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U.S. Department of Energy

Oakland Operations Office, Oakland, California

FINAL PHASE C ADDENDUM TO FINAL WORK PLAN FOR WESTERN DOG PENS, BACKGROUND, AND OFF-SITE INVESTIGATIONS

at the

LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH (LEHR) UNIVERSITY OF CALIFORNIA AT DAVIS, CALIFORNIA

Submitted to:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 95612-5208

Prepared by:

Weiss Associates
5500 Shellmound Street
Emeryville, California 94608

February 13, 1998

DOE Oakland Operations Contract DE-AC03-96SF20686

Weiss Associates
Environmental and Geologic Services

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1301 Clay Street
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SOP 2.1 Sample Handling, Packaging and Shipping

SOP 3.2 Subsurface Soil Sampling while Drilling

SOP 6.1 Sampling Equipment and Well Material Decontamination

SOP 6.2 Drilling, Development and Heavy Equipment Decontamination

ADDENDUM

This addendum to the "Final Work Plan for the Western Dog Pens, Background, and Off-Site Investigations, Laboratory for Energy-related Health Research (LEHR), University of California at Davis, California" (Weiss Associates (WA), 1997a) describes Phase C soil sampling locations and activities within the Western Dog Pens (Figure 1). The Phase C Work Plan Addendum complies with the requirements described in Section 2.1.2.1 of the Final Work Plan.

The primary objective of Phase C work is to collect enough additional data to make remedial decisions for the Western Dog Pens. Soil boring locations for Phase C are based on an evaluation of data:

- gathered from Phase A (records review of Western Dog Pens operation and maintenance records, former Dog Pens employee interviews, compilation of previous sampling data, and reconnaissance surface radiation surveying); and,
- generated during Phase B (detailed inter-pen surface and near surface radiation surveying and sampling) of the Western Dog Pen Investigation conducted in November 1997.

Although the nature of past operations in the Western Dog Pens and the data collected to date indicate that most contamination in the Western Dog Pens appears to be isolated, near-surface contamination, radionuclides and metals above background have been detected up to 21 ft below ground surface (bgs) in past investigations (WA, 1997b). Therefore, Phase C near-surface and depth sampling is important to verify:

- the vertical extent of formerly identified near-surface and deeper areas with radionuclide and metals concentrations significantly above background ("hot spots");
- the vertical extent of recently identified Phase B surface and near-surface radionuclide "hot-spots"; and,
- the possible presence of radionuclide, metals and pesticide "hot-spots" at depth given the absence of widespread near-surface contamination.

Western Dog Pens Investigation Phase C field work, sampling and analysis will be performed in accordance with this addendum, the "Final Work Plan for the Western Dog Pens, Background and Off-Site Investigations," the Quality Assurance Project Plan (QAPP), and appropriate Standard Operating Procedures (SOPs).

Specific issues outlined in this addendum include:

- Phase B data evaluation and definition of minimum "hot-spot" size;
- Cost/benefit analysis comparing the necessary sampling costs to the cost of soil removal or *in-situ* treatment over the entire Western Dog Pens area;
- Identification of sampling locations in select dog pens;
- Underground utility clearance;
- Exploration drilling within select dog pens; and,
- Lithologic logging, sample collection, and sample analysis (Table 1).

Each of these is described in greater detail below.

Phase B Data Evaluation and Definition of Minimum "Hot-Spot" Size

As described in the "Final Work Plan for Western Dog Pens, Background, and Off-Site Investigations," Dog Pens Investigation Phase A results were used to select sampling locations for the Phase B Investigation. In summary, Phase A consisted of: 1) reviewing all previously collected Dog Pens chemical/radiological data; 2) reviewing available reports for information on Dog Pens operations; 3) interviewing former Dog Pens employees; and, 4) conducting a reconnaissance gamma radiation survey over the entire surface of the Western Dog Pens area. Based on Phase A results, sampling strata were defined based on indications (both laboratory results and field readings) about chlordane and radium-226 (Ra-226) levels in each dog pen, and 12 dog pens were randomly selected to represent these strata.

During Phase B: 1) a detailed gamma survey was conducted on the gravel surface of the 12 selected dog pens; 2) 3 to 5 gravel samples were collected from each pen based on the survey results; 3) the gravel was removed and a detailed gamma survey was conducted on the exposed soil surface; and, 4) 4 to 7 surface soil samples were collected from each pen. A total of 46 gravel and 75 soil samples, including four (4) gravel and six (6) soil duplicates, were submitted to General Engineering Laboratories (GEL) in Charleston, South Carolina for selected radionuclide, organochlorine pesticide, mercury, hexavalent chromium, and nitrate analyses.

Phase B data for radionuclide, organochlorine pesticide, mercury, hexavalent chromium and nitrate analyses indicate that:

- Chlordane was detected in all but seven gravel samples at concentrations from 0.0003 milligrams per kilogram (mg/kg) to 0.099 milligrams per kilograms mg/kg, and in all soil samples at concentrations from 0.014 to 2.2 mg/kg; only three soil samples exceeded 0.34 mg/kg (the 10^{-6} excess cancer risk PRG for residential soils): one from pen G-32 at 0.49 mg/kg; one from pen D-25 at 0.77 mg/kg and one from pen E-7 at 2.2 mg/kg.

- Inorganic constituents levels were representative of background (as defined in WA, 1997a), with the exception of:

Constituent	Media	Soil Background	Number of Samples Above Background	Detections >2x Background Maximum Detected *(pen ID for maximum)*
Ra-226	Gravel	0.77 pCi/g	12 out of 46[1]	1 of 46 - 1.94 pCi/g (C-32)
Ra-226	Soil	0.77 pCi/g	8 out of 75	1 of 75 - 1.88 pCi/g (H-32)
Strontium-90	Gravel	0.36 pCi/g	4 out of 46[1]	4 of 46 – maximum of 3.59 pCi/g (C-32)
Cesium-137	Soil	0.053 pCi/g	17 out of 75	2 of 75 - 0.115 pCi/g (D-25); 0.113 pCi/g (G-32)
Thorium-234	Soil	1.09 pCi/g	11 out of 75	None
Uranium-238	Gravel	0.63 pCi/g	6 out of 46[1]	None
Uranium-238	Soil	0.63 pCi/g	23 out of 75	7 of 75 – maximum of 1.62 pCi/g (D-20)
Mercury	Soil	0.49 mg/kg	56 out of 75	17 of 75 – maximum of 2 mg/kg (G-32)
Hexavalent Cr	Gravel	0.099 mg/kg	41 out of 46[1]	26 of 46 – maximum of 0.451 mg/kg (D-25)
Hexavalent Cr	Soil	0.099 mg/kg	7 out of 75	2 of 75 – 0.837 mg/kg (H-30); 0.325 mg/kg (H-30).

[1]Background level is for local soils and may not be appropriate for comparison with this gravel, which is imported

- Identified "hot spots" were of very limited lateral extent.
- There is no discernable intra-pen or inter-pen pattern to the "hot-spot" distribution.
- No correlation is evident between surface gravel "hot-spots" and radionuclide activities and/or organochlorine and metals concentrations reported in soil directly underlying the surface gravel "hot spots".
- There is no correlation between field recorded gamma activities and laboratory reported Ra-226 activities.

The Phase B results indicate that surface "hot spots" of Ra-226 (defined here as activities greater than two times background, or about 1.5 pCi/g) and chlordane (defined here as concentrations greater than 0.5 mg/kg) are few and of very limited lateral extent. Samples adjacent to the identified "hot spots" were located as close as 1.2 ft from the "hot spot". In all cases, samples adjacent to "hot spots" had Ra-226 levels below background and/or chlordane concentrations at least an order of magnitude lower than the "hot spot" concentration. Therefore, based on the Phase B results, "hot spots" of 1.2-ft radius or smaller may be present throughout the Western Dog Pens.

Cost/Benefit Analysis Comparing the Necessary Sampling Costs to the Cost of Soil Removal or *In-Situ* Treatment over the Entire Western Dog Pens Area

As described above, Phase A and Phase B data indicate that there is no predictable pattern to the distribution of surface contamination in the Western Dog Pens. Phase B data also indicate that surface "hot spots" of Ra-226 and chlordane are typically of very limited extent and may have a 1.2-ft radius or smaller. Using this 1.2-ft radius and following United States Environmental Protection Agency (EPA) guidance for "hot spot" identification (EPA, 1992) and the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM, EPA, December 1997), about 19,500 surface soil

samples would have to be collected from the approximately 110,000 square-ft Western Dog Pens to identify all "hot spots" with a 95% confidence level. Even at an 80% confidence level, almost 16,000 samples would be required. Even if the samples were analyzed only for Ra-226 and chlordane, the cost for collecting and analyzing them would be almost $5,000,000 at the 80% confidence level and almost $6,000,000 at the 95% confidence level. Clearly, this cost is not justified given the contaminant levels detected, and that the preliminary cost estimate for complete removal and off-site disposal of the upper 2 ft of dog pens material is in this same range.

Because the sampling and analysis cost for locating all surface "hot-spots" in the Western Dog Pens would be prohibitive, Phase C does not focus on locating and delineating surface hot-spots. Rather, it focuses on examining the vertical extent of contaminants beneath the Western Dog Pens.

Identification of Sampling Locations in Select Dog Pens

Table 1 (attached) summarizes the locations, depths, planned number and type of samples that will be collected during Phase C, and the planned analyses to be performed. Figure 2 highlights the Dog Pens selected for Phase C sampling.

A total of 20 Western Dog Pens have been selected for Phase C investigation (Figure 2). Of the 20 dog pens highlighted, five pens were selected for Phase C investigation for the following reasons:

1. Dog Pen G-22: 5.11 pCi/g Ra-226 detected at 5.75 ft bgs near the pen entrance in 1994.
2. Dog Pen F-26: 1.82/pCi/g Ra-226 detected at 20.5 ft bgs near the pen entrance in 1994.
3. Dog Pen C-15: 15 mg/kg chlordane detected in surface soil beneath the former pedestal in 1996.
4. Dog Pen G-13: 1.9 mg/kg chlordane detected in surface soil beneath the former pedestal in 1996.
5. Dog Pen H-32: 1.88 pCi/g Ra-226 detected in surface soil in the rear central portion of the pen. This is the highest Ra-226 surface soil concentration reported during Phase B of the Western Dog Pen Investigation.

In the absence of Phase B predictable inter-pen and intra-pen hot-spots, the 15 remaining Western Dog Pens proposed for Phase C depth sampling shown on Figure 2 were selected at random using a random number generator (RNG). These 20 pens proposed for subsurface sampling in Phase C plus the 14 other pens sampled at depth in 1994 represent about 10% of the 320 pens in the Western Dog Pens.

The planned soil sample depths shown in Table 1 range from between the surface (just below the gravel) and 26 ft bgs. In addition, ground water from the top of the water table will be collected from six of the 20 boreholes (see Table 1 and Figure 2).

Underground Utility Clearance

Underground utility clearance will be performed prior to the proposed drilling activities. A white box will be spray-painted on the ground surface at each sampling location(s) to designate the specific area(s) requiring utility clearance. Underground Services Alert (USA) will be contacted at least 48 hours prior to the start of fieldwork and UC Davis Facilities Services will also be alerted to the proposed fieldwork. The UC Davis Facilities Services Department will visit the proposed sampling locations and clear each location for UC Davis utilities.

If for any reason the UC Davis Facilities Services Department is uncertain as to the exact location of a utility, an independent line locator may be subcontracted to verify the UC Davis Facilities Service Department's utility clearance prior to the start of fieldwork. Once USA and UC Davis have cleared the proposed locations, fieldwork can begin. During the fieldwork, the upper 5 ft at each proposed soil boring location will be hand-augered as an additional safeguard against unknowingly damaging unmarked utilities.

Exploration Drilling

The proposed borings will be advanced using direct push drilling technology as described in Standard Operating Procedure (SOP) 3.2, Subsurface Soil Sampling While Drilling (attached). Direct push drilling was successfully used at LEHR during the 1997 Data Gaps Investigation. This drilling method produces minimal waste, provides high quality core for logging purposes, is rapid, and uses specific direct push rigs in areas of limited access, like inter-pen concrete curbing at the LEHR Dog Pens.

During logging of the core, a photoionization detector (PID), Geiger Mueller Detector (GM), and scintillation detector (SCIN) will be used to screen for organic vapors and radionuclide activity. At the conclusion of deep soil sampling, coreholes will be backfilled to three ft below grade with grout. Grout will be mixed aboveground and placed into the corehole with a tremie pipe. The upper three ft of the corehole will be backfilled with unused core. Remaining unused core will be spread out immediately near its point of origin in the Western Dog Pens, as specified in the project Draft Investigative Derived Waste Management Plan (PNL, 1994).

Lithologic Logging and Sample Collection

Lithologic core logging will be performed using the United Soil Classification System (USCS) method as described in SOP 15.1, Logging of Soils – Visual Unified Soil Classification

(USCS). Furthermore, soil sample collection during drilling will be conducted according to SOP 3.1, Surface and Shallow Subsurface Soil Sampling, and SOP 3.2, Subsurface Soil Sampling while Drilling, presented in Appendix A of the "Final Work Plan for Western Dog Pens, Background, and Off-Site Investigations" (WA, 1997a).

Direct push drilling methods will follow the Continuous Core Sampling System Methods in SOP 3.2, (attached). Sample handling, packaging, and shipping are described in SOP 2.1 (attached). Decontamination of drilling and sampling equipment will follow the procedures described in Sampling Equipment and Well Material Decontamination in SOP 6.1 and Drilling and Heavy Equipment Decontamination described in SOP 6.2 (attached).

Field personnel will generate a unique Phase C Dog Pen sampling map for each sampled Dog Pen, as depicted on Figure 3.

Soil samples will be collected from each boring at 0, 2 ft bgs, and at three other depths (see Table 1) to approximately 26 ft bgs. The 0 ft bgs sample will be from the first soil encountered beneath any gravel present. Two soil samples will be collected in 6-inch brass tubes for the samples at depths 2 ft bgs and deeper, with two 6-inch intervals of core collected. The upper tube will be utilized for organochlorine pesticides, mercury, nitrate, ammonia, organic nitrogen, total organic carbon (TOC), total chromium, and chromium (VI) analyses; and the lower tube will be utilized for radionuclides analyses.

One duplicate sample will be collected from every fourth boring, for a total of five (5) duplicate samples representing 5% of the total samples. In addition, two rinseate samples will be collected for this sampling event.

Ground Water Sampling

If a perched ground water horizon is encountered and water accumulates in sufficient volume to allow for sampling in any of the twenty boreholes proposed for Phase C, a grab ground water sample will be collected, if possible. In addition, six of the 20 boreholes will be advanced to about 3 ft below the water table and ground water samples will be collected, if possible (see Table 1 and Figure 2). If it takes more than 20 minutes for the water level in the open borehole to recover between bailings, ground water samples for radionuclide analysis will not be collected at this location. Each ground water sample collected will be analyzed for Sr-90, Ra-226, gross alpha, gross beta, mercury, ammonia, organic nitrogen, TOC, total chromium, hexavalent chromium, and nitrate. Each ground water sample will be collected using a clean, disposable plastic bailer and decanted into laboratory-supplied sample containers. Three liters will be collected in plastic bottles and 0.25 liters will be collected in glass bottles. Samples will be shipped to the laboratory within 24 hours utilizing chain-of-custody handling procedures. The laboratory will filter the samples through a 0.45 micron filter and reduce the sample pH to <2 using nitric acid (except for the water to be used for nitrate and hexavalent chromium analyses).

For this sampling event, one bailer blank will also be collected. The bailer blank will consist of deionized water that has been poured into the bailer and decanted into sample bottles in the field, analogous to the procedures for sample collection. The bailer blank will be transported to the laboratory with the other samples, but will only be analyzed if the associated sample results are anomalous. Holding times for most analyses are sufficiently long so that this will be possible.

Ground water sample locations will be recorded in the field notebook and on the appropriate sampling map. Ground water samples will be analyzed by GEL using the same analytical methods and detection limits used for the quarterly ground water monitoring (Dames & Moore, 1997). Used disposable bailers and filters will be bagged with the Personal Protective Equipment (PPE) for storage pending analyses that will be used to determine disposal.

Additional Health and Safety Concerns

Figure 2 (attached) presents the Western Dog Pens selected for Phase C sampling and also shows the Western Dog Pens, which were sampled during Phase B in November 1997. During Phase B, surface gravel was removed to a depth of approximately 1.5 ft from the pens (shown on Figure 2). Removing the gravel exposed native soil in these pens. Recent and predicted future heavy rains may create muddy conditions in these pens. To mitigate the possible spread of mud between pens and/or outside of the pens area, the following measures will be taken:

1. Visqueen shall be placed over exposed native soil where Phase C sampling is to be conducted.
2. The drilling rig will enter and exit only through the Gate at the west end of Row G. This area is still covered with asphalt, and was minimally impacted by Phase B activities.
3. All personnel entering the Western Dog Pens will enter through the gate at the west end of Row F.
4. A canopy will be erected within an appropriate distance of Gate F at the west end of Row F, under which field personnel will don and doff their PPE and where decontamination and body frisking procedures will be conducted.
5. A step off pad will be placed beneath this canopy to prevent the possible transport of radionuclides or other contaminants via footwear.
6. Several pens have been selected and identified on Figure 2 to serve as contingency pens. These contingency pens will be sampled in the event of any of the original 20 pens cannot be sampled.

Furthermore, prior to the start of the field work described in this work plan, the Field Coordinator (FC) will review with the field crew all relevant and appropriate Activity Hazard Analysis (AHA) sheets contained in the Draft Project Health and Safety Plan for LEHR, Davis, California (WA, 1997c).

Summary and Conclusions

Fieldwork will be conducted according to the SOPs presented in Appendix A of the "Final Work Plan for Western Dog Pens, Background, and Off-Site Investigations at the Laboratory for Energy-related Health Research (LEHR), University of California at Davis, California" (WA, 1997a), and in accordance with the attached SOPs. The field activities anticipated for Phase C of the Western Dog Pens Investigation include:

- Chain-of-Custody (SOP 1.1);
- Sample Handling, Packaging, and Shipping (SOP 2.1);
- Surface and Shallow Subsurface Soil Sampling (SOP 3.1);
- Lithologic Logging (SOP 15.1);
- Subsurface Soil Sampling while Drilling (SOP 3.2); and,
- Grab ground water sampling.

As presented in Table 1b of the "Final Work Plan for Western Dog Pens, Background, and Off-site Investigations" (WA, 1997a), soil samples collected from Phase C proposed borings will be analyzed by a contract laboratory for:

- Organochlorine Pesticides/PCBs, by CLP SOW OLM 01.8 (or more recent);
- Ra-226 by gamma spectroscopy analytical method 901.1 (revised from method 903.1 proposed in Table 1b of Work Plan; in-growth and counting times will be sufficient to attain 0.1 pCi/g detection limit);
- Gross Alpha and Gross Beta by analytical method 9310;
- Carbon-14 by liquid scintillation counter;
- Strontium-90 by analytical method 905.0;
- Gamma Emitters by analytical method 901.1;
- Hexavalent Chromium by analytical method 7196;
- Total chromium by appropriate CLP method (selected samples only);
- Mercury by CLP SOW ILM 02.1 (or more recent CLP method);
- Nitrate by analytical method 300.0;
- Organic nitrogen by EPA analytical method 350.1/351.2 (selected samples);
- Ammonia by EPA analytical method 350.1 (selected samples); and,
- Total organic carbon by EPA SW-846 analytical method 9060 (selected samples).

Ground water samples will be analyzed using the methods listed in Table 1.

The results for all three phases (A, B and C) of Western Dog Pens Investigations will be described in a Technical Memorandum to be prepared after Phase C results are received and validated. The planned schedule for conducting Phase C and preparing the Technical Memorandum is presented as Figure 4.

REFERENCES

Dames & Moore, 1997, Revised Field Sampling Plan, LEHR/SCDS Environmental Restoration, April 1997.

Pacific Northwest Laboratory (PNL), 1994, Draft Waste Management Plan for Investigation Derived Wastes, January 1994.

US Environmental Protection Agency (EPA), 1992, Guidance for Data Usability in Risk Assessment (Part A), April 1992, publication 9285.7-09A.

US Environmental Protection Agency (EPA), Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), December 1997, Publication EPA 40L-R-97-016.

Weiss Associates (WA), 1997a, Final Work Plan for Western Dog Pens, Background, and Off-Site Investigations, Laboratory for Energy-related Health Research (LEHR), University of California at Davis, California, October 3, 1997, 31 pp., 4 tables, 8 figures, 1 appendix.

WA, 1997b, Final Site Characterization Summary Report for the DOE Areas at the Laboratory for Energy-related Health Research (LEHR), University of California at Davis, California, November 11, 1997, Rev. 0.

WA, 1997c, Draft Project Health and Safety Plan for LEHR, University of California at Davis, California, February 14, 1997, Rev. B.

FIGURES

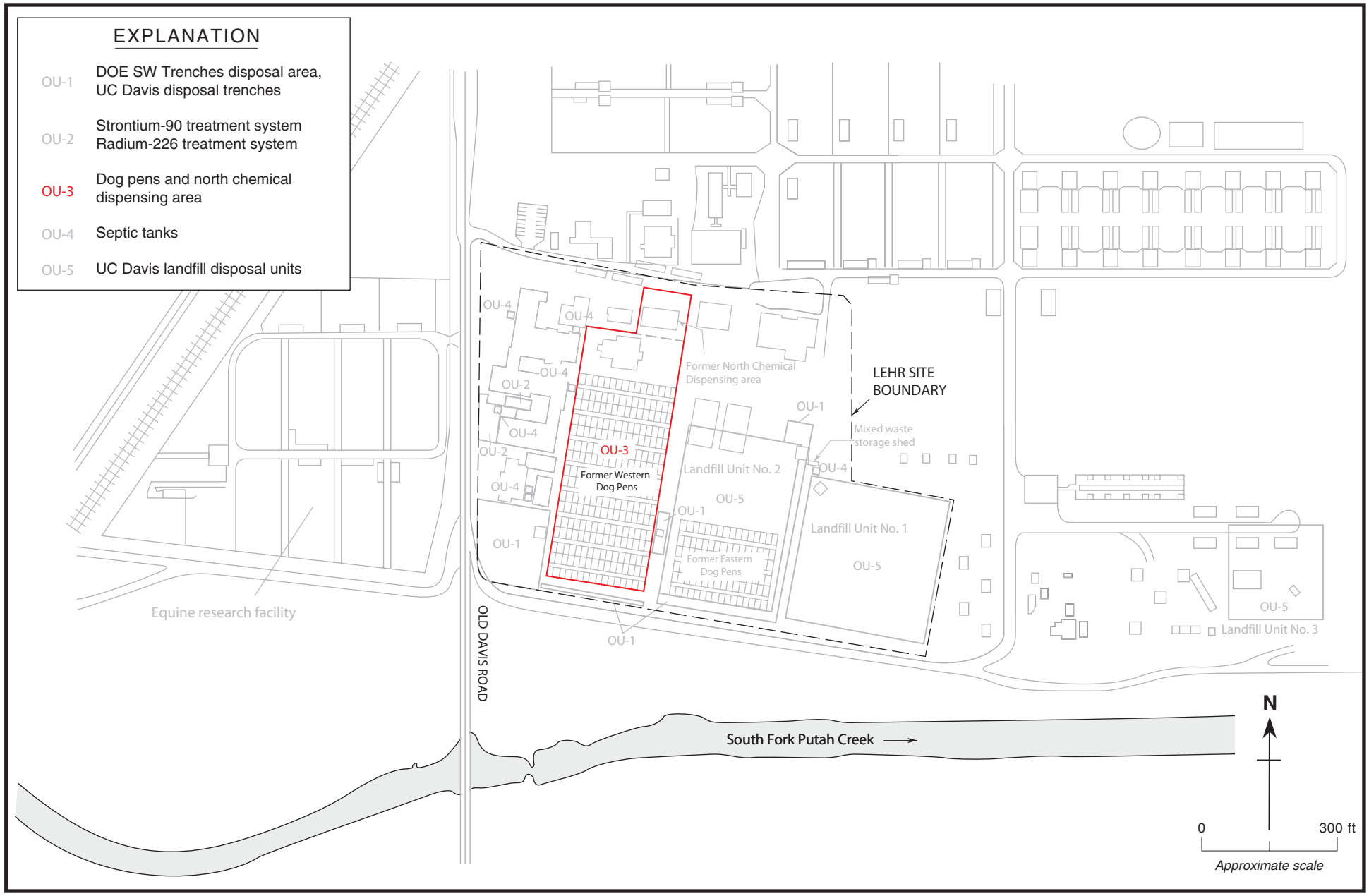

Figure 1. Location of Former Western Dog Pens - LEHR Site, UC Davis, California

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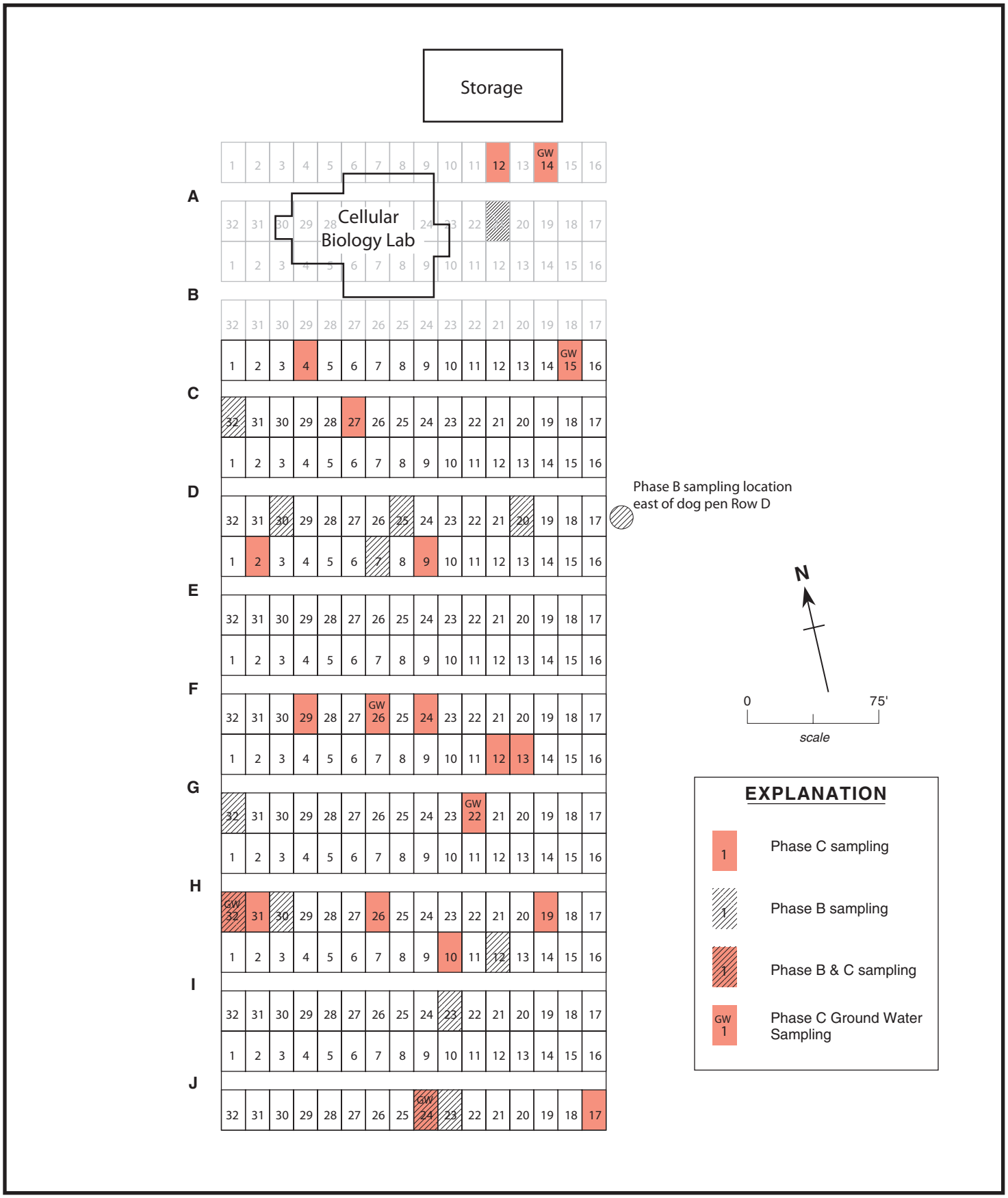

Figure 4. Western Dog Pens Selected for Phase B and Phase C Sampling - LEHR Site, UC Davis, California

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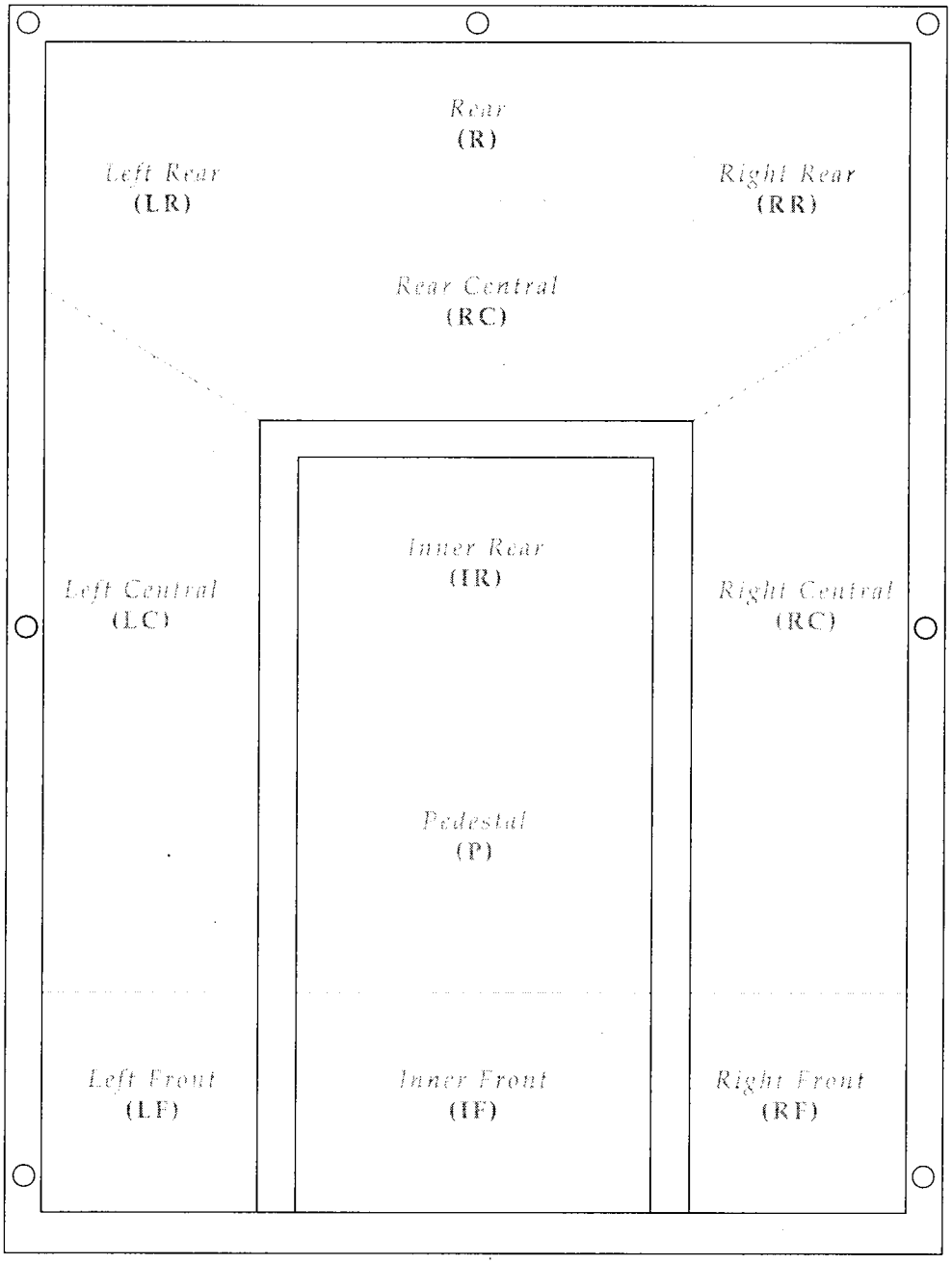
Dog Pen ID _____

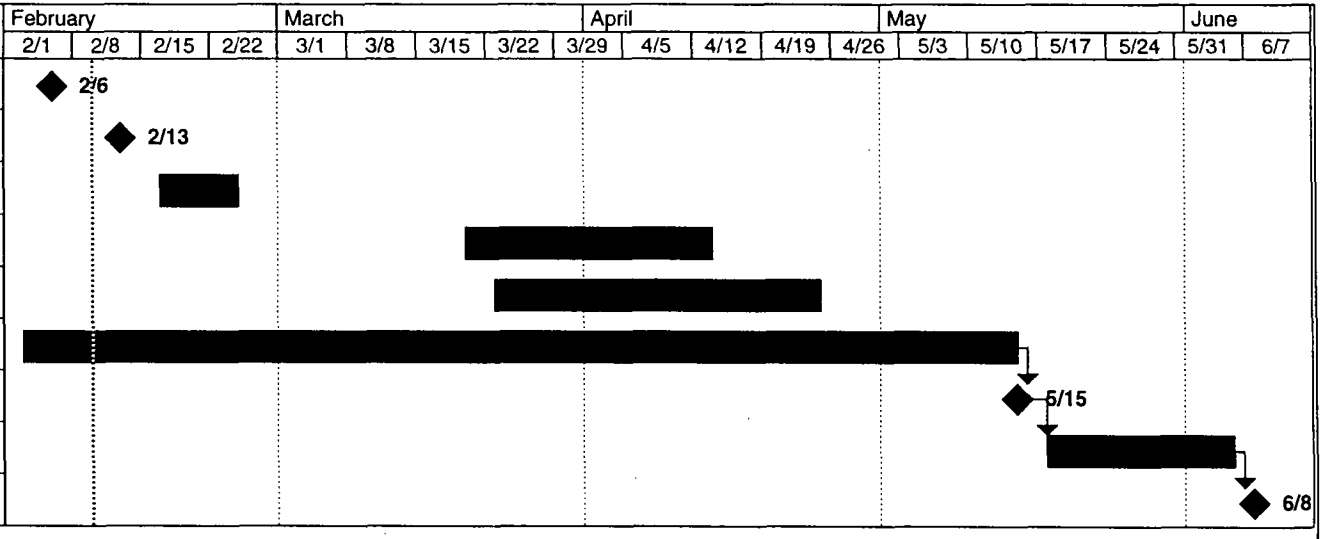


Sample Date	Sample Time	Field Sampler	PID Reading

Directions: Plot sample location and show north arrow direction

Figure 3. Phase C Western Dog Pen Sampling Map - LEHR Site, Davis, California

ID	Task Name	Duration
1	Submit Phase C Work Plan to RPMs	1 day
2	RPM Approval to Proceed	1 day
3	Conduct Fieldwork	6 days
4	Analytic Data Received	17 days
5	Data Validation	25 days
6	Prepare Tech Memo	73 days
7	Draft Tech Memo to DOE-OAK	1 day
8	DOE Review/Incorporate DOE Comment	15 days
9	Tech Memo to RPMs	1 day



Western Dog Pens
Date: Tue 2/10/98

Task		Rolled Up Task		External Tasks	
Progress		Rolled Up Milestone		Project Summary	
Milestone		Rolled Up Progress			
Summary		Split			

Figure 4. Planned Schedule for Western Dog Pens Investigation Phase C and Technical Memorandum

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TABLE

Table 1. Phase C Western Dog Pens Investigation Sampling and Analysis Summary

Dog Pen Location	Sample Depth (ft)	Number of Containers	Sample/ Container Type[1]	Comments
Soil Samples collected from the following locations will be analyzed for: organochlorine pesticides, gamma emitters, radium-226, strontium-90, carbon-14, mercury, hexavalent chromium, and nitrate (see Notes for methods and detection limits).				
A-12	*surface*[2]	2	S/6-in Tubes	
A-12	*2 to 3*	2	S/6-in Tubes	
A-12	*10 to 11*	2	S/6-in Tubes	
A-12	*20 to 21*	2	S/6-in Tubes	
A-12	*25 to 26*	2	S/6-in Tubes	
C-4	*surface*	2	S/6-in Tubes	
C-4	*2 to 3*	2	S/6-in Tubes	
C-4	*8 to 9*	2	S/6-in Tubes	
C-4	*20 to 21*	2	S/6-in Tubes	
C-4	*25 to 26*	2	S/6-in Tubes	
C-27	*surface*	2	S/6-in Tubes	Locate borehole beneath (or as close
C-27	*2 to 3*	2	S/6-in Tubes	as possible to) gravel trench
C-27	*5 to 6*	2	S/6-in Tubes	
C-27	*15 to 16*	2	S/6-in Tubes	
C-27	*25 to 26*	2	S/6-in Tubes	
E-2	*surface*	2	S/6-in Tubes	
E-2	*2 to 3*	2	S/6-in Tubes	
E-2	*10 to 11*	2	S/6-in Tubes	
E-2	*20 to 21*	2	S/6-in Tubes	
E-2	*25 to 26*	2	S/6-in Tubes	
E-9	*surface*	2	S/6-in Tubes	
E-9	*2 to 3*	2	S/6-in Tubes	
E-9	*8 to 9*	2	S/6-in Tubes	
E-9	*15 to 16*	2	S/6-in Tubes	
E-9	*25 to 26*	2	S/6-in Tubes	
F-24	*surface*	2	S/6-in Tubes	
F-24	*2 to 3*	2	S/6-in Tubes	
F-24	*10 to 11*	2	S/6-in Tubes	
F-24	*20 to 21*	2	S/6-in Tubes	
F-24	*25 to 26*	2	S/6-in Tubes	
F-29	*surface*	2	S/6-in Tubes	
F-29	*2 to 3*	2	S/6-in Tubes	
F-29	*5 to 6*	2	S/6-in Tubes	
F-29	*15 to 16*	2	S/6-in Tubes	
F-29	*25 to 26*	2	S/6-in Tubes	
G-12	*surface*	2	S/6-in Tubes	
G-12	*2 to 3*	2	S/6-in Tubes	
G-12	*8 to 9*	2	S/6-in Tubes	
G-12	*20 to 21*	2	S/6-in Tubes	
G-12	*25 to 26*	2	S/6-in Tubes	
G-13	*surface*	2	S/6-in Tubes	Locate borehole at former pedestal
G-13	*2 to 3*	2	S/6-in Tubes	location
G-13	*8 to 9*	2	S/6-in Tubes	
G-13	*15 to 16*	2	S/6-in Tubes	
G-13	*25 to 26*	2	S/6-in Tubes	

Table 1. Phase C Western Dog Pens Investigation Sampling and Analysis Summary (continued)

Dog Pen Location	Sample Depth (ft)	Number of Containers	Sample/ Container Type[1]	Comments
H-19	*surface*	2	S/6-in Tubes	
H-19	*2 to 3*	2	S/6-in Tubes	
H-19	*5 to 6*	2	S/6-in Tubes	
H-19	*15 to 16*	2	S/6-in Tubes	
H-19	*25 to 26*	2	S/6-in Tubes	
H-26	*surface*	2	S/6-in Tubes	
H-26	*2 to 3*	2	S/6-in Tubes	
H-26	*5 to 6*	2	S/6-in Tubes	
H-26	*15 to 16*	2	S/6-in Tubes	
H-26	*25 to 26*	2	S/6-in Tubes	
H-31	*surface*	2	S/6-in Tubes	
H-31	*2 to 3*	2	S/6-in Tubes	
H-31	*5 to 6*	2	S/6-in Tubes	
H-31	*15 to 16*	2	S/6-in Tubes	
H-31	*25 to 26*	2	S/6-in Tubes	
I-10	*surface*	2	S/6-in Tubes	
I-10	*2 to 3*	2	S/6-in Tubes	
I-10	*8 to 9*	2	S/6-in Tubes	
I-10	*15 to 16*	2	S/6-in Tubes	
I-10	*25 to 26*	2	S/6-in Tubes	
J-20	*surface*	2	S/6-in Tubes	
J-20	*2 to 3*	2	S/6-in Tubes	
J-20	*10 to 11*	2	S/6-in Tubes	
J-20	*20 to 21*	2	S/6-in Tubes	
J-20	*25 to 26*	2	S/6-in Tubes	
Soil Samples collected from the following locations will be analyzed for: organochlorine pesticides, gamma emitters, radium-226, strontium-90, carbon-14, mercury, total chromium, hexavalent chromium, nitrate, organic nitrogen, ammonia, and total organic carbon. Ground water samples will be analyzed for this same list, except they will not be analyzed for organochlorine pesticides, gamma emitters, and carbon-14.				
A-14	*surface*	2	S/6-in Tubes	
A-14	*2 to 3*	2	S/6-in Tubes	
A-14	*5 to 6*	2	S/6-in Tubes	
A-14	*15 to 16*	2	S/6-in Tubes	
A-14	*25 to 26*	2	S/6-in Tubes	
A-14	*Ground water*	4	3 1-liter plastic 1 0.25-liter glass	
C-15	*surface*	2	S/6-in Tubes	Locate borehole at former pedestal
C-15	*2 to 3*	2	S/6-in Tubes	location
C-15	*10 to 11*	2	S/6-in Tubes	
C-15	*20 to 21*	2	S/6-in Tubes	
C-15	*25 to 26*	2	S/6-in Tubes	
C-15	*Ground water*	4	3 1-liter plastic 1 0.25-liter glass	
F-26	*surface*	2	S/6-in Tubes	Locate borehole at "inner front" of
F-26	*2 to 3*	2	S/6-in Tubes	pen (at center of pen entrance)
F-26	*8 to 9*	2	S/6-in Tubes	

Table 1. Phase C Western Dog Pens Investigation Sampling and Analysis Summary (continued)

Dog Pen Location	Sample Depth (ft)	Number of Containers	Sample/ Container Type[1]	Comments
F-26	*15 to 16*	2	S/6-in Tubes	
F-26	*20 to 21*	2	S/6-in Tubes	
F-26	*Ground water*	4	3 1-liter plastic 1 0.25-liter glass	
G-22	*surface*	2	S/6-in Tubes	Locate borehole at "inner front" of pen (at center of pen entrance)
G-22	*2 to 3*	2	S/6-in Tubes	
G-22	*5 to 6*	2	S/6-in Tubes	
G-22	*15 to 16*	2	S/6-in Tubes	
G-22	*25 to 26*	2	S/6-in Tubes	
G-22	*Ground water*	4	3 1-liter plastic 1 0.25-liter glass	
H-32	*surface*	2	S/6-in Tubes	Locate borehole in "rear central" of pen
H-32	*2 to 3*	2	S/6-in Tubes	
H-32	*10 to 11*	2	S/6-in Tubes	
H-32	*20 to 21*	2	S/6-in Tubes	
H-32	*25 to 26*	2	S/6-in Tubes	
H-32	*Ground water*	4	3 1-liter plastic 1 0.25-liter glass	
J-24	*surface*	2	S/6-in Tubes	
J-24	*2 to 3*	2	S/6-in Tubes	
J-24	*5 to 6*	2	S/6-in Tubes	
J-24	*15 to 16*	2	S/6-in Tubes	
J-24	*25 to 26*	2	S/6-in Tubes	
J-24	*Ground water*	4	3 1-liter plastic 1 0.25-liter glass	
Equipment Rinseate Sample		8	5 1-liter plastic; 2 1-liter glass; 1 0.25-liter glass	
Equipment Rinseate Sample		8	5 1-liter plastic; 2 1-liter glass; 1 0.25-liter glass	

Abbreviations:

LSC = Liquid Scintillation Counter

Notes:

1 = S = Soil
2 = "Surface" means first soil beneath any gravel present

Table 1. Phase C Western Dog Pens Investigation Sampling and Analysis Summary (continued)

Analyses:

Samples will be analyzed for some or all of the following constituents:

Constituent	Analytical Method	Media Analyzed
Organochlorine Pesticides	CLP SOW OLM01.8	soil
Gross Alpha	9310	soil/ground water
Gross Beta	9310	soil/ground water
Carbon-14	LSC	soil
Sr-90	905.0	soil/ground water
Gamma Emitters	901.1	soil
Ra-226	901.1	soil/ground water
Total Chromium	CLP	soil/ground water
Hexavalent Chromium	7196	soil/ground water
Mercury	CLP SOW ILM 02.1	soil/ground water
Nitrate	300.0	soil/ground water
Organic Nitrogen	EPA 350.1/351.2	soil/ground water
Ammonia	EPA 350.1	soil/ground water
Total Organic Carbon	EPA 415.2	soil/ground water

Gamma Emitters

Analyte	Detection Limits (pCi/g)
Ac-228	0.5
Bi-212	1
Bi-214	0.2
Co-60	0.1
Cs-137	0.1
K-40	2
Pb-210	10
Pb-212	0.1
Pb-214	0.2
Ra-226	0.1
Th-234	5
Tl-208	0.2
U-235	0.5
U-238	0.5

ATTACHMENTS

SAMPLE HANDLING, PACKAGING AND SHIPPING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) outlines the methods and responsibilities for field personnel to use in the packaging and shipping of environmental samples, hazardous materials and hazardous waste samples for chemical and physical analysis. This SOP only applies to the packaging and shipping of limited quantity, low concentration environmental samples. The details in this SOP are only applicable to the general requirements for sample packaging and shipping and should only be used as a guide for developing more job-specific work plans.

2.0 REFERENCES

EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14.

EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies Under CERCLA, Interim Final OSWER Directive 9355.3-01.

Code of Federal Regulations, DOT 49 CFR Parts 100 to 177, Revised October 1, 1992.

Dangerous Goods Regulations, IATA, January 1, 1994.

SQP 4.2 - Records Management.

3.0 DEFINITIONS

3.1 Environmental Sample

A limited quantity, low concentration sample that does not require Department of Transportation (DOT) or International Air Transportation Association (IATA) hazardous waste labeling as a hazardous waste or material.

3.2 Hazardous Waste Sample

Medium or high concentration sample requiring either DOT or IATA labeling as a hazardous waste or material.

3.3 Hazardous Waste

Any substance listed in 40 CFR Subpart D (260.30 et seq.) or otherwise characterized as ignitable, corrosive, reactive, or toxic as specified in Subpart C (261.20 et seq.) that would be subject to manifest and packaging requirements specified in 40 CFR 262. Hazardous waste is defined and regulated by the U.S. Environmental Protection Agency (EPA).

3.4 Hazardous Material

A substance or material in a quantity or form, which may pose an unreasonable risk to health, safety, and/or property when transported in commerce. Hazardous material is defined and regulated by DOT (49 CFR 173.2 and 172.101) and IATA (Section 4.2).

3.5 Sample

Physical evidence collected from a facility or the environment which is representative of conditions at the point and time at which the sample is collected.

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 Compliance with this procedure is the responsibility of project management, site management, health and safety, and field personnel.

4.1.2 The Project Manager is responsible for the development and review of site-specific work plans which address the specific sample handling, packaging, and shipping requirements for the project. The PM should review the project specific documentation forms to ensure they are appropriate for the field activities. The Project Manager is also responsible for seeing that field personnel receive proper training and maintain quality assurance/quality control (QA/QC).

4.1.3 The Project Quality Assurance Specialist (PQAS) is responsible for the periodic review of documentation generated during sample handling, packaging, and shipping and the periodic review and audit of field personnel as they perform the work. If problems arise, the PQAS is also responsible for swift implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to requirements, issuing nonconformances).

4.1.4 Health and Safety Officer (HSO) is responsible for ensuring complete compliance with the Health and Safety Plan by all personnel on site. He/She is responsible for ensuring that all protective measures are identified and implemented to adequately protect site workers.

4.1.5 Radiological Control Technician (RCT) – is responsible for assisting the HSO in the performance of monitoring, posting and evaluation of work-site safety and radiological controls conditions.

4.2 Sample Handling

4.2.1 Inspect the sampling containers to ensure that they are appropriate for the samples being collected, correctly preserved, and undamaged.

4.2.2 When collecting a sample, always use approved/site specific personal protective equipment (e.g., gloves, etc.) to prevent cross-contamination from sample to sample but also as a health and safety requirement.

4.3 Field Packaging

4.3.1 Collect the samples in accordance with the site-specific work plans and applicable SOPs.

4.3.2 As soon as possible after sample collection, tightly seal the container, and place a piece of custody tape over or around the cap. The custody tape should be placed over the cap so that any attempt to remove the cap will cause the tape to be broken. Do not place custody tape over a volatile organic analysis (VOA) vial septum.

4.3.3 Place all containers in separate, appropriately sized, airtight, seam sealing polyethylene bags (e.g., Ziploc™). Seal the bag, removing any excess air.

4.3.4 Place the bagged container inside an insulating shipping container, "cooler." This cooler should have frozen blue ice inside to assure samples remain cool, "4°C," during transit from field to the packaging location.

4.3.5 Maintain the samples under chain-of-custody (COC) (SOP 1.1) in accordance with the site-specific work plans and appropriate SOPs.

4.4 Sample Packaging

4.4.1 Inspect the integrity of the shipping container. The container is generally a "cooler" constructed of heavy plastic or metal with appropriate insulating properties so that variations in temperature during shipping are minimized. Also make sure that the drain plug has been sealed.

4.4.2 Place two to four inches of absorbent packaging material (e.g., Vermiculite™) in the bottom of the shipping container.

4.4.3 Carefully check the COC record against the collected sample labels and containers to ensure that the sample numbers, sample description, date and time of collection, container type and volume, preservative, and the required analytical methods are correct and in agreement.

4.4.4 Place the samples in the shipping container, allowing sufficient room between the samples to place ice and/or packing material.

4.4.5 Double bag and seal crushed or cubed ice in heavy-duty polyethylene bags. Place these bags of ice on top of and between samples. Blue ice should not be used for sample shipping; it does not maintain the 4°C temperature necessary for regulatory compliance. The remaining space will be filled with packing material.

4.4.6 All samples requiring 4°C temperature preservation will be acceptable "as in" within the range of 4°C ± 2°C. The laboratory should record the temperature of receipt on the COC. For all samples received from 6°C to 10°C, the sample(s) and temperature (in 1°C increments) will be noted on the COC and then analyzed. Samples with temperatures greater than 10°C and VOA samples below 0°C will be reported immediately to the Project Manager.

4.5 Sample Shipping

4.5.1 The person in charge of sample custody will time, date, and sign over relinquishment of custody on the COC. When a common carrier is to be used for sample shipment, also record the air/waybill number (tracking number) and the name of the carrier on the COC record. Place the original copy of the COC record in a sealed, clear plastic envelop or bag and tape the COC record envelope to the inside lid of the shipping container. Retain a copy of the COC record for tracking purposes.

4.5.2 Using nylon reinforced strapping tape or mailing tape, seal the shipping container.

4.5.3 Place custody tape over opposite ends of the lid.

4.5.4 Mark the container "THIS END UP," or apply arrow labels that indicate the proper position to be maintained during shipping.

4.5.5 Apply a label stating the name and address of the shipper and the receiving laboratory on the outside of the cooler.

4.5.6 Turn the sample(s) over to the courier or carrier for delivery to the laboratory. All samples should be shipped by the fastest available method to the laboratory as soon as possible after sample collection.

NOTE: The courier or carrier is not responsible for sample custody and is not required to sign the COC.

4.5.7 Contact the appropriate laboratory personnel to advise them of the sample shipment.

4.5.8 Review the COC and sample collection forms for completeness and turn them over to site or project management personnel.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, at the discretion of the Project Task Leader, if the substitute form contains, as a minimum, similar information as the referenced form. Also, forms may be combined or data collected in an alternate fashion at the discretion of the Project Task Leader. The PQAM should approve alternate form use if the minimum data recommended in this SOP will not be collected and/or tabulated.

SUBSURFACE SOIL SAMPLING WHILE DRILLING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for subsurface soil sampling while drilling. Several methods may be used to collect subsurface samples. The more common drilling methods and sampling procedures are described below. Proper collection procedures are necessary to assure the quality and integrity of all subsurface soil samples. Additional specific procedures and requirements will be provided in the project work plans, as necessary.

2.0 REFERENCES

American Society for Testing Materials (ASTM), 1989, Standard Method for Penetration Test and Split-Barrel Sampling of Soils, Method D-1586-84, Philadelphia, PA.

American Society for Testing Materials (ASTM), 1986, Standard Practice for Thin-Walled Tube Sampling of Soils, Method D-1587-83, Philadelphia, PA, p. 304-307.

American Society for Testing Materials (ASTM), 1986, Standard Practice for Ring-Lined Barrel Sampling of Soils, Method D-3550-84, Philadelphia, PA, p. 560-563.

SOP 1.1 - Chain-of-Custody

SOP 2.1 - Sample Handling, Packaging and Shipping

SOP 6.1 - Sampling Equipment and Well Material Decontamination

SOP 14.1 - Hollow Stem Auger Drilling

SOP 14.2 - Mud Rotary Drilling

SOP 14.3 - Air Rotary Drilling

SOP 14.4 - Dual Tube Percussion Drilling

SOP 15.1 - Lithologic Logging

SOP 17.1 - Sample Labeling

SOP 17.2 - Sample Numbering

SOP 19.1 - On-Site Sample Storage

SQP 4.2 - Records Management

3.0 DEFINITIONS

3.1 Borehole

Any hole drilled into the subsurface for the purpose of identifying lithology, collecting soil or water samples, and/or installing monitoring wells.

3.2 Split-Spoon Sampler

A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. This device can be driven into resistant (semi-consolidated) materials using a drive weight or drilling jars mounted in the drilling rig. A standard split-spoon sampler (used for performing standard penetration tests) is 2 inches in outside diameter and 1-3/8 inches in inside diameter. This standard spoon typically is available in two common lengths, providing either 20-inch or 26-inch internal longitudinal clearance for obtaining 18-inch or 24-inch long samples, respectively. Six-inch long sleeves (tubes) of brass, stainless steel, or plastic are commonly placed inside the sampler to collect and retain soil samples. A five-foot long split-spoon sampler is also available. A California modified split-spoon sampler is also commonly used. The design is similar to the standard split-spoon except the outside diameter is 2½ inches and the inside diameter is 2 inches.

3.3 Shelby Tube Sampler

A thin-walled metal tube used to recover relatively undisturbed samples. These tubes are available in various sizes, ranging from 2 to 5 inches in outside diameter and 18 to 54 inches in length. A stationary piston device is included in the sampler to reduce sampling disturbance and increase sample recovery.

3.4 Drilling Jars

A set pair of linked, heat-treated steel bars. The jars may be attached to a wireline sampling string incorporating a split spoon or other impact sampler. The jars are used to drive the sampler into the soil below the bottom of the borehole.

3.5 Continuous Core Sampling System Methods

Continuous core sampling system methods utilize a core barrel, which recovers a soil core from the interval the barrel is advanced through. Soil samples are collected in 1.5-inch to 2.65-inch diameter brass or stainless steel sleeves inside the inner sample barrel. Typically, the sleeves are removed from the sample barrel and given to the site geologist or engineer for testing and lithologic description. The outer-drive barrel is recovered after the total depth of the boring is attained.

4.0 PROCEDURES

This section describes both the responsibilities and procedures involved with subsurface soil sampling while drilling. Proper subsurface soil sampling procedures are necessary to ensure the quality and integrity of the samples. The details this SOP should be used in conjunction with project work plans. The project work plans will generally provide the following information:

- Sample collection objectives;
- Locations of soil borings and target horizons or depths of soil samples to be collected;
- Numbers and volumes of samples to be collected;
- Types of analyses to be conducted for the samples;
- Specific quality control (QC) procedures and sampling required; and,
- Any additional subsurface soil sampling requirements or procedures beyond those covered in this SOP, as necessary.

There are many different methods that may be used for subsurface soil sample collection during drilling. This SOP focuses on the two most common methods of soil sample collection: split-spoon sampling and Shelby tube sampling. At a minimum, the procedures outlined below for these two subsurface soil sampling methods will be followed. If other subsurface soil sampling methods are deemed necessary to meet project objectives, the procedures for these methods will be updated in this SOP or included in the project work plans.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to subsurface soil sampling activities during drilling are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from procedures to the Site Superintendent, Field Coordinator, or the PQAS.

4.2 General Sampling Considerations

The two subsurface soil-sampling methods covered in this SOP, split-spoon and Shelby tube, are commonly used in conjunction with hollow stem auger, air rotary and dual tube percussion drilling methods. Split-spoon or Shelby tube sampling may be conducted when drilling with mud rotary methods. However, when using this drilling method the samples are not generally useful for chemical analyses. This is because the samples may become invaded or chemically altered when they are travel through the drilling mud during sample retrieval. In addition, loose unconsolidated soils may also literally wash out of the samplers when they travel through the mud column.

The procedures described in this SOP must be used in conjunction with the SOP prescribed for the specific drilling method used at the site. SOPs 14.1, 14.2, 14.3 and 14.4 specifically cover hollow stem auger, mud rotary, air rotary, and dual tube percussion drilling methods, respectively. Included in these drilling method SOPs are specific drilling requirements related to subsurface soil sampling. These also include, but are not limited to, site clearance, site preparation, and health and safety requirements. Consequently, the SOP for the specific drilling method to be used at the site, the project work plans, and this SOP must be reviewed together before the initiation of drilling and sampling.

4.3 Split-Spoon Sampling

Split-spoon samples for chemical analysis are usually obtained in brass, plastic, or stainless steel sleeves. The types, dimensions and number of sleeves to be used, along with the length and type of sampler, will be stated in the project work plans. The split-spoon sampler, lined with the sleeves, is connected to the drill rod string or a wireline sampling string and is driven by a hammer (140 or 340 pound, depending on the size of the sampler) or drilling jars into the undisturbed soil below the bottom of the borehole. The procedure for collecting samples from the split-spoon sampler will be outlined in the project work plans. The standard procedure is described below.

4.3.1 Calibrate all field analytical and health and safety monitoring equipment according to the instrument manufacturer's specifications. Calibration results will be recorded on the appropriate form(s) as specified by the project-specific work plans. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.

4.3.2 Wear the appropriate personal protective equipment as specified in the project work plans and the applicable drilling method SOP. Personnel protection will typically include a hard hat, safety glasses, gloves, steel-toed boots, hearing protection, and coveralls.

4.3.3 Between each sampling location and prior to each sampling run, decontaminate the sampler, sleeves, and other sampling equipment as described in SOP 6.1.

4.3.4 Advance the borehole to the desired depth or target horizon where the sampling run is to begin. During drilling, monitor vapors in the breathing zone according to the project work plans and drilling method SOP.

4.3.5 When the desired sampling depth or target horizon is reached, remove the drill bit or plug from inside the drive casing or augers.

4.3.6 Insert the sleeves into the split-spoon sampler, connect the halves, and screw together the rear threaded collar and front drive shoe. Attach the split-spoon sampler to the bottom end of the drill rod string or wireline sampling string. Set up and attach the specified weight hammer, if used.

4.3.7 Drive the sampler into the soil at the bottom of the borehole. Record the type of sampler assembly and hammer weight on the Borehole/Well construction log (Attachment 6.1) and/or other appropriate form(s), as specified in the project work plans. To minimize off-gassing of the volatiles, the sampler should not be driven until the sampling team is ready to process the sample.

4.3.8 When conducting penetration testing, observe and record on the Borehole/Well construction log the number of hammer blows per six inches of penetration.

4.3.9 Pull the drill rod or wireline sampling string up from the bottom of the borehole and remove the sampler.

4.3.10 Remove the drive shoe and rear collar from the sampler and open the split barrel.

4.3.11 Remove the sleeves one at a time. Observe and record the amount of sample recovery on the Borehole/Well construction log. Any observed field problems associated with the sampling attempt (e.g., refusal) or lack of recovery should also be noted.

4.3.12 Select sleeve(s) to be submitted for laboratory analysis. Sample sleeve selection should be based on five factors: judgement that the sample represents relatively undisturbed intact material, not slough; proximity to the drive shoe; minimal exposure to air; lithology; and obvious evidence of contamination. The project work plans will specify which sample sleeves will be submitted for specific analyses and confirm the selection criteria.

4.3.13 Place teflon film over each end of sleeves to be submitted for chemical analysis and seal each end with plastic end caps. Place custody tape over each end cap so that any attempt to remove the cap will break the tape.

4.3.14 Appropriately label and number each sleeve to be submitted for analysis per SOPs 17.1 and 17.2, respectively. The label will be filled out using waterproof ink and will contain, at a minimum, the following information:

- Project number;

- Boring number;
- Sample number;
- Bottom depth of sleeve;
- Date and time of sample collection;
- Parameters for analysis; and,
- Sampler's initials.

4.3.15 Document the sampling event on the Borehole/Well Construction Log (Attachment 6.1) or an equivalent form as specified in the project work plans. At a minimum, this log will contain:

- Project name and number;
- Date and time of the sampling event;
- Drilling and sampling methods;
- Sample number;
- Sample location;
- Boring number;
- Sample depth;
- Sample description;
- Weather conditions;
- Any detected odor, discoloration and/or other evidence of the presence of contaminants;
- Unusual events; and,
- Signature or initials of the sampler.

4.3.16 Appropriately preserve, package, handle, and ship the samples in accordance with the procedures outlined in SOP 2.1 and the project work plans. The samples shall also be maintained under custody per SOP 1.1. Samples stored on-site will be subject to the provisions of SOP 19.1.

4.3.17 One of the sample sleeves may also be utilized for lithologic logging per SOP 15.1. This sleeve may not then be retained for chemical analysis as soil must be removed from the sleeve to effectively describe the soil/lithology and compile the lithologic log.

4.3.18 Where required by the project work plans, remove the soil from one of the remaining sleeves and place in a seam-sealing, polyethylene bag for organic vapor screening. Place the bag in the sunlight for at least five minutes, then using an organic vapor probe (e.g., portable photoionization detector, flame ionization detector, or other appropriate instrument), monitor the soil for organic vapors. Record the reading on the Borehole/Well Construction Log (Attachment 6.1), the Sample Collection Log (SOP 3.1), and any other form(s) specified in the project work plans.

4.3.19 Repeat this sampling procedure at the intervals specified in the project work plans until the bottom of the borehole is reached and/or last sample collected.

4.4 Thin Walled or Shelby Tube Sampling

A thin-walled tube, or Shelby tube sampler, may be used to collect relatively undisturbed soil samples. The procedure for collecting soil samples using a Shelby tube sampler should be outlined in the project work plans. The standard procedure is described below.

4.4.1 Calibrate all field analytical and health and safety monitoring equipment as discussed in Section 4.3.1.

4.4.2 Wear the appropriate personal protective equipment as described in Section 4.3.2.

4.4.3 Between each sampling location and prior to each sampling run, decontaminate the sampler and other sampling equipment as described in SOP 6.1.

4.4.4 Advance the borehole to the desired depth or target horizon where the sampling run is to begin. While drilling, monitor the breathing zone according to the project work plans and applicable drilling method SOP.

4.4.5 Connect the sampling tube to the drill rod string and advance the tube to the bottom of the boring. The tube is then pushed about 2 to 2.5 feet into the soil with a continuous, rapid motion without impact or twisting.

4.4.6 Pull the drill rod string up from the bottom of the borehole and remove the sampling tube from the string. Observe and record the amount of sample recovery and any associated problems as discussed in Section 4.3.11.

4.4.7 Place Teflon film over each end of the tube if it is to be submitted for chemical analysis and seal the ends with plastic end caps. Place custody tape over each end cap so that any attempt to remove the cap will break the tape. With a waterproof marker, write a "T" for top on the trailing end and a "B" for bottom on the leading end of the tube.

4.4.8 Appropriately label and number the tube as described in Section 4.3.14.

4.4.9 Document the sampling event on the Borehole/Well Construction Log (Attachment 6.1) as discussed in Section 4.3.15.

4.4.10 Appropriately preserve, package, handle and ship the sample in accordance with the procedures outlined in SOP 2.1 and the project work plans. The samples shall also be maintained under custody per SOP 1.1. Samples stored on-site will be subject to the provisions of SOP 19.1.

4.4.11 Repeat this sampling procedure at the intervals specified in the project work plans until the bottom of the borehole is reached and/or last sample collected.

4.5 Continuous Core Sampling Method

Continuous core sampling system methods may be specified where continuous soil cores are to be recovered by direct push coring methods (e.g., Geoprobe or Envirocore). The continuous core sampling method utilizes a core barrel, which recovers soil core from the interval the barrel is advanced through. The barrel is recovered after the total depth of the boring is attained.

The standard procedure for collecting samples using a continuous core sampling device is described below.

4.5.1 Calibrate all field analytical and health and safety monitoring equipment as discussed in Section 4.3.1.

4.5.2 Wear the appropriate personal protective equipment as described in Section 4.3.2.

4.5.3 Between each sampling location, prior to each sampling run and/or as required, decontaminate the sampler and other sampling equipment as described in SOP 6.1.

4.5.4 Advance the continuous sampler to the desired depth or target horizon while monitoring the breathing zone according to the project work plans and applicable drilling method SOP. A three or more foot section of the sampler (consisting of inner sampling rods and outer drive casing) are driven into the ground simultaneously.

4.5.5 After being driven three feet, the small diameter (1.5-inch) inner sampling rods are removed from the borehole using a hydraulic winch. The larger (2-inch) diameter drive casing is left in place to prevent the borehole from collapsing. Soil samples are collected in 1.5-inch diameter stainless steel sleeves inside the inner sample barrel. The sleeves are removed from the sample barrel and given to the site geologist or engineer for chemical analysis and lithologic interpretation. New sleeves are then added to the sample barrel, and it is then lowered back into the borehole. An additional three or more feet of inner rods and outer drive casing are attached and the process is repeated until the desired depth is reached.

4.5.6 Once the soil has been continuously cored to the desired depth, the inner sampling rods are removed, while the outer casing remains in place to hold the boring open. Observe and record the amount of sample recovery and any associated problems as discussed in Section 4.3.11.

4.5.7 Place Teflon film over each end of the tube if it is to be submitted for chemical analysis and seal the ends with plastic end caps. Place custody tape over each end cap so that any attempt to remove the cap will break the tape. With a waterproof marker, write a "T" for top on the trailing end and a "B" for bottom on the leading end of the tube.

4.5.8 Appropriately label and number the tube as described in Section 4.3.14.

4.5.9 Document the sampling event on the Borehole/Well Construction Log (Attachment 6.1) as discussed in Section 4.3.15.

4.5.10 Appropriately preserve, package, handle and ship the sample in accordance with the procedures outlined in SOP 2.1 and the project work plans. The samples shall also be maintained under custody per SOP 1.1. Samples stored on-site will be subject to the provisions of SOP 19.1.

Repeat this sampling procedure continuously until the bottom of the borehole is reached and/or last sample collected as specified in the work plan.

4.5.11 Finally, cement grout is place in the borehole, from bottom to top, as the drive casing is withdrawn. This seals the borehole and prevents it from acting as a conduit for potential contaminant migration.

5.0 RECORDS

Records generated as a result of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Borehole/Well Construction Log

A form referenced or attached to this SOP may be replaced with a substitute form, at the discretion of the Project Task Leader, if the substitute form contains, as a minimum, similar information as the referenced form. Also, forms may be combined or data collected in an alternate fashion at the discretion of the Project Task Leader. The PQAM should approve alternate form use if the minimum data recommended in this SOP would not be collected and/or tabulated.

ATTACHMENT 6.1

6.1 BOREHOLE/WELL CONSTRUCTION LOG

[Form(s) on Following Page(s)]

WEISS ASSOCIATES

BOREHOLE / WELL CONSTRUCTION LOG

Page ____ of ____

OREHOLE LOCATION

pproximate Scale:

otes:

Project: (facility, address, city, state)	Borehole/Well No:
	Job No:
Logged By:	Edited By:
Project Manager:	Drill Rig:
Drilling Contractor: (name, city, state)	
Driller:	License # : C57-
Drilling Method:	Sample Method:
Well Head Completion:	Ground Surface Elevation:
Hammer Weight/Drop:	Borehole Diameter:
Started, Time:	Date:
Completed, Time:	Date:

Water Depth						
Boring/Casing Depth						
Time						
Date						

Total Boring Depth:	Total Well Depth:
Screened Interval:	Well Diameter:
Sand Pack (Type and Interval):	
Well Development Method:	
Time: Date:	Flow Rate:
Geophysical Logs, Type:	
By:	Date:

Sample ID	PID / FID (ppm)	Sampler Type / depth	Blows per 6 Inches	Inches Driven	Inches Recovered	Sample Condition	Boring Diameter	Diagram: Conductor Casing(s) Interval and Diameter	Diagram: Sand / Grout	Diagram: Well Casing / Screen	Depth in Feet	Recovery / Sample Loc.	Contact / Hyd. Conduct.	LITHOLOGIC DESCRIPTIONS
											1			
											2			
											3			
											4			
											5			
											6			
											7			
											8			
											9			
											10			

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BOREHOLE / WELL CONSTRUCTION LOG (cont.)

Page ____ of ____

Project / Job No.:

Borehole/Well No.:

Notes:

Sample ID	PID/FID	Sampler Type	Blows / 6 Inches	Inches Driven	Inches Recov'd	Sample Cond.	Boring Diameter	Conduct. Casing	Sand / Grout	Well Casing	Depth (ft)	Recovery	Contact
											1		
											2		
											3		
											4		
											5		
											6		
											7		
											8		
											9		
											0		
											1		
											2		
											3		
											4		
											5		
											6		
											7		
											8		
											9		
											0		

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SAMPLING EQUIPMENT AND WELL MATERIAL DECONTAMINATION

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel in the decontamination of sampling equipment and well construction materials. Proper equipment decontamination is essential in ensuring the quality and integrity of samples collected during a given sampling event. Additional specific sampling equipment and well material decontamination procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

EPA, September 1987, EPA Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14.

EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01.

SOP 6.2 - Drilling and Heavy Equipment Decontamination

SQP 4.2 - Records Management

3.0 DEFINITIONS

3.1 Deionized Analyte-Free Water

Ion-free, analyte-free water produced on site or purchased from a supplier with a deionization chamber equipped with a carbon filter.

3.2 Potable Water

Treated municipal water, or other drinking-grade water.

3.3 Laboratory Grade Detergent

A standard brand of laboratory-grade detergent, such as "Alconox" or "Liquinox."

3.4 Methanol

Laboratory-grade methanol alcohol, CAS #67-56-1.

3.5 Hexane

Laboratory-grade hexane, CAS #110-54-3.

3.6 HPLC Water

High performance liquid chemotrgraphy-grade water.

4.0 PROCEDURE

This section contains responsibilities, requirements, and procedures for sampling equipment and well material decontamination. The decontamination is required to maintain proper quality and integrity of collected samples.

The details within this SOP should be used in conjunction with the project work plans. The project work plans will provide the following information:

- Types of equipment requiring decontamination under this SOP;
- Specific materials to be used for the decontamination; and
- Additional decontamination requirements and procedures beyond those covered in this SOP, as necessary.

All field personnel associated with decontamination of sampling equipment or well materials must read both this SOP and the project work plans prior to implementation of related decontamination activities. Information and requirements for the decontamination of any and all drilling and heavy equipment is provided in SOP No. 6.2.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all sampling equipment and well material decontamination activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for the implementation of corrective action (i.e., retaining personnel, additional review of work plans and SOPs, variances to decontamination requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to sampling equipment and well material decontamination activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Site Superintendent, Field Coordinator, or the PQAS.

4.2 Decontamination Facility

If possible, sampling equipment decontamination will take place in an area designed exclusively for decontamination. This area will ideally be located within the contamination reduction zone on the project site. Well materials may be decontaminated at the facility set up for decontamination of drilling and heavy equipment (see SOP No. 6.2).

Each decontamination facility will be constructed so that the equipment, as well as all wastes generated during decontamination (e.g., soil, rinsate, liquid spray, debris, etc.), are fully contained. In addition, chemical products used in the decontamination process must be properly containerized and labeled.

4.3 Decontamination of Non-Dedicated Sampling Equipment

Each piece of reusable, non-dedicated sampling equipment will be decontaminated before each sampling event. The standard procedure will be performed as described below.

4.3.1 Suitable personal protective equipment (specified by the project work plans) must be worn by all personnel involved with the task to reduce personal exposure.

4.3.2 Heavily caked soil and/or other material will be scraped or brushed from equipment. The scrapings will be placed into an appropriate container for disposal. Steam cleaning of equipment may be required to remove material from samplers.

4.3.3 Equipment that will not be damaged by water should be placed into a wash tub containing a laboratory-grade detergent solution and scrubbed with a brush or clean cloth. Rinsing will then be conducted with fresh, potable water, followed by deionized water.

4.3.4 Methanol, hexane, and HPLC water rinses may then follow for some sampler components when specified by the project work plans.

4.3.5 Any equipment that may be damaged by submersion into water will be wiped clean using a sponge and detergent solution. Cleaning will be followed by wiping the equipment with deionized water.

4.3.6 Air dry the rinsed equipment. Soil organic vapor (SOV) sampling equipment should be flushed dry with bottled air of known quality and/or as per the project work plans.

4.3.7 Place decontaminated equipment on clean plastic sheeting to prevent contact with contaminated soil. If equipment is not used immediately, cover or wrap the equipment in clean plastic sheeting to minimize airborne contamination.

4.3.8 Decontamination activities will be documented on the Field Activity Daily Log (FADL) (SOP 1.1) or other appropriate form(s), as specified by the project work plans.

4.4 Decontamination of Dedicated Sampling Equipment

Dedicated sampling equipment, such as submersible pumps, will be decontaminated prior to installation inside monitoring wells. At a minimum, the procedure outlined below must be performed. If factory-cleaned, hermetically sealed materials are used, no decontamination will be necessary, provided that laboratory decontamination certification is submitted with the equipment.

4.4.1 Suitable personal protective equipment will be worn by all personnel involved in the task, in accordance with the project work plans.

4.4.2 Foot vale and pumping lines will be washed with a laboratory-grade detergent solution.

4.4.3 The equipment will then be rinsed twice with tap water, followed by a rinse with deionized water.

4.4.4 Air dry.

4.4.5 Place decontaminated equipment on clean plastic sheeting to prevent contact with contaminated soil. If equipment is not used immediately, cover or wrap the equipment in clean plastic sheeting to minimize airborne contamination.

4.4.6 Decontamination activities will be documented on the FADL or the appropriate form(s), as specified by the project work plans.

4.5 Decontamination of Well Materials

Well materials including well casing, well screens, centralizers, and end caps will be decontaminated prior to use in constructing monitoring wells. (If factory-cleaned, hermetically sealed material are used, no decontamination will be necessary, provided that laboratory decontamination certification is submitted with the equipment.) The standard procedure outlined below must be performed when decontaminating well materials.

4.5.1 Appropriate personal protective equipment will be worn by all personnel involved in the task, in accordance with the project work plans.

4.5.2 Materials will be thoroughly sprayed and washed with water using a high pressure steam cleaner.

4.5.3 Air dry.

4.5.4 Decontaminated materials will be placed on clean metal racks or clean plastic sheeting. If equipment is not used immediately, cover or wrap the equipment in clean plastic sheeting to minimize airborne contamination.

4.5.5 Decontamination activities will be documented on the FADL or other appropriate form(s), as specified by the project work plans.

5.0 RECORDS

Records generated as a result of this SOP will be maintained in the Project Records file in accordance with SQP No. 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, at the discretion of the Project Task Leader, if the substitute form contains, as a minimum, similar information as the referenced form. Also, forms may be combined or data collected in an alternate fashion at the discretion of the Project Task Leader. The PQAM should approve alternate form use if the minimum data recommended in this SOP will not be collected and/or tabulated.

DRILLING, DEVELOPMENT AND HEAVY EQUIPMENT DECONTAMINATION

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines for use by field personnel in the decontamination of drilling, development and heavy equipment. The details within this SOP are applicable as general requirements for drilling, development and heavy equipment decontamination, and should also be used in conjunction with project work plans.

2.0 REFERENCES

EPA, September 1987, EPA Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14.

EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01.

SQP 4.2 - Records Management

SOP 6.1 - Sampling Equipment and Well Material Decontamination

3.0 DEFINITIONS

3.1 Laboratory Grade Detergent

A standard brand of laboratory-grade detergent, such as "Alconox" or "Liquinox."

3.2 Potable Water

Water dispensed from a municipal water system, or other drinking-grade water.

4.0 PROCEDURE

4.1.1 Compliance with this procedure is the responsibility of project management and field personnel. This SOP and the project work plans should be reviewed before implementing drilling, development, and heavy equipment decontamination at the project field area.

4.1.2 The Project Manager has the responsibility for ensuring that the decontamination of drilling, development and heavy equipment is properly performed through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.3 The Project QA Specialist (PQAS) has the responsibility for periodic review of procedures and documentation associated with the decontamination of drilling, development and heavy equipment. If perceived variances occur, the PQAS is also responsible for issuing notices of nonconformances and requesting corrective actions. Additionally, he/she will perform inspections and may monitor the decontamination activities.

4.1.4 The project staff assigned to drilling, development, trenching, or construction activities are responsible for ensuring that subcontractors or equipment operators properly decontaminate the drilling, development, and heavy equipment associated with those tasks. The project staff are also responsible for documenting the decontamination activities on the Field Activity Daily Log (FADL) (SOP 1.1) and/or appropriate form(s) as specified in the project work plans.

4.2 General

4.2.1 This section provides requirements for the set up of a decontamination facility for drilling, development, and heavy equipment and the decontamination procedures to be followed. The project work plans will provide specific information regarding:

- Types of equipment requiring decontamination under this SOP;
- Location of the decontamination station;
- Types and/or specifications on materials to be used in the fabrication of the decontamination station; and,
- Types of materials and additional details on the procedures to be used in the decontamination process.

4.2.2 All field personnel associated with either the fabrication of the decontamination station or the decontamination of drilling, development or heavy equipment must read both this SOP and the project work plans prior to implementation of related decontamination activities. Information and requirements for the decontamination of any and all equipment used specifically for sampling is presented in SOP 6.1.

4.3 Decontamination Facility

4.3.1 A decontamination station will be set up in an area exclusively for decontamination of drilling, well development, and/or heavy equipment. The location of the decontamination station will be specified in the project work plans. All decontamination of drilling, development, and heavy equipment will be conducted within the station.

4.3.2 At a minimum, the station will be constructed such that all rinsates, liquid spray, soil, debris, and other decontamination wastes are fully contained and may be collected for appropriate waste

management and disposal. The station may be as simple as a bermed, impermeable polyethylene sheeting of sufficient thickness. More sophisticated designs involving self-contained metal decontamination pads in combination with bermed polyethylene sheeting may also be used, depending on project-specific requirements. These requirements along with specific equipment and construction specifications for the decontamination station will be provided in the project work plans.

4.4 Decontamination of Downhole Equipment

4.4.1 All downhole drilling and development equipment (including but not limited to drill pipe, drive casing, drill rods, bits, tools, bailers, etc.) will be thoroughly decontaminated before mobilization onto each site and between borings or wells at each site or as required in the project work plans. Decontamination will be performed in accordance with this SOP and the project work plans. The standard procedure will be performed as described below.

4.4.2 Appropriate personal protective equipment (as specified in the project work plans) must be worn by all personnel involved with the task to limit personal exposure.

4.4.3 Equipment caked with drill cuttings, soil, or other material will initially be scraped or brushed. The scrapings will be containerized and appropriately disposed.

4.4.4 Equipment will then be sprayed with potable water.

4.4.5 Washed equipment will then be rinsed with potable water.

4.4.6 Decontaminated downhole equipment (such as drill pipe, drive casing, bits, tools, bailers, etc.) will be placed on clean plastic sheeting to prevent contact with contaminated soil and allowed to air dry. If equipment is not used immediately, it may be covered or wrapped in plastic sheeting to minimize airborne contamination.

4.4.7 Decontamination activities will be documented by the Site Superintendent, lead geologist, or lead engineer on the FADL and/or appropriate form(s), as specified in the project work plans.

4.5 Decontamination of Heavy Equipment

4.5.1 Heavy equipment (e.g., drill rigs, development rigs, backhoes, and other earthmoving equipment) will be decontaminated between drilling sites or inside the contaminant reduction area prior to entering and leaving an exclusion zone. Decontamination will be performed in accordance with this SOP and the project work plans. The standard procedure will be performed as described below.

4.5.1.1 Appropriate personal protective equipment (as specified in the project work plans) will be worn by all personnel involved in the task, in order to limit personal exposure.

4.5.1.2 Equipment caked with drill cuttings, soil, or other material will be initially scraped or brushed. The scrapings will be containerized and appropriately disposed.

4.5.1.3 Equipment will then be sprayed with potable water.

4.5.1.4 Clean equipment will then be rinsed with potable water.

4.5.2 During the decontamination effort, fluid systems should be inspected for any leaks or problems that might potentially result in an inadvertent release at the site, thereby contributing to the volume of waste or contamination. Any identified problems should be immediately repaired and documented on the FADL. Decontamination should then be completed before moving the equipment onto the site or exclusion zone.

4.5.3 Decontamination activities will be documented by the Site Superintendent, lead geologist, or lead engineer on the FADL and/or appropriate form(s), as specified in the project work plans.

4.5.4 Between boreholes at the same site, the back-end of the drilling rigs will be washed with potable water until surfaces are visibly free of soil buildup.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, at the discretion of the Project Task Leader, if the substitute form contains, as a minimum, similar information as the referenced form. Also, forms may be combined or data collected in an alternate fashion at the discretion of the Project Task Leader. The PQAM should approve alternate form use if the minimum data recommended in this SOP will not be collected and/or tabulated.