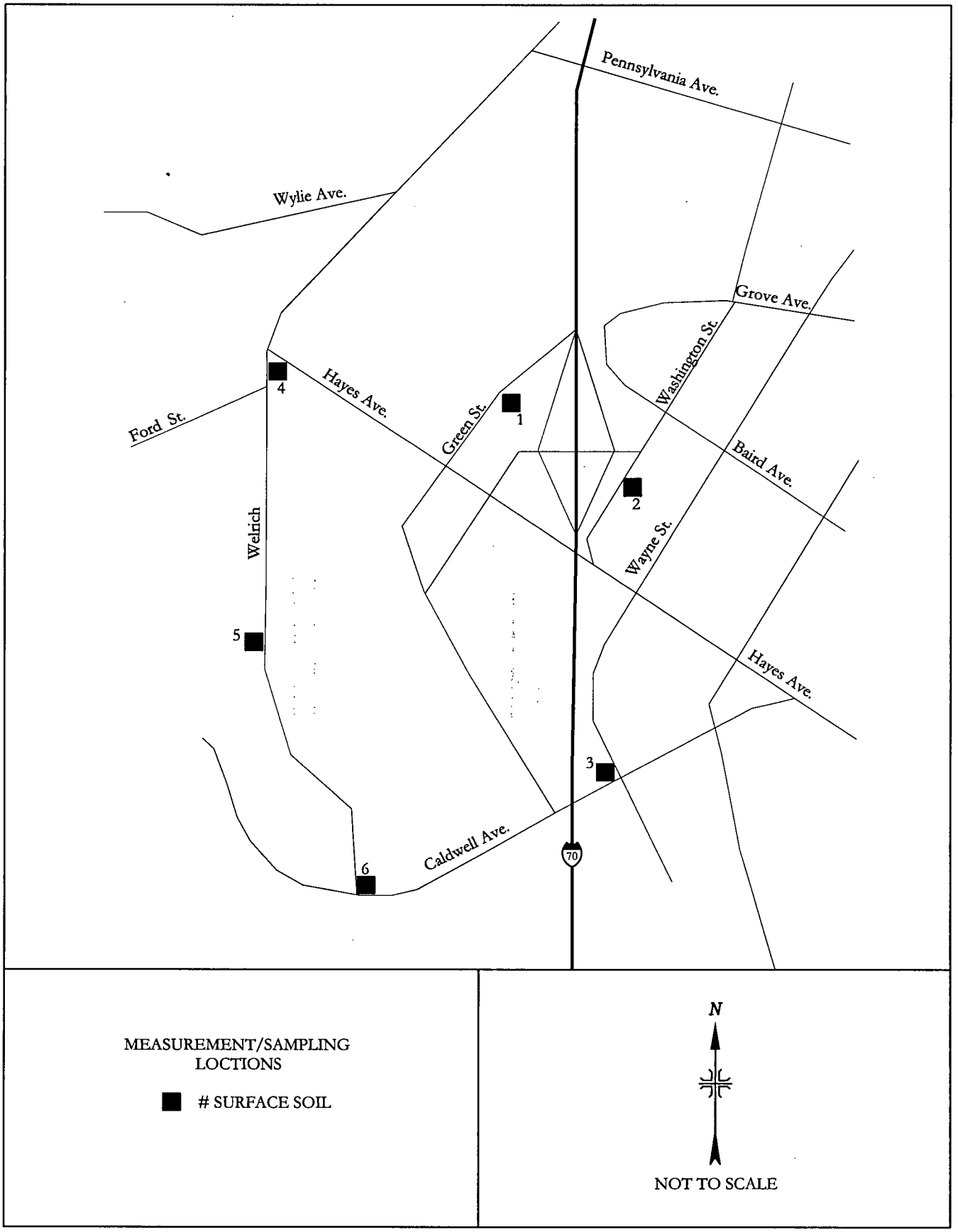
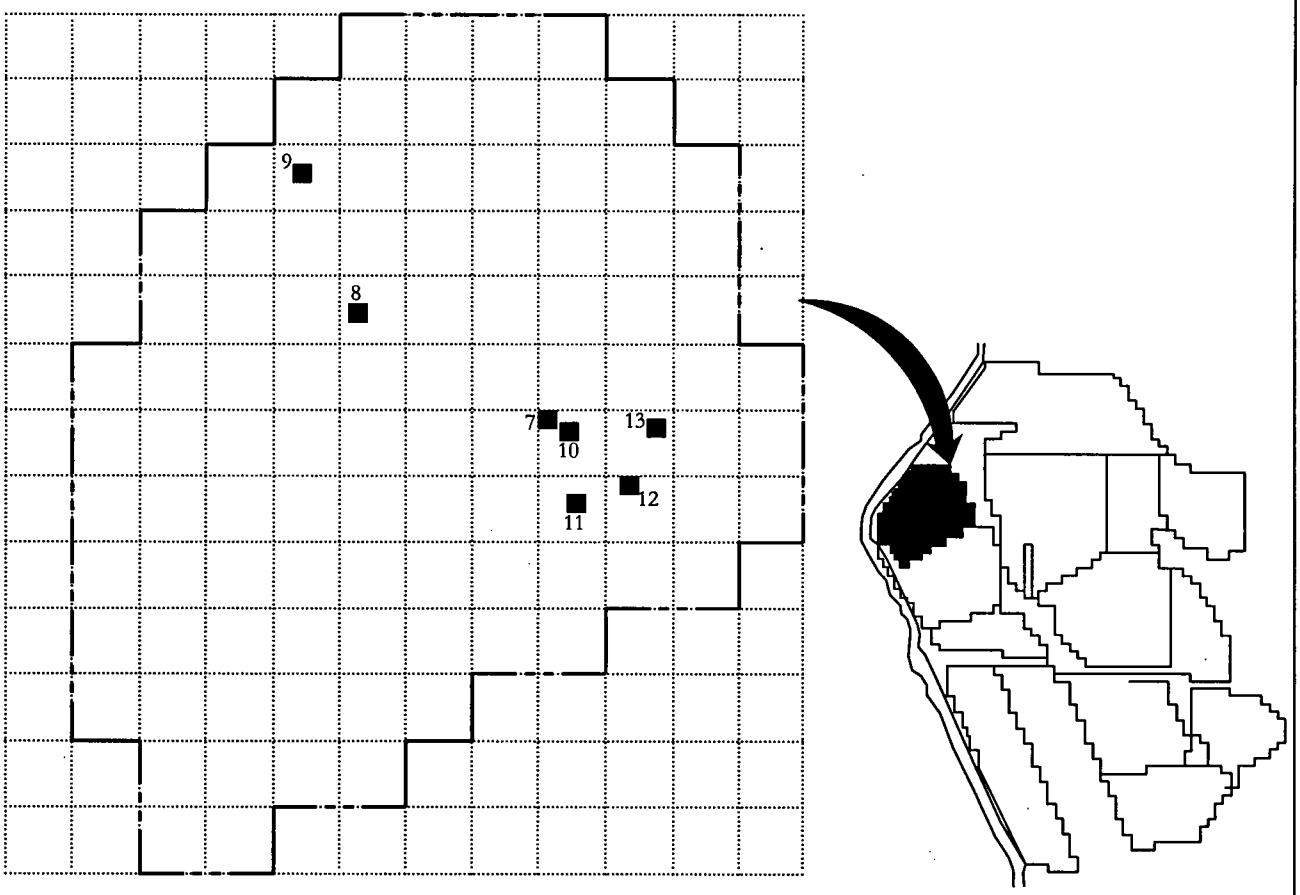


FIGURE 3: Molycorp Washington Remediation Project - Background Soil Sample Locations



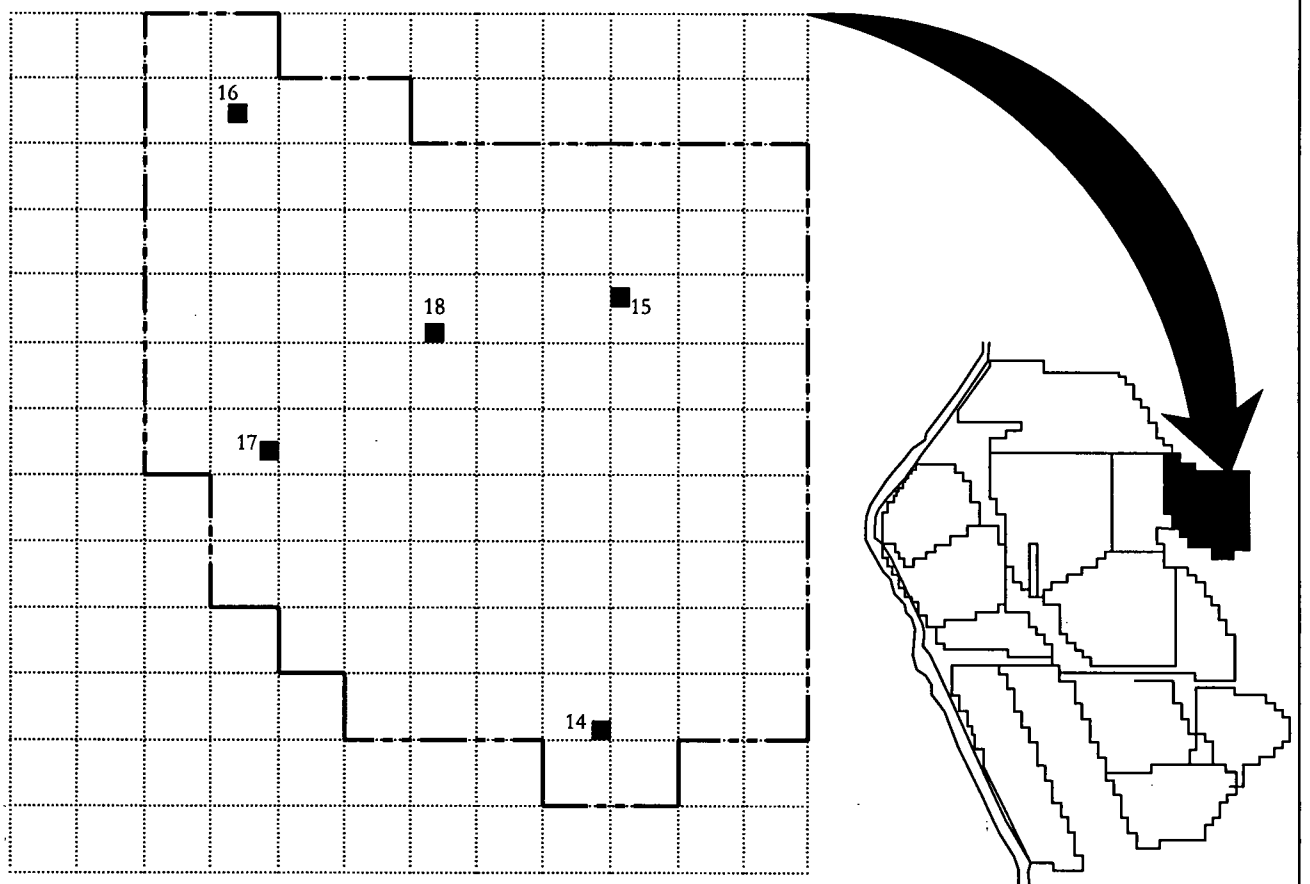
MEASUREMENT/SAMPLING LOCATIONS

■ # SURFACE SOIL

N

NOT TO SCALE

FIGURE 4: Survey Unit Area A1 North - Soil Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

■ # SURFACE SOIL

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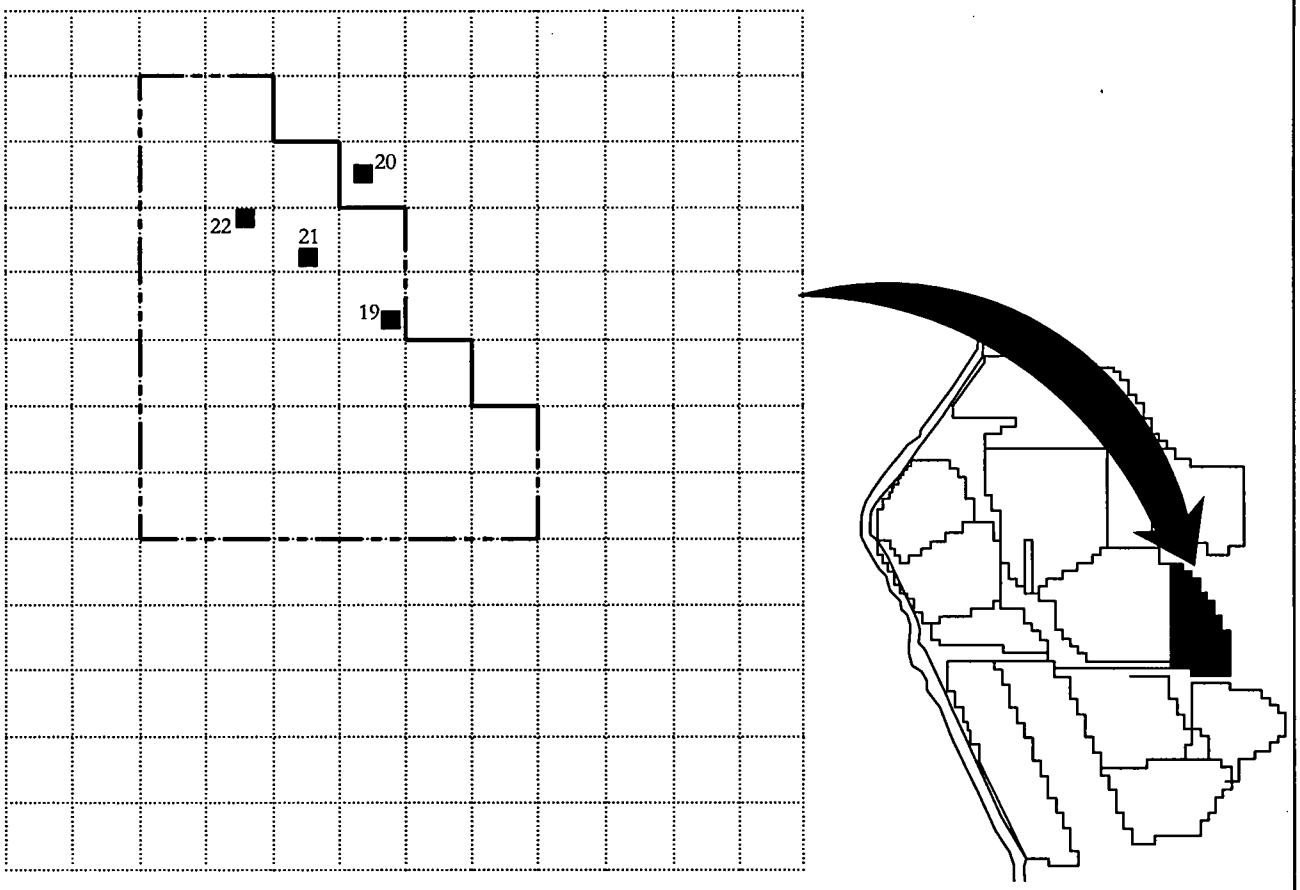
NOT TO SCALE

FIGURE 5: Survey Unit Area A5A - Soil Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

■ # SURFACE SOIL

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NOT TO SCALE

FIGURE 6: Survey Unit Area A6 - Soil Sampling Locations

TABLES

TABLE 1

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY ORISE FOR BACKGROUND AND FROM AREA A1 NORTH MOLYCORP WASHINGTON REMEDIATION PROJECT WASHINGTON, PENNSYLVANIA

ORISE Sample ID	Sample Depth (ft)	Radionuclide Concentrations in Soil Samples (pCi/g)						
		Ra-226	Th-228	Th-232	Total Thorium[a]	U-235	U-238	Total Uranium[b]
Background Samples[c]								
1706S0001	0 to 0.5	0.93 ± 0.11[d]	1.57 ± 0.12	1.48 ± 0.24	3.05 ± 0.27	0.16 ± 0.18	2.06 ± 0.64	4.3 ± 1.3
1706S0002	0 to 0.5	0.86 ± 0.11	1.30 ± 0.11	1.45 ± 0.25	2.75 ± 0.27	0.06 ± 0.18	1.72 ± 0.90	3.5 ± 1.8
1706S0003	0 to 0.5	0.74 ± 0.07	0.65 ± 0.05	0.68 ± 0.11	1.33 ± 0.12	0.04 ± 0.09	0.96 ± 0.40	1.96 ± 0.81
1706S0004	0 to 0.5	0.86 ± 0.10	1.17 ± 0.10	1.24 ± 0.25	2.41 ± 0.27	0.14 ± 0.14	1.78 ± 0.75	3.7 ± 1.5
1706S0005	0 to 0.5	0.88 ± 0.11	1.37 ± 0.11	1.50 ± 0.25	2.87 ± 0.27	0.12 ± 0.15	1.34 ± 0.87	2.8 ± 1.7
1706S0006	0 to 0.5	1.04 ± 0.12	1.47 ± 0.12	1.51 ± 0.25	2.98 ± 0.28	0.05 ± 0.14	0.97 ± 0.79	2.0 ± 1.6
BKG Average	*0 to 0.5*	*0.89 ± 0.26*	*1.26 ± 0.26*	*1.31 ± 0.57*	*2.57 ± 0.62*	*0.10 ± 0.37*	*1.5 ± 1.8*	*3.0 ± 3.7*
Area A1 North[e]								
Judgmental Soil Samples[f]								
1706S0007	8 to 10	3.30 ± 0.36	25.6 ± 1.5	26.0 ± 2.3	51.5 ± 2.7	0.45 ± 0.52	6.3 ± 2.4	13.1 ± 4.9
1706S0008	6 to 8	2.54 ± 0.38	18.9 ± 1.2	19.2 ± 1.8	38.0 ± 2.2	-0.06 ± 0.54	6.4 ± 2.8	12.8 ± 5.6
1706S0009	6 to 8	7.10 ± 0.48	21.8 ± 1.3	22.6 ± 2.0	44.3 ± 2.4	0.45 ± 0.56	9.3 ± 2.7	19.1 ± 5.4

TABLE 1 (continued)

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY ORISE FOR BACKGROUND AND FROM AREA A1 NORTH MOLYCORP WASHINGTON REMEDIATION PROJECT WASHINGTON, PENNSYLVANIA

ORISE Sample ID	Sample Depth (ft)	Radionuclide Concentrations in Soil Samples (pCi/g)						
		Ra-226	Th-228	Th-232	Total Thorium[a]	U-235	U-238	Total Uranium[b]
Grid Block Samples[f]								
1706S0010	8 to 10	0.62 ± 0.30	1.63 ± 0.32	1.52 ± 0.68	3.15 ± 0.75	0.08 ± 0.41	0.9 ± 2.2	1.9 ± 4.4
1706S0011	8 to 10	0.50 ± 0.30	1.36 ± 0.32	1.36 ± 0.66	2.72 ± 0.73	-0.04 ± 0.40	0.3 ± 2.1	0.5 ± 4.2
1706S0012	8 to 10	0.30 ± 0.29	1.55 ± 0.32	1.75 ± 0.69	3.30 ± 0.76	-0.03 ± 0.40	-0.3 ± 2.2	-0.6 ± 4.4
1706S0013	8 to 10	0.27 ± 0.27	0.61 ± 0.29	0.86 ± 0.62	1.47 ± 0.68	0.03 ± 0.40	-0.1 ± 2.0	-0.1 ± 3.9
Grid Average[g]	*8 to 10*	*0.42 ± 0.58*	*1.28 ± 0.63*	*1.4 ± 1.3*	*2.7 ± 1.5*	*0.01 ± 0.80*	*0.2 ± 4.2*	*0.5 ± 8.4*

[a]Total thorium calculated by adding Th-228 to Th-232 concentrations.
[b]Total uranium calculated by doubling the U-238 concentration and adding the U-235 concentration.
[c]Refer to Figure 3.
[d]Uncertainties represent the 95% confidence level based on total propagated uncertainties.
[e]Refer to Figure 4.
[f]Average background concentrations for each radionuclide were subtracted from the site soil samples.
[g]Grid layer average determined by averaging soil sample locations 10 through 13.

TABLE 2

RADIONUCLIDE CONCENTRATIONS IN PADEP SAMPLES COLLECTED FROM AREAS A5A, A6, A1 SOUTH AND A1A MOLYCORP WASHINGTON REMEDIATION PROJECT WASHINGTON, PENNSYLVANIA

ORISE Sample ID	Molycorp/ PADEP Sample ID[a]	Sample Depth (ft)	Radionuclide Concentrations in Soil Samples[b] (pCi/g)						
			Ra-226	Th-228	Th-232	Total Thorium[c]	U-235	U-238	Total Uranium[d]
Area A5A PADEP Samples[e]									
1706S0014	MW-01	8 to 10	0.70 ± 0.30[f]	0.26 ± 0.28	0.33 ± 0.61	0.59 ± 0.67	0.16 ± 0.42	1.3 ± 2.0	2.7 ± 4.1
1706S0015	MW-02	10 to 12	0.12 ± 0.28	0.04 ± 0.27	0.21 ± 0.63	0.25 ± 0.69	0.12 ± 0.40	0.0[g] ± 2.0	0.0 ± 4.0
1706S0016	MW-03	10 to 12	0.70 ± 0.28	0.21 ± 0.27	0.32 ± 0.60	0.53 ± 0.66	0.14 ± 0.39	0.6 ± 1.9	1.3 ± 3.9
1706S0017	MW-04	10 to 12	0.85 ± 0.29	0.07 ± 0.27	0.33 ± 0.60	0.40 ± 0.66	0.25 ± 0.42	0.1 ± 2.0	0.4 ± 3.9
1706S0018	MW-05	10 to 12	0.26 ± 0.29	0.17 ± 0.28	0.11 ± 0.62	0.28 ± 0.68	0.10 ± 0.42	-0.2 ± 2.0	-0.2 ± 4.0
Area A6 PADEP Samples[h]									
1706S0019	MW-06	2 to 4	0.42 ± 0.28	0.41 ± 0.28	0.70 ± 0.63	1.11 ± 0.69	-0.02 ± 0.43	0.5 ± 1.9	1.0 ± 3.8
1706S0020	MW-07	2 to 4	-0.23 ± 0.27	-0.58 ± 0.26	-0.56 ± 0.58	-1.14 ± 0.64	-0.10 ± 0.38	-0.2 ± 1.9	-0.5 ± 3.8
1706S0021	MW-08	2 to 4	-0.23 ± 0.27	-0.56 ± 0.27	-0.64 ± 0.58	-1.20 ± 0.64	-0.02 ± 0.38	0.9 ± 1.9	-1.8 ± 3.8
1706S0022	MW-09	2 to 4	1.87 ± 0.31	7.11 ± 0.54	7.26 ± 0.93	14.4 ± 1.1	0.16 ± 0.42	3.3 ± 2.1	6.8 ± 4.1
Area A1 South PADEP Samples[i]									
1706S0030	A2e08D-DUP	6 to 8	0.05 ± 0.27	-0.04 ± 0.27	-0.08 ± 0.61	-0.13 ± 0.67	-0.05 ± 0.39	-0.5 ± 1.9	-1.1 ± 3.8
1706S0031	A2e07A-DUP	6 to 8	0.02 ± 0.28	-0.01 ± 0.27	-0.04 ± 0.62	-0.05 ± 0.68	0.03 ± 0.39	0.0 ± 2.0	0.0 ± 4.1
1706S0032	A2d05D-DUP	6 to 8	0.17 ± 0.27	0.24 ± 0.28	0.13 ± 0.61	0.37 ± 0.67	0.05 ± 0.38	0.1 ± 1.9	0.1 ± 3.9
1706S0033	Bias Sample - DUP	6 to 8	0.38 ± 0.28	1.41 ± 0.31	1.60 ± 0.66	3.01 ± 0.73	0.17 ± 0.42	0.1 ± 1.9	0.4 ± 3.9

TABLE 2 (continued)

RADIONUCLIDE CONCENTRATIONS IN PADEP SAMPLES COLLECTED FROM AREAS A5A, A6, A1 SOUTH AND A1A MOLYCORP WASHINGTON REMEDIATION PROJECT WASHINGTON, PENNSYLVANIA

ORISE Sample ID	Molycorp/ PADEP Sample ID[a]	Sample Depth (ft)	Radionuclide Concentrations in Soil Samples[b] (pCi/g)						
			Ra-226	Th-228	Th-232	Total Thorium[c]	U-235	U-238	Total Uranium[d]
Area A1A PADEP Samples[i]									
1706S0034	A2g09C-DUP	10 to 12	0.14 ± 0.27	1.67 ± 0.31	1.90 ± 0.64	3.57 ± 0.72	-0.11 ± 0.38	-0.2 ± 2.0	-0.4 ± 3.9
1706S0035	A2j05D-DUP	6 to 8	0.56 ± 0.29	1.17 ± 0.30	1.03 ± 0.64	2.20 ± 0.70	0.08 ± 0.41	0.3 ± 2.0	0.7 ± 4.0
1706S0036	B2a10D-DUP	2 to 4	0.45 ± 0.28	0.13 ± 0.28	0.10 ± 0.61	0.23 ± 0.67	0.04 ± 0.39	-0.1 ± 2.0	-0.2 ± 4.0
1706S0037	A2i08B-V11706S0031	4 to 6	0.55 ± 0.29	-0.01 ± 0.27	-0.18 ± 0.61	-0.20 ± 0.67	0.03 ± 0.39	0.2 ± 2.0	0.3 ± 4.0
1706S0038	A2i09B-V11706S0032	6 to 8	1.35 ± 0.31	2.89 ± 0.36	3.29 ± 0.74	6.18 ± 0.83	0.18 ± 0.47	2.3 ± 2.2	4.8 ± 4.4

[a]Sample identification provided by PADEP and Malcolm Pirnie personnel.
[b]Average background concentrations for each radionuclide were subtracted from the site soil samples.
[c]Total thorium calculated by adding Th-228 to Th-232 concentrations.
[d]Total uranium calculated by doubling the U-238 concentration and adding the U-235 concentration.
[e]Refer to Figure 5.
[f]Uncertainties represent the 95% confidence level based on total propagated uncertainties.
[g]Zero values are due to rounding.
[h]Refer to Figure 6.
[i]Figure not provided.

TABLE 3

INTERLABORATORY COMPARISON ANALYSES OF SOIL PILE SAMPLES FROM AREA A1 MOLYCORP WASHINGTON REMEDIATION PROJECT WASHINGTON, PENNSYLVANIA

ORISE Sample ID	Molycorp Sample ID[a]	Radionuclide Concentrations in Soil Samples[b] (pCi/g)						
		Ra-226	Th-228	Th-232	Total Thorium[c]	U-235	U-238	Total Uranium[d]
Overburden Stockpiles 1 and 3								
1706S0024	A1-O-S3-07	1.80 ± 0.31[e]	2.34 ± 0.34	2.13 ± 0.68	4.47 ± 0.76	0.02 ± 0.40	1.5 ± 2.0	3.0 ± 4.1
		8.08 ± 32.7	3.46 ± 0.190	3.46 ± 0.190	--[f]	-0.197 ± 0.201	5.16 ± 1.90	--
1706S0025	A1-O-S1-08	1.28 ± 0.31	8.41 ± 0.62	8.2 ± 1.0	16.6 ± 1.2	0.12 ± 0.43	2.1 ± 2.2	4.4 ± 4.5
		5.10 ± 0.810	8.90 ± 0.408	8.90 ± 0.408	--	0.228 ± 0.034	5.96 ± 2.27	--
1706S0026	A1-O-S1-31	3.11 ± 0.36	15.8 ± 1.0	15.6 ± 1.5	31.3 ± 1.8	0.11 ± 0.44	3.7 ± 2.2	7.6 ± 4.5
		7.62 ± 1.15	15.4 ± 0.690	15.4 ± 0.690	--	0.409 ± 0.058	4.85 ± 2.19	--
Intermediate Stockpile								
1706S0023	A1-I-S1-10	3.40 ± 0.38	11.00 ± 0.77	11.0 ± 1.2	22.0 ± 1.5	0.23 ± 0.47	2.9 ± 2.6	6.1 ± 5.2
		9.09 ± 1.17	11.3 ± 0.567	11.3 ± 0.567	--	0.424 ± 0.052	6.58 ± 2.63	--
1706S0029	A1-I-S1-18	1.83 ± 0.31	4.35 ± 0.43	4.50 ± 0.78	8.85 ± 0.89	0.14 ± 0.40	2.8 ± 2.1	5.8 ± 4.3
		31.3 ± 4.57	31.7 ± 1.57	31.7 ± 1.57	--	1.71 ± 0.247	23.0 ± 12.4	--
Disposal Stockpile								
1706S0027	A1-D-S1-09	5.81 ± 0.83	58.1 ± 3.5	60.6 ± 5.3	118.6 ± 6.4	0.0[g] ± 1.3	13.2 ± 7.7	26 ± 15
		14.1 ± 2.44	54.9 ± 2.67	54.9 ± 2.67	--	0.670 ± 0.108	8.23 ± 3.57	--
1706S0028	A1-D-S1-16	6.87 ± 0.93	80.5 ± 4.7	77.4 ± 6.6	157.8 ± 8.1	-0.8 ± 1.3	12.3 ± 6.9	24 ± 14
		17.2 ± 2.73	72.7 ± 3.52	72.7 ± 3.52	--	0.750 ± 0.118	15.6 ± 5.34	--

[a]Shaded area data are the sample identification soil sample results as provided by Malcolm Pirnie.
[b]Average background concentrations for each radionuclide were subtracted from the ORISE site soil samples.
[c]Total thorium calculated by adding Th-228 to Th-232 concentrations.
[d]Total uranium calculated by adding doubling the U-238 concentration and adding the U-235 concentration.
[e]ORISE uncertainties represent the 95% confidence level based on total propagated uncertainties.
[f]Not applicable.
[g]Zero values are due to rounding.

TABLE 4

SITE-SPECIFIC SUBSURFACE SOIL AVERAGING LIMITS
MOLYCORP WASHINGTON REMEDIATION PROJECT
WASHINGTON, PENNSYLVANIA

TABLE 4-2
Site-Specific Subsurface Soil Averaging Limits - Molycorp's Washington, PA Site

Layer #	Layer	# of Quadrants	Volume (ft3)	Uranium (238 + 234)	Average, pCi/g Thorium (232 + 228)	Ra (226)
1	**0 to 2 feet Layer**				Average	
	4 Samples from Layer Area	4	2153	18.7	14.2	7.4
	Maximum in Layer	1	538	25.4	17.8	9.4
2	**0 to 4 feet Layer**					
	2 Vertical Quadrants	2	1076	21.8	15.7	8.2
	4 Samples from Layer Area	4	2153	30.9	25.7	13.2
	8 Samples from Surface to this Layer	8	4306	15.5	12.9	6.6
	Maximum in Layer	1	538	43.6	31.5	16.5
3	**0 to 6 feet Layer**					
	3 Vertical Quadrants	3	1615	20.1	14.9	7.8
	4 Samples from Layer Area	4	2153	40.0	35.7	18.1
	12 Samples from Surface to this Layer	12	6458	13.3	11.9	6.0
	Maximum in Layer	1	538	60.2	44.7	23.3
4	**0 to 8 feet Layer**					
	4 Vertical Quadrants	4	2153	18.7	14.2	7.4
	4 Samples from Layer Area	4	2153	47.2	44.8	22.5
	16 Samples from Surface to this Layer	16	8611	11.8	11.2	5.6
	Maximum in Layer	1	538	74.8	56.9	29.6
5	**0 to 10 feet Layer**					
	5 Vertical Quadrants	5	2691	17.8	13.8	7.2
	4 Samples from Layer Area	4	2153	53.3	53.0	26.4
	20 Samples from Surface to this Layer	20	10764	10.7	10.6	5.3
	Maximum in Layer	1	538	88.8	69.2	35.9
6	**0 to 12 feet Layer**					
	6 Vertical Quadrants	6	3229	16.9	13.5	7.0
	4 Samples from Layer Area	4	2153	63.8	63.4	31.6
	24 Samples from Surface to this Layer	24	12917	10.6	10.6	5.3
	Maximum in Layer	1	538	101.5	80.9	41.8
7	**0 to 14 feet Layer**					
	7 Vertical Quadrants	7	3767	16.2	13.2	6.8
	4 Samples from Layer Area	4	2153	74.2	73.8	36.8
	28 Samples from Surface to this Layer	28	15069	10.6	10.5	5.3
	Maximum in Layer	1	538	113.1	92.1	47.7
8	**Each Layer deeper than 14 feet**					
	Maximum in Layer	1	538	129.2	105.2	54.6

Assumptions					
Area:	100	m2	1076	ft2
Quadrants:	25	m2	269	ft2
Thickness:	NA		2	ft
Area Volume:	NA		2153	ft3
Quadrant Volume:	NA		538	ft3

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