COMPLETION REPORT

for the

SOURCE REMOVAL

of

POLYCHLORINATED BIPHENYLS

RF\RMRS-97-044
Revision 0

July 29, 1997

NOV 2001
RECEIVED
RECORDS CENTER

ADMIN RECORD

1/267

DOCUMENT CLASSIFICATION
REVIEW WAIVER PER
CLASSIFICATION OFFICE

SW-A-004414

TABLE OF CONTENTS

Section		Page
1.0	INTRODUCTION/PURPOSE	1
2.0	BACKGROUND AND PRE-REMEDIATION ACTIVITIES	2
3.0	REMEDIATION ACTIVITIES	5
	3.1 Brief Description of Remediation Activities by Each Site	6
	3.2 Quality Control	8
	3.3 Summary of Remediation Activities	9
4.0	WASTE DISPOSAL	19
5.0	CONCLUSIONS	20
6.0	REFERENCES	21

FIGURES

Figure 1-1, PCB Remediation Sites 3

TABLES

Table 2-1, Pre-Remediation Soil and Concrete Levels 4
Table 3-1, PCB Post-Removal Levels in Soil 10
Table 3-2, Method 8080 & 4020 Verification Samples 11
Table 4-1, PCB Waste Volumes Removed Per Site 19

APPENDICES

Appendix A - Site Maps
Appendix B - Method 8080 PCB Cleanup Verification Data
Appendix C - Midwest Research Institute (MRI) Verification of PCB Spill Cleanup by Sampling and Analysis

2

LIST OF ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
HRR	Historical Release Report
HSP	Health and Safety Plan
IHSS	Individual Hazardous Substance Site
MRI	Midwest Research Institute
NFA	No Further Action
OU	Operable Unit
PAC	Potential Area of Concern
PAM	Proposed Action Memorandum
PCB	Polychlorinated Biphenyl
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RMRS	Rocky Mountain Remediation Services, L.L.C.
ROD	Record of Decision
SAP	Sampling and Analysis Plan
TSCA	Toxic Substance Control Act
U	not detected
ug/kg	micrograms per kilogram
yd^3	Cubic Yards

3

DEFINITIONS

Aroclor	A common tradename for PCB dielectric oil used in transformers. Aroclor 1254 means that a biphenyl molecule (two chlorine atoms surrounded by 12 carbon atoms) is chlorinated at a 54% ratio by weight.
Certificate of Disposal	A Certificate of Disposal is a document generated by the disposer of PCB waste for PCBs and/or PCB Items disposed of at the facility.
Chemical Waste Landfill	A landfill at which protection against risk of injury to human health or the environment from migration of PCBs to land, water, or the atmosphere is provided from PCBs and PCB items deposited therein by locating, engineering, and operating the landfill as specified in 40 CFR 761.75.
Destructive Samples	Collection of physical samples usually on porous surfaces using an impact drill or other means.
Draft EPA Method 4020	A field screening method used to acquire cost effective in situ data (Immunoassay) to determine areal extent and vertical migration of PCBs. This method may also be used to verify decontamination is appropriate.
EPA Method 8080	An EPA approved method for laboratory analysis of PCBs commonly used to verify final cleanup standards were met.
Hydrohammer	A heavy duty pneumatic "jack hammer like" attachment usually fitted to a backhoe or excavator for breaking rock or concrete.
Kettleman, California	A selected Chemical Waste Landfill for this PCB removal project.
Outdoor Electrical	Outdoor, fenced, and restricted access area used in the Substation transmission and/or distribution of electrical power as defined under 40 CFR 761.30(l)(l)(ii).
PCB(s)	Polychlorinated biphenyl(s) are chemical substances consisting of the biphenyl molecule which has been chlorinated to varying degrees. PCBs are often associated with other chlorinated hydrocarbon compounds such as Furans and Dioxins.

4

Restricted Access Area	A location limited by natural or manmade barriers at least 0.1 kilometers from residential or commercial areas. PCB spills or releases occurring in a Restricted Access Area must be cleaned up to 25 ppm PCBs by weight for soil and 100ug/100cm^2 for all other solid surfaces per 40 CFR 761.125.
TSCA	The Toxic Substance Control Act (TSCA) was passed by Congress in 1976 and was designed primarily as a vehicle in which chemicals could be evaluated before use thereby reducing risk to human health, other organisms and the environment.

5

1.0 Introduction

This completion report describes the Polychlorinated Biphenyl (PCB) Removal Project, including the site histories, remediation activities, and the disposition of the waste. The removal activities began in the fall of 1995 and concluded in late summer of 1996. All removal activities were conducted in accordance with the *Final Proposed Action Memorandum* (PAM), *Remediation of PCBs* (DOE 1995), *Final Sampling and Analysis Plan* (SAP) (RMRS 1995a), and *Final Project-Specific Health and Safety Plan/PCB Removal Project* (RMRS 1995b).

The remediation of PCBs was initiated with the discovery of PCB-contaminated soil in July of 1991. Specific sites (hereafter referred to as PCB sites) were identified through a site-wide assessment (EG&G 1991), assigned a unique identification number (i.e., PCB Site 1), and incorporated into the *Historical Release Report* (HRR) (DOE 1992) as Potential Areas of Concern (PACs). Of those identified in the HRR, twelve required additional evaluation because of suspected PCB levels in excess of the 25 parts per million (total) Toxic Substances Control Act (TSCA) guidance for Restricted Access Areas at outdoor electrical substations. The investigation and subsequent remediation was performed in accordance with Section I.B.10 of the Interagency Agreement (IAG) (DOE 1991) which provides a mechanism to expedite a Risk Reduction/Source Removal Action utilizing an approved PAM. The Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (CDPHE) concurred with this approach and approved the 25 ppm guidance level for PCB contamination at the Rocky Flats Environmental Technology Site (RFETS).

Remediation of 11 of the 12 PACs was successful in obtaining closure criteria as demonstrated by post-removal verification results below the 25 ppm standard. The *Annual Update for the Historical Release Report* (DOE 1996b) submitted to the Department of Energy (DOE), EPA and CDPHE in accordance with the *Final Rocky Flats Cleanup Agreement* (RFCA) (DOE 1996a) proposed No Further Action (NFA) status for these 11 PACs. These sites will be officially closed under the Industrial Area Operable Unit (OU) Record of Decision (ROD). The ROD will also address the PAC (PAC-1102/PCB-21) at which residual concentrations above the 25 ppm standard remain. The validation results will be evaluated for data usability as part of the quality control for the project and submitted as an addendum to this report.

6

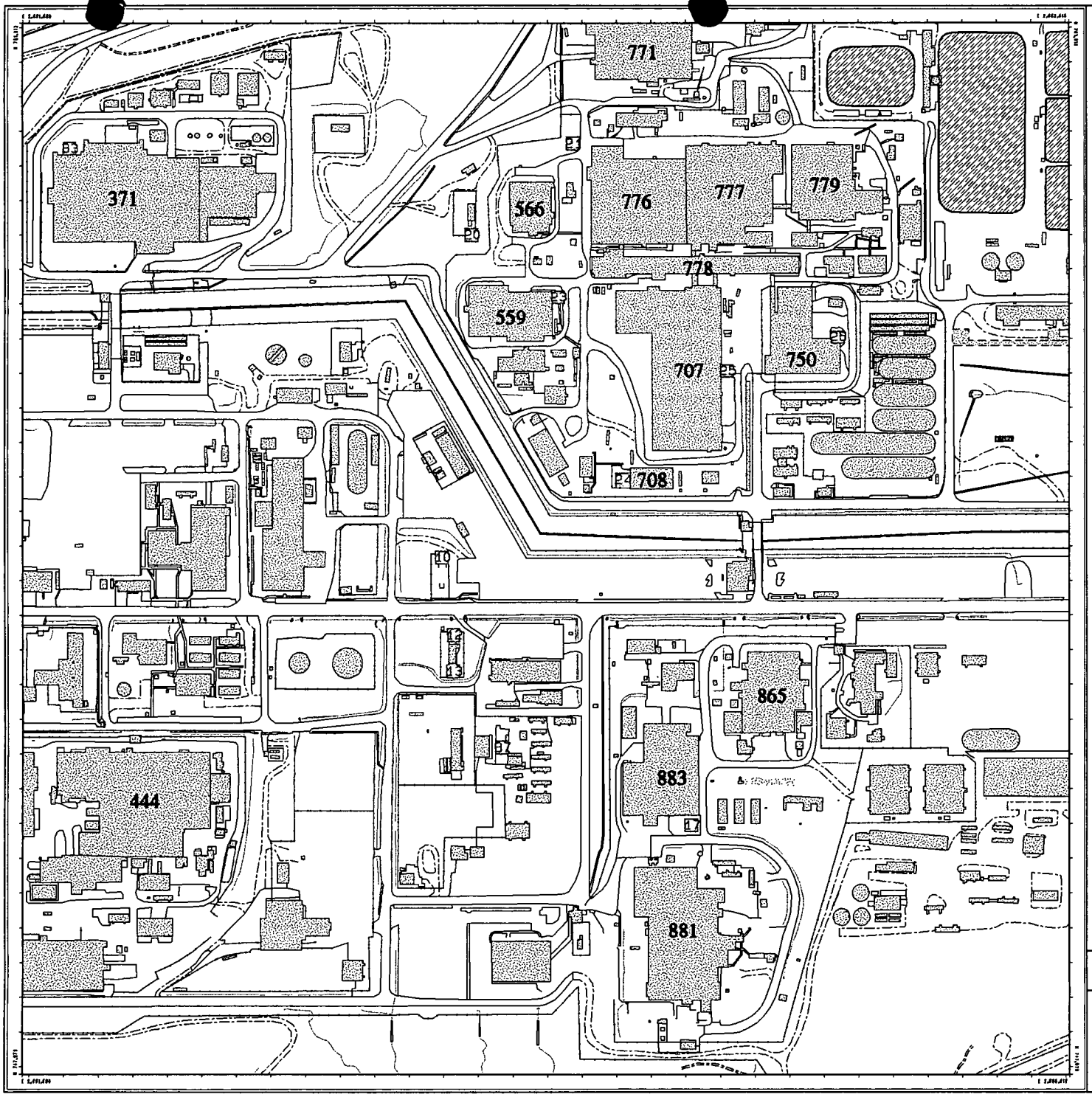
2.0 Background and Pre-remediation Activities

A sitewide program was initiated in 1991 to identify known, suspect, and potential PCB contaminated sites at RFETS. The study, documented in *Assessment of Potential Environmental Releases of PCBs Preliminary Assessment/Site Description,* (EG&G 1991) consisted of document and record reviews, personnel interviews, and field sampling and analysis at 37 locations. These suspect locations became known as PCB sites 1-37. Based on the results presented in the assessment (EG&G 1991), the following sites were targeted for expedited action in accordance with Section I.B.10 of the *Rocky Flats Interagency Agreement* (IAG) (DOE 1991) as documented in the *Final PAM, Remediation of PCBs* (DOE 1995). The locations, identified by PCB site number, are illustrated on the site map which follows.

To delineate the lateral and vertical extent of PCB contamination at these sites, surficial and subsurface soil samples were collected and analyzed in the field using an immunoassay technique, Draft Method 4020. Additionally, if concrete was present within a given PCB site, then the area of the site was calculated and statistically gridded so that destructive concrete samples could be collected and analyzed using EPA Method 8080. Grid squares were assigned a number and samples were collected based upon random number generation. In several cases, the collection points fell within an unattainable area (such as under a transformer) and the sampling grid had to be re-run.

Table 2-1 provides a cross-reference between PCB TSCA site numbers as identified in the original PCB assessment (EG&G 1991) and its respective PAC number as presented in the HRR (DOE 1992). In addition, pre-remediation PCB concentrations for the soil and concrete samples are provided with the closest adjacent building for site reference.

7



PCB Contamination Sites

Figure 1

EXPLANATION

PCB Sites

Standard Map Features

- Buildings or other structures
- Solar evaporation ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads

DATA SOURCE:
PCB locations from DOE Historical Report, 1992. Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/96

Scale = 1 : 4920
1 inch represents 410 feet

100 0 200 400ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

RMRS Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: 97-0042

July 29, 1997

/gis2/projects/fy97/97-0042/pcb-v2.aml

Table 2-1. Pre-Remediation Soil and Concrete Levels

HRR PAC #	TSCA Loc. Code	Building Number	Sample Number	Matrix[1]	Aroclor 1242 (ppm)	Aroclor 1248 (ppm)	Aroclor 1254 (ppm)	Aroclor 1260 (ppm)
500-905	PCB-10	555/558	SS00385ST	SOIL	U	U	U	480.0
500-905	PCB-10	555/558	CT00028EG	CONCRETE	U	U	U	0.4
600-1003	PCB-12/13	661/675	SS00376ST	SOIL	U	U	U	540.0
600-1003	PCB-13	661/675	CT00039RM	CONCRETE	U	U	U	0.1
800-1207	PCB-17	883	SS00470ST	SOIL	U	160.0	U	U
800-1207	PCB-17	883	CT00016EG	CONCRETE	U	2.5	1.0	0.1
500-900	PCB-20	515/516	SS00625ST	SOIL	U	U	U	26.0
500-900	PCB-20	515/516	CT00036EG	CONCRETE	0.9	U	U	0.9
700-1102	PCB-21	776	SS00503ST	SOIL	U	U	U	480.0
700-1102	PCB-21	776	CT00003EG	CONCRETE	U	U	U	56.0
500-902	PCB-23	559	SS00385ST	SOIL	U	190.0	U	U
500-902	PCB-23	559	CT00004EG	CONCRETE	U	U	U	0.04
700-1104	PCB-24	708	SS00583ST	SOIL	U	U	860.0	U
700-1104	PCB-24	708	CT00008EG	CONCRETE	U	U	U	U
700-1103	PCB-25[2]	707	SS00325ST	SOIL	U	U	1600.0	U
700-1111	PCB-26	750	SS00513ST	SOIL	U	160.0	U	U
700-1111	PCB-26	750	CT00011EG	CONCRETE	U	U	U	U
300-708[3]	PCB-33	371	SS00606ST	SOIL	U	U	U	>50
300-708	PCB-33	371	CT00030EG	CONCRETE	1.3	U	U	U
600-1000	PCB-37	662	G03484	SOIL	U	73.0	U	86.0
600-1000	PCB-37	662	SS00569RM	CONCRETE	U	U	0.2	1.2

[1] Maximum Concentration
[2] PCB site 25 did not have any concrete to analyze
[3] Chlorinsoil® data indicated >50 ppm (EG&G 1991)

9

3.0 Remediation Activities

The *Final PAM, Remediation of PCBs* (DOE 1995) guided the remediation of approximately 500 cubic yards of soil and concrete from 12 PCB sites. All activities were conducted in accordance with the PAM and *Final Project-Specific Health and Safety Plan/PCB Removal Project* (RMRS 1995b). Verification sampling included a combination of field screening using Draft Method 4020 and confirmational split samples analyzed using SW-846 Method 8080 as specified in the *Final Sampling and Analysis Plan* (SAP) (RMRS 1995a). To assure that the 25 ppm TSCA guidance level was achieved during cleanup, a target remediation goal of 10 ppm (total) PCBs, or less, using the Method 4020 field screening analysis was prescribed for the removal.

Remediation began in the fall of 1995 and was completed in late summer of 1996. Excavated material with PCB concentrations exceeding the 25 ppm standard were disposed off-site at an EPA-approved disposal facility. Concrete transformer pads were broken with a hydrohammer and subsequently removed using backhoes, excavators, front-end loaders and hand shovels. Concrete with PCB concentrations less than the 25 ppm was disposed at the RFETS landfill. Soil was removed in a similar manner, in one foot lifts. Details of the excavation activities for each PCB site are included in Section 3.1.

As the remediation progressed, verification samples were collected using the EPA Midwest Research Institute (MRI) grid methodology (Appendix C). Field screening analysis of samples collected from this grid was performed in an on-site (mobile) laboratory using the immunoassay technique prescribed in SW-846, Draft Method 4020. Excavation activities proceeded in 1 foot lifts (i.e., additional soil was excavated) until the immunoassay results indicated that the total PCB concentration was near, or below, the 10 ppm remediation goal. One exception is noted. At PCB site PCB-37, 6 of the immunoassay results exceeded the 10 ppm remediation goal, but re-analysis using a 25 ppm calibration standard and analysis from split samples using Method 8080 verify that the soil was below the 25 ppm guidance level.

Twenty percent of the samples for each verification grid were split and analyzed using SW-846 Method 8080 to confirm the accuracy of the field screening method. In addition, for every twenty samples, one duplicate was collected and analyzed using the same method. All samples were collected using clean and/or decontaminated sampling equipment (i.e., spoons/scoops). At a minimum, one equipment smear sample was collected daily and/or between sites and analyzed using the 4020 immunoassay technique to assess cross-contamination and positive bias (i.e., false positive) potential. The final MRI grid of verification samples was considered as the confirmation grid for that site (see Appendix A). Split samples were then shipped off-site for SW-846 Method 8080 analysis to provide cleanup verification (see Appendix B). Table 3-1 shows post-removal split sample results confirming that all of the sites, with the exception of PCB-21, were remediated to less than 25 ppm PCBs by weight and, in most cases, substantially lower. Table 3-2 provides a comprehensive data summary of Method 8080 soil and concrete samples on a site-

by-site basis. The table also includes results from the Draft Method 4020 immunoassay field screening analysis, confirmational splits, and Method 8080 analysis of clean fill material obtained off-site. Excavations were backfilled with PCB-free structural material (<1 ppm PCBs by weight) obtained from an off-site source and the sites were reclaimed to, at a minimum, their original condition.

3.1 Brief Description of Remediation Activities by Each Site

PCB-10 (555/558 Substation):

Approximately 4.3 yd^3 of soil were removed from the northwest corner of the 555/558 substation using shovels during the first week of September 1995. The PCB-10 site was confirmed at <10 ppm PCBs by weight in soil using EPA Method 8080. The confirmation of remediation of soils at this site provide the basis for NFA status.

PCB-12/13 (661/675 Substation):

Approximately 46.7 yd^3 of soil were removed from around the substation using hand shovels during the second and third week of February 1996. The PCB-12 & 13 sites were confirmed at <10 ppm PCBs by weight in soil using EPA Method 8080. The confirmation of remediation of soils at this site provide the basis for NFA status.

PCB-17 (Southeast Corner of Building 883):

Approximately 22.1 yd^3 of soil, 2 yd^3 of asphalt and 8.5 yd^3 of concrete were removed from the southeast corner of Building 883 using backhoes, front-end loaders, a hydrohammer, and shovels during the second week of September 1995. The PCB-17 site was confirmed at <10 ppm PCBs by weight in soil using EPA Method 8080. The confirmation of remediation of soils at this site provide the basis for NFA status.

PCB-20 (515/516 Substation):

Approximately 5.8 yd^3 of soil were removed from the south side of the 515/516 Substation using a backhoe, a bobcat and hand shovels in late August 1995. The contaminated soil was located immediately east of the 516 transformer. The PCB-20 site was confirmed at <10 ppm PCBs by weight in soil using EPA Method 8080. The confirmation of remediation of soils at this site provide the basis for NFA status.

PCB-21 (Northwest Corner of Building 776)

Approximately 177 yd^3 of soil and 10.7 yd^3 of concrete were removed from the northwest corner of Building 776 with backhoes, front-end loaders, excavators, a hydrohammer, and hand shovels

between October 2, 1995 and June 24, 1996. Numerous removal events (i.e., re-excavations) to a total depth of approximately 17 feet were required in the attempt to achieve the cleanup guidance level of 25 ppm (total PCBs). The guidance level was not achieved; however, the site was cleaned from an initial PCB contaminant level of 480 ppm in the soil and 56 ppm on the concrete pad to 70 ppm PCBs in soil at a single location and at a 17 foot depth. The excavation activity was stopped due to equipment limitations and health and safety concerns as documented in the Final Annual Update to the Historical Release Report (HRR) transmitted to the EPA and CDPHE on September 30, 1996. An extensive survey was conducted of the excavation prior to backfilling with structural grade fill. No available information could be found explaining contaminant levels at such depth, however, the diligent effort significantly reduced risk to human health and the environment.

PCB-23 (East of Building 559):

Approximately 27.2 yd^3 of soil were removed from the northeast corner of Building 559 using a backhoe, a hydrohammer, front-end loaders, a bobcat and hand shovels during the last several weeks of September 1995. The PCB-23 site was confirmed at <10 ppm PCBs by weight using EPA Method 8080. The confirmation of remediation of soils at this site provide the basis for NFA status.

PCB-24 (West of Building 708):

Approximately 24.1 yd^3 of soil and 1.5 yd^3 of concrete were removed from the west side of Building 708 using backhoes, front-end loaders, a hydrohammer, a bobcat, concrete saw, and hand shovels in early October 1995. The PCB-24 site was confirmed at <10 ppm PCBs by weight in soil using EPA Method 8080. The confirmation of remediation of soils at this site provide the basis for NFA status.

PCB-25 (East Side of Building 707):

In 1991, one of the six transformers located on the rooftop of Building 707 was identified as leaking PCB dielectric oil. Further investigation revealed that rain water had carried PCBs, via a downspout, from the contaminated rooftop to the soil below. An extensive PCB cleanup was initiated in 1991 and 1992 under TSCA regulations and the roof was declared clean. The contaminated soil area below was cordoned off and marked "PCB Contaminated Area" until appropriate actions could be taken under CERCLA. Approximately 64.8 yd^3 of soil were removed from an area immediately south of the main entrance doorway of Building 707 (east side) using backhoes, front-end loaders, excavators, bobcats and hand shovels during the second half of September 1995. The PCB-25 site was confirmed at <10 ppm PCBs by weight using EPA Method 8080. The confirmation of remediation of soils at this site provide the basis for NFA status.

12

PCB-26 (East of Building 750):

Approximately 12.1 yd^3 of soil and 8.0 yd^3 of concrete were removed from the old transformer location on the east side of Building 750 using backhoes, front-end loaders, a hydrohammer, a bobcat and hand shovels in late September 1995. The PCB-26 site was confirmed at <10 ppm PCBs by weight in soil using EPA Method 8080. The confirmation of remediation of soils at this site provide the basis for NFA status.

PCB-33 (North of Building 371):

Approximately 1.08 yd^3 of soil were removed immediately north of Transformer 371-2 using hand shovels in late August 1995. Destructive concrete verification sampling show no other PCB contamination. The PCB-33 site was confirmed at <10 ppm PCBs by weight in the soil using EPA Method 8080. The confirmation of remediation of soils at this site provide the basis for NFA status.

PCB-37 (East of Building 662):

Approximately 85.1 yd^3 of soil were removed from the east side of Building 662 using backhoes, front-end loaders, bobcats and hand shovels during the month of July 1996. Method 8080 analysis of destructive concrete samples collected verify that all concrete areas were clean. The PCB-37 site was confirmed at <25 ppm PCBs by weight in soil using EPA Method 8080. The confirmation of remediation of soils at this site provide the basis for NFA status.

3.2 Quality Control Samples

Duplicate, split, smear, and method blank samples were collected in accordance with the *Final SAP* (RMRS 1995a). The results for these samples as indicators of the quality of the sampling and analysis in support of remediation activities is discussed for each of these sample type. The quality assurance/quality control samples will be further evaluated with the validated data for usability with respect to precision, accuracy, representativeness, comparability, and completeness and submitted as an addendum to this report.

As indicated in Table 3-2, duplicates were collected at a minimum of 1 per site or at an approximate frequency of 1 for every 10 samples. The duplicates were analyzed by Draft Method 4020 as an indicator of the precision of the measurement. A comparison of the duplicate results indicate that method produced precise (i.e., reproducible) measurements.

Split samples were collected and analyzed by Method 8080 to confirm the measurements obtained from the Draft Method 4040 results. The 86 split samples are identified in column four of Table 3-2, Method 8080 Soil Results. Comparison of the Method 8080 results with the Draft Method

4020 results indicate that the Draft Method adequately represent the concentrations at the remediation sites with only one exception. Out of the 86 split samples analyzed, sample SS00206RM showed an inconsistency between the two methods with a 12 ppm concentration detected via Method 8080 and a less than 10 ppm observation made using Draft Method 4020. PCB Site 25 is the only site affected by this inconsistency. As indicated on Table 3-2, five other split samples collected at PCB Site 25 indicate levels well below the 10 ppm target remediation goal and the 25 ppm guidance level.

Smear samples were collected by wiping the sampling equipment with a 10 by 10 centimeter wipe saturated with methanol. The smear sample results are an indication of cross-contamination and the potential for positive bias in the sample results. A total of 72 smear samples were collected. Of the 72 smears, 2 samples showed a positive result (i.e., greater than 10 ppm). A positive result for a smear sample could indicate that the concentrations in the samples associated with the smear were potentially positively biased. The effect of positive bias on the samples is a potential false positive result. The site associated with the two smear samples is PCB Site 37. As indicated on Table 3-2, the site was remediated until levels below the 25 ppm were achieved. As a result, the effect of the positive bias is considered negligible.

For all data reported, none of the method blanks analyzed by Draft Method 4020 had positive detections. A total of 79 method blank samples to assess the potential for positive bias in the sample results. The method blank samples were analyzed by Draft Method 4020. Of the 79 method blank results, 77 were negative (i.e, less than 10 ppm). Two of the method blank samples indicated positive (i.e., greater than 10 ppm) results. A positive result for a method blank could indicate that the concentrations in the samples were potentially positively biased. The effect of positive bias on the samples is a potential false positive result. The site associated with the two method blank samples with positive results is PCB Site 21. As indicated on Table 3-2, the site was remediated until levels below 25 ppm were achieved. Therefore, the effect of the positive bias is considered negligible.

3.3 Summary of Remediation Activities

The volume of soil and concrete excavated for each location is summarized in Section 4.0 and presented in Table 4-1. All of the remediation sites were confirmed to be less than 10 ppm PCBs by weight with the exception of site PCB-37 which is confirmed to be less than 25 ppm and site PCB-21 which was halted for safety reasons at approximately 17 feet. Contaminated soil and concrete was shipped to an EPA-approved, TSCA-licensed chemical waste landfill in Kettleman, California for final disposal. In most cases, concrete samples collected from the old transformer pads were well below the 25 ppm cleanup level, and soil contamination could be removed within an approximate 4 foot depth. All of the excavations were reclaimed to their original condition which included placement and compaction of structural grade fill material. The structural fill was sampled for PCBs using Method 8080 on two occasions (see Table 3-2, page 17).

14

Table 3-1. PCB Post-Removal Levels in Soil[1]

Location Code	Location	Sample Number	Aroclor 1248 (ppm)	Aroclor 1254 (ppm)	Aroclor 1260 (ppm)
PCB-10	555/558	SS00033RM	U	U	1.3
PCB-12/13	661/675	SS00455RM	U	U	0.7
PCB-17	883	SS00090RM	3.1	U	U
PCB-20	515/516	SS00011RM	U	U	0.9
PCB-21	776	SS00533RM	U	U	70.0
PCB-23	559	SS00132RM	2.4	0.6	U
PCB-24	708	SS00301RM	U	3.2	U
PCB-25	707	SS00206RM	U	7.0	5.0
PCB-26	750	SS00162RM	5.9	U	U
PCB-33	371	SS00002RM	U	U	U
PCB-37	662	SS00569RM	1.2	U	3.1
PCB-37	662	SS00616RM	U	2.5	0.6

[1]Maximum concentrations

Table 3-2. Comprehensive Data Summary Method 8080 and 4020 Samples Collected Per Site.

PCB Site Location	Sample Numbers	Method 8080 Concrete Results (ppm)	Method 8080 Soil Results (ppm)	Method 4020 Immunoassay Results (ppm)
PCB-10	CT00021EG	U		
PCB-10	CT00022EG	U		
PCB-10	CT00023EG	U		
PCB-10	CT00024EG	.04		
PCB-10	CT00025EG	U		
PCB-10	SS00021RM			<10
PCB-10	SS00022RM			<10
PCB-10	SS00024RM			<10
PCB-10	SS00025RM			<10
PCB-10	SS00026RM		.05	<10
PCB-10	SS00027RM			<10
PCB-10	SS00028RM		U	<10
PCB-10	SS00029RM			<10
PCB-10	SS00032RM			<10
PCB-10	SS00033RM		1.30	<10
PCB-10	SS00034RM(dup)			<10
PCB-12/13	CT00037RM	U		
PCB-12/13	CT00038RM	U		
PCB-12/13	CT00039RM	.07		
PCB-12/13	CT00040RM	U		
PCB-12/13	CT00041RM	U		
PCB-12/13	CT00042RM	U		
PCB-12/13	CT00076RM	.08		
PCB-12/13	CT00081RM	U		
PCB-12/13	SS00426RM			<10
PCB-12/13	SS00427RM			<10
PCB-12/13	SS00428RM(dup)			<10
PCB-12/13	SS00429RM			<10
PCB-12/13	SS00430RM		.12	<10
PCB-12/13	SS00431RM			<10
PCB-12/13	SS00432RM			<10
PCB-12/13	SS00433RM			<10
PCB-12/13	SS00434RM		.46	<10
PCB-12/13	SS00435RM			<10
PCB-12/13	SS00436RM			<10
PCB-12/13	SS00437RM		.44	<10
PCB-12/13	SS00438RM		.18	<10
PCB-12/13	SS00439RM			<10
PCB-12/13	SS00440RM			<10
PCB-12/13	SS00441RM		U	<10
PCB-12/13	SS00442RM			<10
PCB-12/13	SS00443RM			<10
PCB-12/13	SS00444RM			<10
PCB-12/13	SS00445RM			<10
PCB-12/13	SS00446RM(dup)			<10
PCB-12/13	SS00447RM		.27	<10
PCB-12/13	SS00448RM			<10
PCB-12/13	SS00449RM			<10
PCB-12/13	SS00450RM		U	<10
PCB-12/13	SS00451RM			<10
PCB-12/13	SS00452RM			<10

16

PCB Site Location	Sample Numbers	Method 8080 Concrete Results (ppm)	Method 8080 Soil Results (ppm)	Method 4020 Immunoassay Results (ppm)
PCB-12/13	SS00453RM			<10
PCB-12/13	SS00454RM			<10
PCB-12/13	SS00455RM		.67	<10
PCB-12/13	SS00456RM			<10
PCB-12/13	SS00457RM			<10
PCB-12/13	SS00458RM			<10
PCB-12/13	SS00459RM			<10
PCB-12/13	SS00460RM		.11	<10
PCB-12/13	SS00461RM(dup)			<10
PCB-12/13	SS00462RM			<10
PCB-12/13	SS00463RM		.42	<10
PCB-12/13	SS00464RM		.27	<10
PCB-12/13	SS00465RM			<10
PCB-12/13	SS00466RM			<10
PCB-12/13	SS00467RM			<10
PCB-12/13	SS00468RM			<10
PCB-12/13	SS00469RM			<10
PCB-12/13	SS00470RM(dup)			<10
PCB-12/13	SS00471RM			<10
PCB-12/13	SS00472RM			<10
PCB-12/13	SS00473RM		.28	<10
PCB-12/13	SS00474RM			<10
PCB-12/13	SS00475RM			<10
PCB-12/13	SS00476RM			<10
PCB-12/13	SS00477RM		.13	<10
PCB-12/13	SS00478RM			<10
PCB-12/13	SS00479RM(dup)			<10
PCB-12/13	SS00480RM			<10
PCB-12/13	SS00481RM		.34	<10
PCB-12/13	SS00482RM			<10
PCB-12/13	SS00483RM			<10
PCB-12/13	SS00484RM			<10
PCB-12/13	SS00485RM			<10
PCB-17	CT00014EG	.12		
PCB-17	CT00015EG	.13		
PCB-17	CT00016EG	3.60		
PCB-17	SS00065RM			<10
PCB-17	SS00068RM			<10
PCB-17	SS00070RM		2.70	<10
PCB-17	SS00071RM			<10
PCB-17	SS00073RM			<10
PCB-17	SS00074RM			<10
PCB-17	SS00079RM		.30	<10
PCB-17	SS00080RM			<10
PCB-17	SS00083RM			<10
PCB-17	SS00084RM			<10
PCB-17	SS00085RM(dup)			<10
PCB-17	SS00087RM			<10
PCB-17	SS00088RM			<10
PCB-17	SS00089RM			<10
PCB-17	SS00090RM		3.10	<10
PCB-17	SS00091RM			<10
PCB-17	SS00092RM			<10
PCB-17	SS00093RM			<10
PCB-17	SS00094RM		1.30	<10
PCB-17	SS00095RM(dup)		1.80	<10

17

PCB Site Location	Sample Numbers	Method 8080 Concrete Results (ppm)	Method 8080 Soil Results (ppm)	Method 4020 Immunoassay Results (ppm)
PCB-17	SS00096RM			<10
PCB-17	SS00097RM		.47	<10
PCB-17	SS00098RM			<10
PCB-17	SS00099RM			<10
PCB-17	SS00101RM			<10
PCB-17	SS00102RM			<10
PCB-20	CT00035EG	.73		
PCB-20	CT00036EG	.86		
PCB-20	SS00011RM		.93	<10
PCB-20	SS00012RM			<10
PCB-20	SS00013RM			<10
PCB-20	SS00014RM			<10
PCB-20	SS00015RM			<10
PCB-20	SS00016RM		.14	<10
PCB-20	SS00017RM			<10
PCB-20	SS00018RM			<10
PCB-20	SS00019RM			<10
PCB-20	SS00040RM(dup)			<10
PCB-21	CT00001EG	U		
PCB-21	CT00002EG	.10		
PCB-21	CT00003EG	56.0		
PCB-21	SS00295RM			>10
PCB-21	SS00349RM			>10
PCB-21	SS00350RM(dup)			<10
PCB-21	SS00351RM			<10
PCB-21	SS00352RM		3.10	<10
PCB-21	SS00353RM			<10
PCB-21	SS00355RM			<10
PCB-21	SS00359RM		.23	<10
PCB-21	SS00363RM			<10
PCB-21	SS00364RM		.80	<10
PCB-21	SS00367RM		.24	<10
PCB-21	SS00368RM			<10
PCB-21	SS00371RM			<10
PCB-21	SS00372RM			<10
PCB-21	SS00375RM			<10
PCB-21	SS00376RM			<10
PCB-21	SS00379RM(dup)			<10
PCB-21	SS00405RM			<10
PCB-21	SS00407RM			<10
PCB-21	SS00411RM			<10
PCB-21	SS00413RM			<10
PCB-21	SS00415RM			<10
PCB-21	SS00416RM			<10
PCB-21	SS00417RM			<10
PCB-21	SS00418RM			<10
PCB-21	SS00419RM			<10
PCB-21	SS00421RM			<10
PCB-21	SS00422RM			<10
PCB-21	SS00423RM			<10
PCB-21	SS00495RM		4.10	
PCB-21	SS00497RM		3.19	<10
PCB-21	SS00498RM		.94	<10
PCB-21	SS00500RM		.80	<10
PCB-21	SS00525RM			<25

18

PCB Site Location	Sample Numbers	Method 8080 Concrete Results (ppm)	Method 8080 Soil Results (ppm)	Method 4020 Immunoassay Results (ppm)
PCB-21	SS00526RM		11.0	<25
PCB-21	SS00527RM			<25
PCB-21	SS00528RM			<10
PCB-21	SS00529RM			<10
PCB-21	SS00531RM		5.70	<10
PCB-21	SS00532RM			<25
PCB-21	SS00533RM		70.0	>25
PCB-21	SS00534RM		46.0	>25
PCB-21	SS00535RM		46.0	>25
PCB-21	SS00536RM(dup)			>25
PCB-21	SS00537RM		49.0	>25
PCB-21	SS00538RM		56.0	>25
PCB-21	SS00539RM		15.0	>25
PCB-23	CT00004EG	.04		
PCB-23	CT00005EG	U		
PCB-23	CT00006EG	U		
PCB-23	CT00007EG	U		
PCB-23	SS00131RM			<10
PCB-23	SS00132RM		2.98	<10
PCB-23	SS00133RM			<10
PCB-23	SS00134RM			<10
PCB-23	SS00135RM			<10
PCB-23	SS00138RM			<10
PCB-23	SS00140RM			<10
PCB-23	SS00141RM			<10
PCB-23	SS00142RM			<10
PCB-23	SS00144RM			<10
PCB-23	SS00145RM		.06	<10
PCB-23	SS00146RM(dup)			<10
PCB-23	SS00147RM			<10
PCB-23	SS00149RM			<10
PCB-23	SS00150RM		.42	<10
PCB-23	SS00151RM			<10
PCB-23	SS00152RM			<10
PCB-23	SS00153RM			<10
PCB-23	SS00154RM			<10
PCB-23	SS00155RM(dup)			<10
PCB-23	SS00156RM			<10
PCB-23	SS00157RM			<10
PCB-23	SS00197RM		.46	<10
PCB-23	SS00198RM			<10
PCB-23	SS00199RM			<10
PCB-23	SS00201RM			<10
PCB-23	SS00202RM			<10
PCB-23	SS00203RM		.09	<10
PCB-23	SS00204RM			<10
PCB-23	SS00205RM(dup)			<10
PCB-23	SS00264RM			<10
PCB-23	SS00265RM		.11	<10
PCB-23	SS00266RM			<10
PCB-23	SS00267RM			<10
PCB-23	SS00268RM			<10
PCB-24	CT00008EG	U		
PCB-24	CT00009EG	U		
PCB-24	CT00010EG	U		

PCB Site Location	Sample Numbers	Method 8080 Concrete Results (ppm)	Method 8080 Soil Results (ppm)	Method 4020 Immunoassay Results (ppm)
PCB-24	SS00255RM			<10
PCB-24	SS00256RM		.04	<10
PCB-24	SS00257RM			<10
PCB-24	SS00258RM		U	<10
PCB-24	SS00259RM			<10
PCB-24	SS00260RM			<10
PCB-24	SS00261RM			<10
PCB-24	SS00262RM			<10
PCB-24	SS00263RM(dup)			<10
PCB-24	SS00298RM			<10
PCB-24	SS00299RM			<10
PCB-24	SS00300RM			<10
PCB-24	SS00301RM		3.20	<10
PCB-24	SS00302RM			<10
PCB-24	SS00305RM		2.10	<10
PCB-24	SS00309RM			<10
PCB-24	SS00310RM		.32	<10
PCB-24	SS00311RM			<10
PCB-24	SS00312RM			<10
PCB-24	SS00313RM			<10
PCB-24	SS00314RM			<10
PCB-24	SS00315RM			<10
PCB-24	SS00316RM		U	<10
PCB-24	SS00317RM			<10
PCB-24	SS00318RM			<10
PCB-24	SS00319RM		.58	<10
PCB-24	SS00320RM(dup)			<10
PCB-25	SS00172RM			<10
PCB-25	SS00173RM			<10
PCB-25	SS00174RM			<10
PCB-25	SS00175RM			<10
PCB-25	SS00176RM			<10
PCB-25	SS00177RM		1.10	<10
PCB-25	SS00178RM			<10
PCB-25	SS00179RM			<10
PCB-25	SS00183RM			<10
PCB-25	SS00184RM			<10
PCB-25	SS00185RM		1.39	<10
PCB-25	SS00186RM			<10
PCB-25	SS00187RM			<10
PCB-25	SS00188RM			<10
PCB-25	SS00191RM(dup)			<10
PCB-25	SS00195RM			<10
PCB-25	SS00198RM			<10
PCB-25	SS00206RM		12.0	<10
PCB-25	SS00207RM			<10
PCB-25	SS00208RM			<10
PCB-25	SS00209RM			<10
PCB-25	SS00210RM			<10
PCB-25	SS00211RM			<10
PCB-25	SS00212RM		2.05	<10
PCB-25	SS00213RM		2.06	<10
PCB-25	SS00214RM			<10
PCB-25	SS00215RM			<10
PCB-25	SS00216RM(dup)			<10
PCB-25	SS00217RM		.53	<10

PCB Site Location	Sample Numbers	Method 8080 Concrete Results (ppm)	Method 8080 Soil Results (ppm)	Method 4020 Immunoassay Results (ppm)
PCB-25	SS00218RM			<10
PCB-25	SS00219RM			<10
PCB-25	SS00220RM			<10
PCB-25	SS00221RM			<10
PCB-25	SS00222RM			<10
PCB-26	CT00011EG	U		
PCB-26	CT00012EG	.03		
PCB-26	CT00013EG	U		
PCB-26	SS00103RM			<10
PCB-26	SS00104RM			<10
PCB-26	SS00106RM			<10
PCB-26	SS00108RM		.16	<10
PCB-26	SS00109RM			<10
PCB-26	SS00110RM			<10
PCB-26	SS00114RM			<10
PCB-26	SS00118RM			<10
PCB-26	SS00123RM			<10
PCB-26	SS00124RM			<10
PCB-26	SS00125RM			<10
PCB-26	SS00126RM			<10
PCB-26	SS00127RM			<10
PCB-26	SS00128RM			<10
PCB-26	SS00130RM(dup)			<10
PCB-26	SS00158RM			<10
PCB-26	SS00160RM		.65	<10
PCB-26	SS00161RM			<10
PCB-26	SS00162RM		5.90	<10
PCB-26	SS00163RM			<10
PCB-26	SS00164RM			<10
PCB-26	SS00165RM		.09	<10
PCB-26	SS00166RM			<10
PCB-26	SS00167RM			<10
PCB-26	SS00168RM		2.80	<10
PCB-26	SS00169RM(dup)			<10
PCB-26	SS00170RM		2.30	<10
PCB-26	SS00171RM		U	<10
PCB-33	CT00029EG	.21		
PCB-33	CT00030EG	1.30		
PCB-33	CT00031EG	.21		
PCB-33	CT00032EG	U		
PCB-33	SS00001RM			<10
PCB-33	SS00002RM		U	<10
PCB-33	SS00004RM		U	<10
PCB-33	SS00005RM			<10
PCB-33	SS00007RM			<10
PCB-33	SS00010RM(dup)			<10
PCB-37	CT00051EG	U		
PCB-37	CT00052EG	U		
PCB-37	CT00053EG	U		
PCB-37	CT00054EG	U		
PCB-37	CT00055EG	.24		
PCB-37	CT00056EG	U		
PCB-37	CT00057EG	1.40		
PCB-37	CT00058EG	U		

21

PCB Site Location	Sample Numbers	Method 8080 Concrete Results (ppm)	Method 8080 Soil Results (ppm)	Method 4020 Immunoassay Results (ppm)
PCB-37	CT00059EG	U		
PCB-37	CT00060EG	U		
PCB-37	CT00061EG	U		
PCB-37	CT00062EG	U		
PCB-37	CT00063EG	U		
PCB-37	CT00064EG	U		
PCB-37	CT00065EG(dup)	U		
PCB-37	CT00066EG	U		
PCB-37	CT00067EG	U		
PCB-37	CT00068EG	U		
PCB-37	CT00069EG	U		
PCB-37	CT00070EG	U		
PCB-37	CT00071EG	U		
PCB-37	CT00072EG(dup)	U		
PCB-37	CT00073EG	U		
PCB-37	CT00074EG	U		
PCB-37	SS00540RM			<10
PCB-37	SS00541RM			<10
PCB-37	SS00542RM			<10
PCB-37	SS00543RM			<10
PCB-37	SS00544RM(dup)			<10
PCB-37	SS00545RM		U	<10
PCB-37	SS00546RM		.38	<10
PCB-37	SS00547RM			<10
PCB-37	SS00548RM		U	<10
PCB-37	SS00549RM			<10
PCB-37	SS00550RM			<10
PCB-37	SS00551RM			<10
PCB-37	SS00552RM			<10
PCB-37	SS00553RM		.11	<10
PCB-37	SS00554RM			<10
PCB-37	SS00555RM			<10
PCB-37	SS00556RM		U	<10
PCB-37	SS00557RM			<10
PCB-37	SS00558RM			<10
PCB-37	SS00559RM			<10
PCB-37	SS00560RM			<10
PCB-37	SS00561RM			<10
PCB-37	SS00562RM			<10
PCB-37	SS00563RM		U	<10
PCB-37	SS00564RM			<10
PCB-37	SS00565RM(dup)			<10
PCB-37	SS00566RM			<10
PCB-37	SS00567RM			<10
PCB-37	SS00568RM			<10
PCB-37	SS00569RM		4.30	<25
PCB-37	SS00570RM			<25
PCB-37	SS00571RM			<25
PCB-37	SS00572RM		.20	<10
PCB-37	SS00574RM			<10
PCB-37	SS00576RM			<10
PCB-37	SS00577RM			<10
PCB-37	SS00578RM		.77	<10
PCB-37	SS00579RM			<10
PCB-37	SS00580RM			<10
PCB-37	SS00581RM			<10
PCB-37	SS00583RM		.24	<10

22

PCB Site Location	Sample Numbers	Method 8080 Concrete Results (ppm)	Method 8080 Soil Results (ppm)	Method 4020 Immunoassay Results (ppm)
PCB-37	SS00584RM			<10
PCB-37	SS00585RM		.10	<10
PCB-37	SS00586RM			<10
PCB-37	SS00587RM			<10
PCB-37	SS00588RM			<10
PCB-37	SS00589RM			<10
PCB-37	SS00590RM			<10
PCB-37	SS00591RM		U	<10
PCB-37	SS00592RM			<10
PCB-37	SS00593RM(dup)			<10
PCB-37	SS00594RM			<10
PCB-37	SS00595RM			<10
PCB-37	SS00596RM			<10
PCB-37	SS00597RM			<10
PCB-37	SS00598RM			<10
PCB-37	SS00599RM			<10
PCB-37	SS00600RM		U	<10
PCB-37	SS00601RM			<10
PCB-37	SS00602RM			<10
PCB-37	SS00603RM		U	<10
PCB-37	SS00604RM			<10
PCB-37	SS00605RM			<10
PCB-37	SS00606RM			<10
PCB-37	SS00607RM(dup)			<10
PCB-37	SS00608RM			<10
PCB-37	SS00609RM		U	<25
PCB-37	SS00610RM			<10
PCB-37	SS00611RM			<10
PCB-37	SS00612RM		.59	<10
PCB-37	SS00613RM			<10
PCB-37	SS00614RM			<10
PCB-37	SS00615RM			<10
PCB-37	SS00616RM		3.06	<25
PCB-37	SS00617RM			<25
Fill Material	SS00020RM		U	
Fill Material	SS00254RM		U	

Sample Number prefixes

CT = Concrete

SS = Soil

U = not detected

4.0 Waste Disposal

Approximately 500 yd^3 of contaminated soil and concrete was excavated from all of the sites and shipped to an EPA-approved, TSCA-permitted chemical waste landfill in Kettleman, California. In addition to the contaminated soil and concrete waste, Personal Protective Equipment (PPE) waste and immunoassay residual lab wastes were also shipped to Kettleman.

Concrete and/or asphalt from PCB Site 17 (near Bldg. 883), PCB Site 23, (northeast corner of Bldg. 559), PCB Site 24 (west of Bldg. 708), and PCB Site 26 (east of Bldg. 750) was shipped to the Rocky Flats onsite landfill for disposal. This overlying material was sampled using Method 8080 and removed to facilitate the excavation of underlying contaminated soils. All of the destructive samples collected from the above mentioned sites were <10 ppm PCBs. Table 4-1 shows the volume of PCB contaminated waste generated per site.

Table 4-1. PCB-Contaminated Waste Removed Per Site.

Site	Soil Removed (yd^3)	Concrete Removed (yd^3)
PCB-10 (555/558 Substation)	4.3	0
PCB-12/13 (661/675 Substation)	46.7	0
PCB-17 (Bldg. 883)	22.1	2 (asphalt) + 8.5 (concrete)
PCB-20 (515/516 Substation)	5.8	0
PCB-21 (Bldg. 776)	177	10.7
PCB-23 (Bldg. 559)	27.2	2.5
PCB-24 (Bldg. 708)	24.1	1.5
PCB-25 (Bldg. 707)	64.8	0
PCB-26 (Bldg. 750)	12.1	8.0
PCB-33 (Bldg. 371)	1.08	0
PCB-37 (Bldg. 662)	85.1	0
TOTAL	470.8	33.2

5.0 Conclusions

The PCB remediation was performed in accordance with the *Final PAM, PCB Remediation* (DOE 1995), *Final SAP*, (RMRS 1995a), and *Final Project-Specific Health and Safety Plan* (RMRS 1995b). Eleven PACs, which correspond to 13 of the originally designated PCB sites (EG&G 1991), were remediated to below 25 ppm total PCB standard. As a result, these sites were submitted for proposed No Further Action (NFA) status in the *Annual Update for the Historical Release Report* (DOE 1996b). These sites will be officially closed under the Industrial Area OU ROD.

PCB concentrations in two areas at PCB Site 21 (approximately 0.23 yd^3 total) remain at levels greater than 10 ppm, but less than 25 ppm. Six attempts to adequately remediate PCB Site 21 were made. One small area (approximately 1.1 yd^3) remains at 70 ppm PCBs. The excavation progressed to a depth of 17 feet and, due to physical constraints of the equipment and health and safety concerns, additional excavation at PCB Site 21 was ceased. The Industrial Area OU ROD will also address PCB Site 21 at which residual concentrations above the 25 ppm standard remain.

Approximately 2,000 field screening samples were collected and analyzed during the course of the project resulting in significant cost savings over conventional laboratory analysis. Utilization of SW-846 Draft Method 4020 allowed remediation activities to continue while samples were being analyzed on location in a mobile laboratory. The approach also included targeting a 10 ppm remediation goal to assure that the 25 ppm cleanup standard was achieved. Final verification split samples and quality control samples were collected under accepted MRI protocols once the 4020 screens showed less than 10 ppm. Final cleanup verification samples were analyzed using EPA Method 8080 (see Appendix B). The MRI site verification sampling grids, EPA Method 8080 analysis, and specific MRI guidance documentation utilized in executing the project are included as appendixes. The validation results will be evaluated for data usability as part of the quality control for the project and submitted as an addendum to this report. All of the remediation sites addressed in this completion report were restored to, at a minimum, their original condition. There were no injuries during this project.

6.0 References

EPA 1986. *Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup*, EPA-560/5-86-017. 55 pp.

DOE 1991. *Rocky Flats Interagency Agreement,* Rocky Flats Plant, Golden, CO, January.

EG&G 1991. *Assessment of Potential Environmental Releases of Polychlorinated Biphenyls (PCBs) Preliminary Assessment/Site Description,* Rocky Flats Plant, Golden, CO, July.

DOE 1992. *Historical Release Report for the Rocky Flats Plant*, Rocky Flats Plant, Golden, CO, August.

DOE 1995. *Final Proposed Action Memorandum for Remediation of Polychlorinated Biphenyls*, RF/ER-95-0066.UN, Rocky Flats Environmental Technology Site, Golden, CO, July.

RMRS 1995a. *Final Sampling and Analysis Plan for the Removal of Polychlorinated Biphenyls*, RF/ER-95-0101, Rocky Flats Environmental Technology Site, Golden, CO, August.

RMRS 1995b. *Project-Specific Health & Safety Plan-PCB Hot Spot Removal Project*, RF/ER-95-0102, Rocky Flats Environmental Technology Site, Golden, CO, August.

DOE 1996a. *Final Rocky Flats Cleanup Agreement,* Rocky Flats Environmental Technology Site, Golden, CO, July.

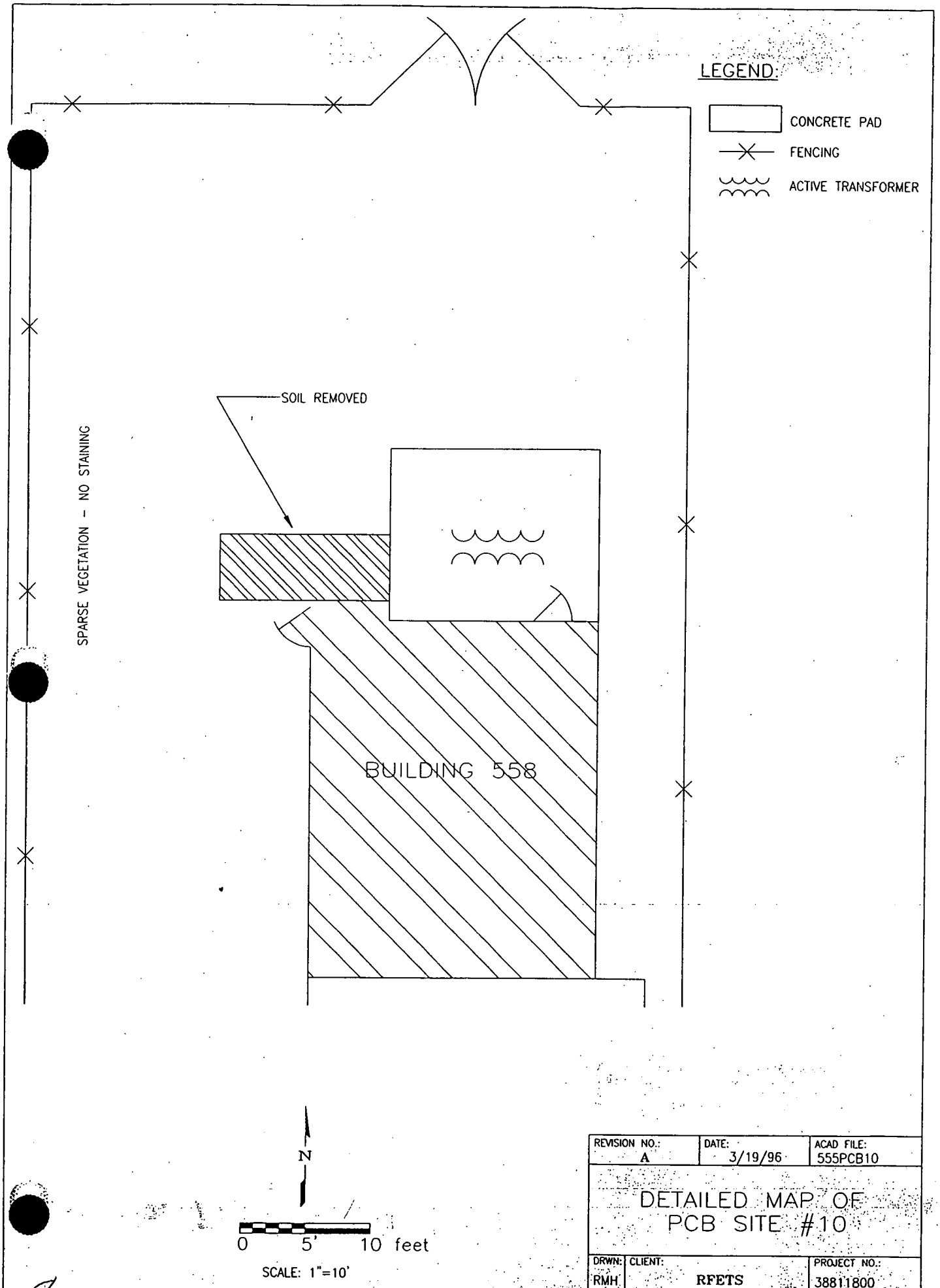
DOE 1996b. *Annual Update for the Historical Release Report*, Rocky Flats Environmental Technology Site, Golden, CO, August.

26

Appendix A

Site Maps

Best Available Copy

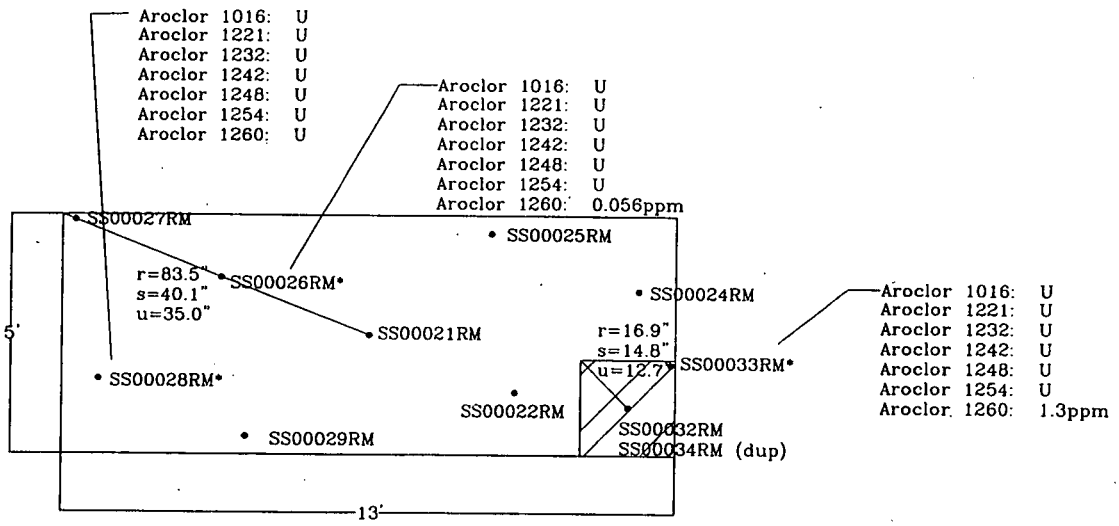


REVISION NO.:	DATE:	ACAD FILE:
A	3/19/96	555PCB10

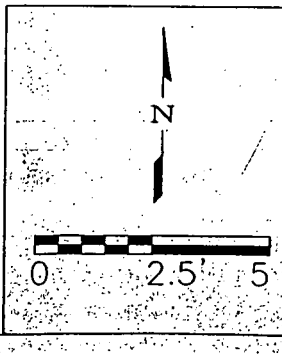
DETAILED MAP OF PCB SITE #10

DRWN:	CLIENT:	PROJECT NO.:
RMH	RFETS	38811800
CHKD: CLB	LOCATION: GOLDEN, CO	FIGURE NO.: 2-1

28



Note:
All samples are <10ppm PCBs by immunoassay analysis.



LEGEND:

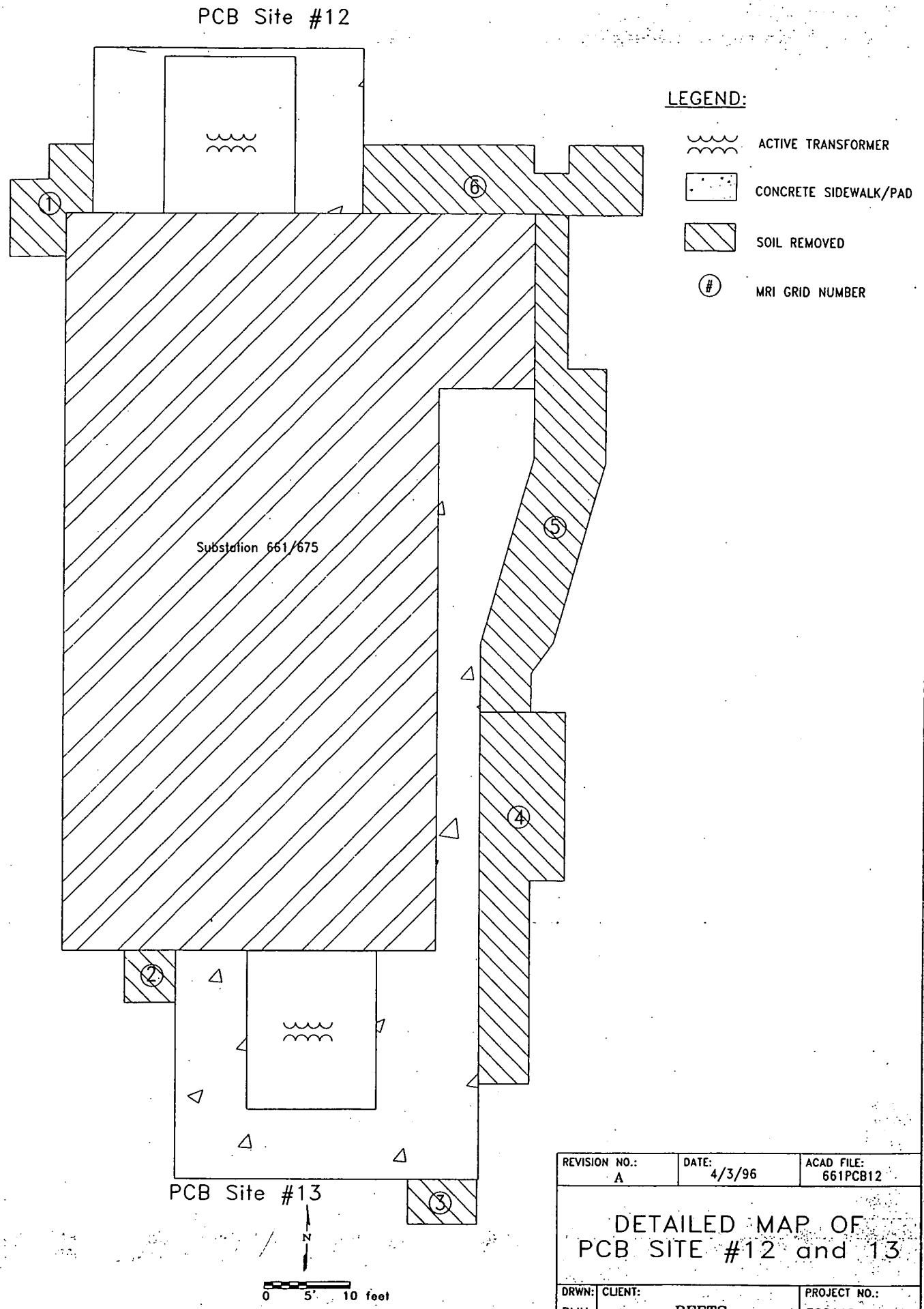
- ⊕ Sample Point
- * Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

REV. NO.	DATE:	FILENAME:
A	3/5/96	555MRI

MRI GRID LAYOUT
PCB-10/11 (555/558 Substation)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	38811800

29



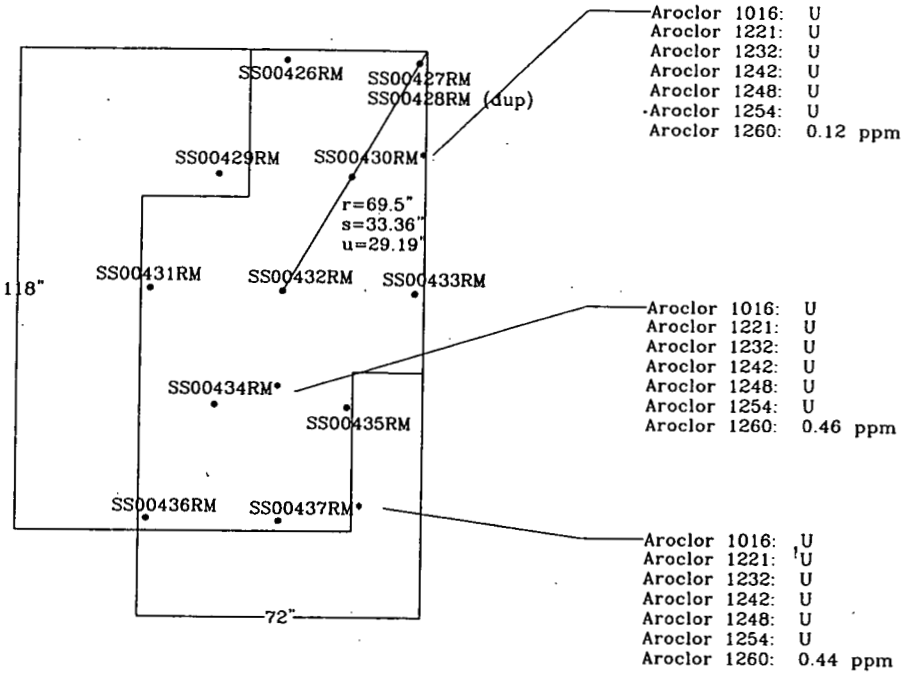
REVISION NO.:	DATE:	ACAD FILE:
A	4/3/96	661PCB12

DETAILED MAP OF PCB SITE #12 and 13

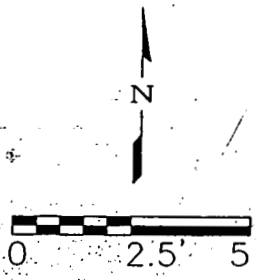
DRWN:	CLIENT:	PROJECT NO.:
RMH	RFETS	38811800
CHKD:	LOCATION:	FIGURE NO.:
CLB	GOLDEN, CO	

30

1



Note:
All samples are <10ppm PCBs by immunoassay analysis.



LEGEND:

- ● Sample Point
- * Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

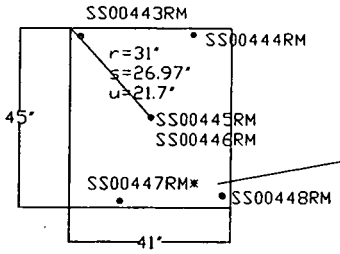
REV. NO.	DATE:	FILENAME:
A	4/3/96	661MRI1

MRI GRID LAYOUT
PCB-12/13 (Substation 661/675)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	38811800

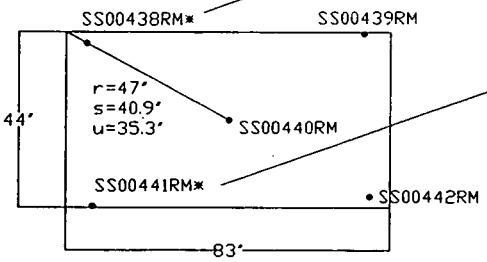
31

②



Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: 0.27 ppm

③



Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: 0.18 ppm

Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: U

Note:
All samples are <10ppm PCBs by immunoassay analysis.

N

LEGEND:
- ● Sample Point
- * Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

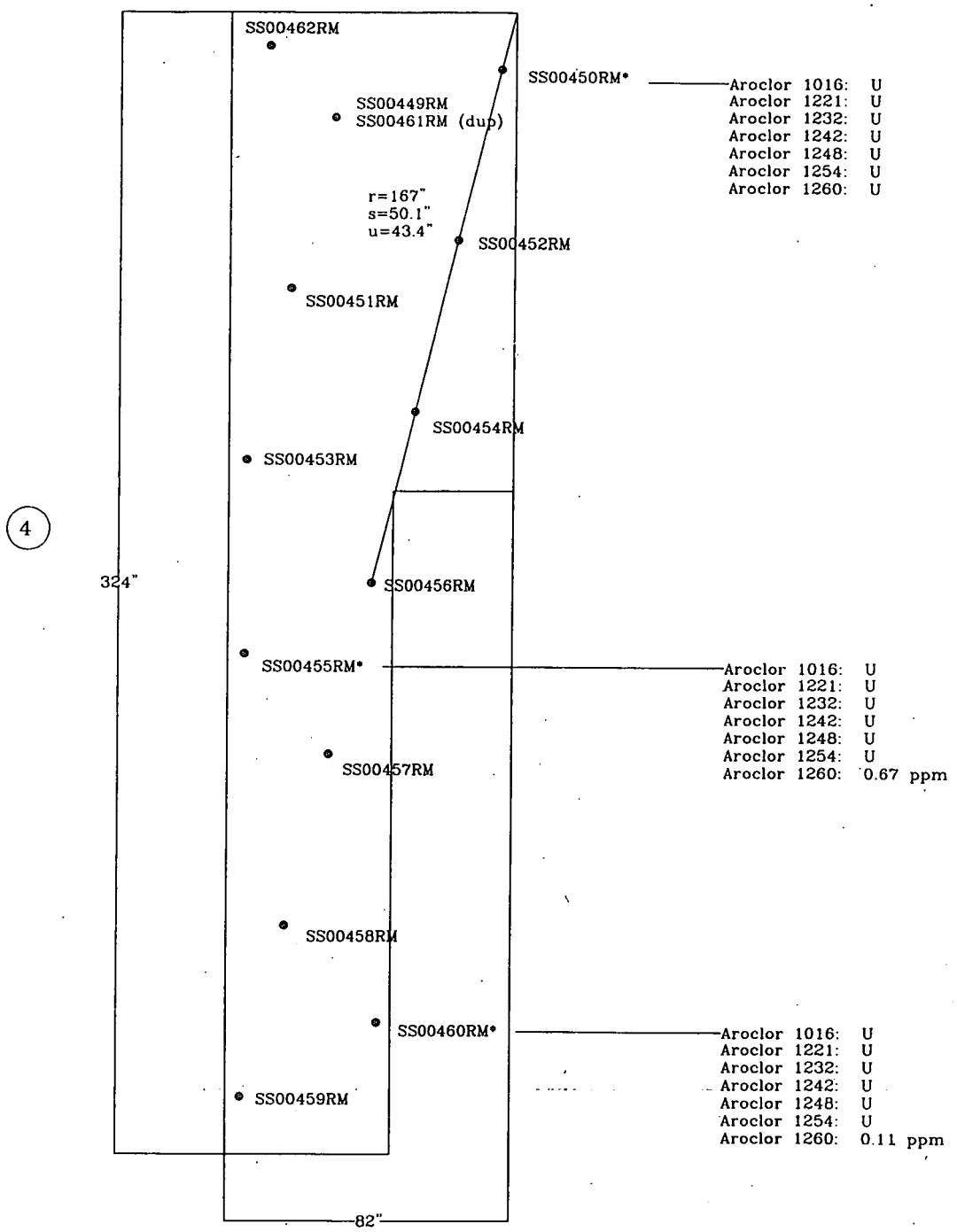
0 2.5' 5 feet

REV. NO.	DATE:	FILENAME:
A	4/3/96	661MRI23

MRI GRID LAYOUT
PCB-12/13 (Substation 661/675)

DRWN:	CHKD:	CHARGE NO.
RMH	CLB	38811800

32



Note:
All samples are <10ppm PCBs by immunoassay analysis.

N

LEGEND:

- Sample Point
- Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

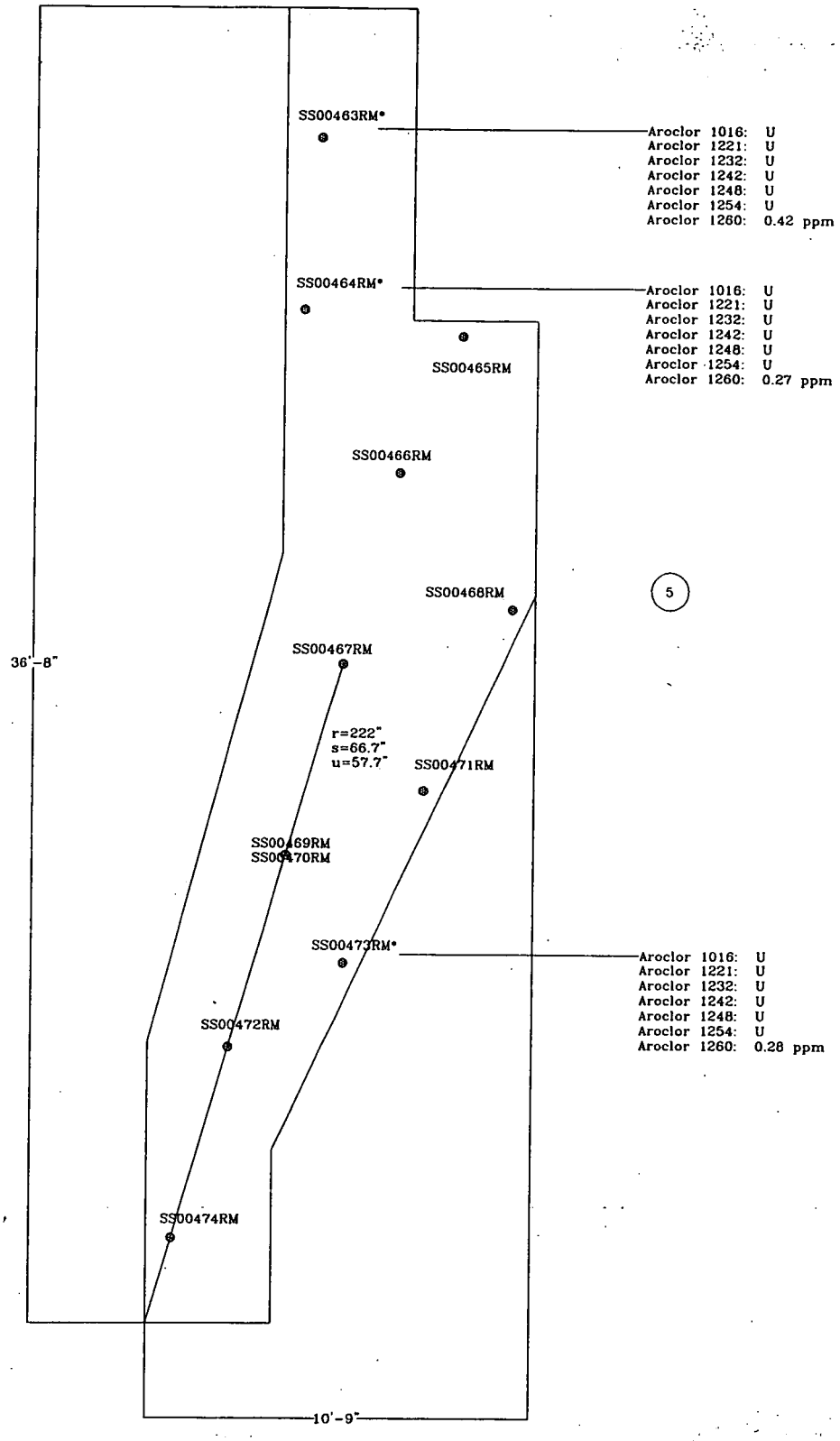
0 2.5' 5 feet

REV. NO.	DATE:	FILENAME:
A	4/3/96	661MRI4

MRI GRID LAYOUT
PCB-12/13 (Substation 661/675)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	38811800

33



Note:
All samples are <10ppm PCBs by immunoassay analysis.

LEGEND:

- Sample Point
- Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

N

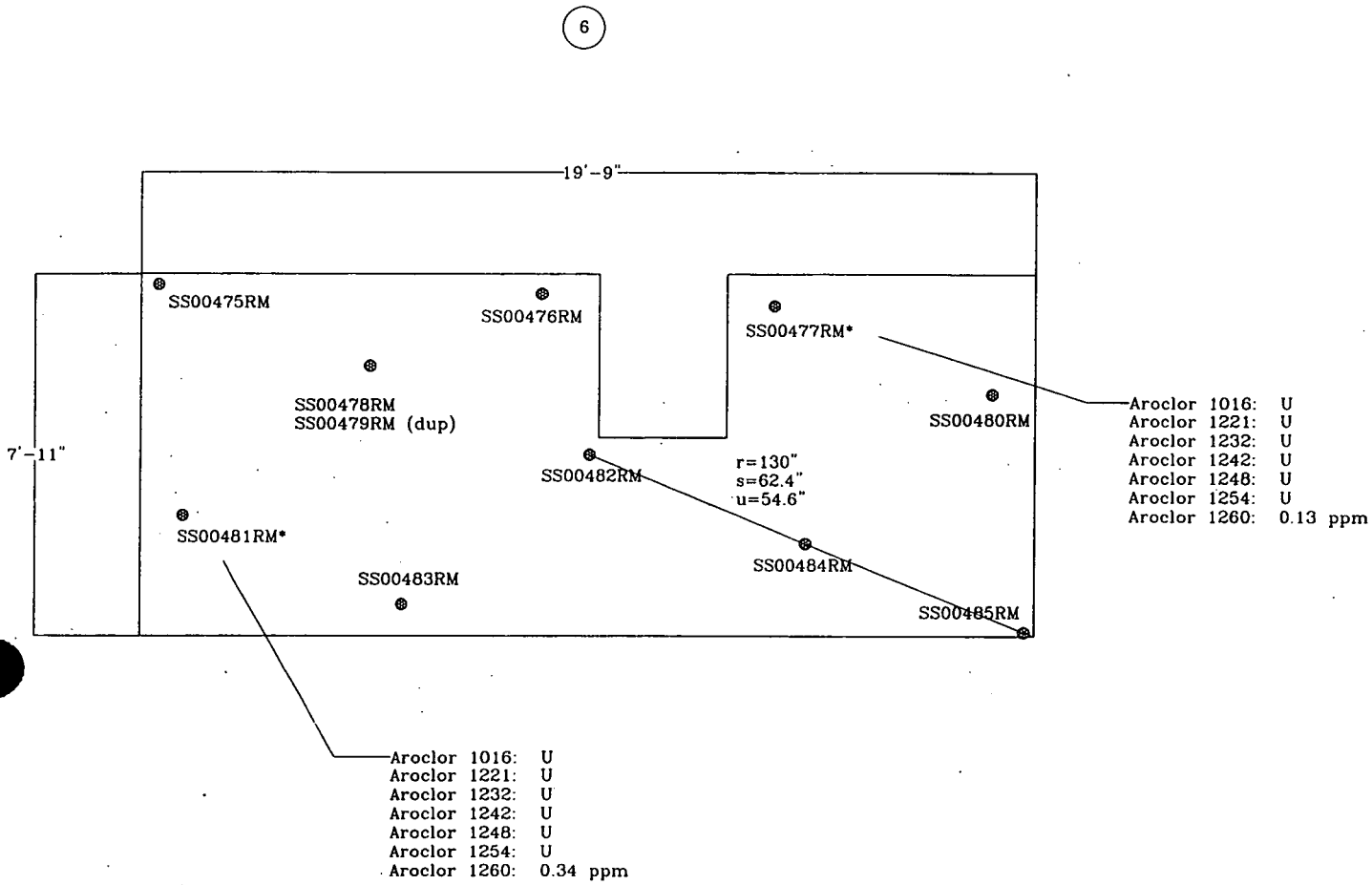
0 2.5' 5 feet

REV. NO.	DATE:	FILENAME:
A	8/20/96	661MRI5

MRI GRID LAYOUT
PCB-12/13 (Substation 661/675)

DRWN:	CHKD:	CHARGE NO.
RMH	CLB	38811800

34



Note:
All samples are <10ppm PCBs by immunoassay analysis.

N

LEGEND:

- ⊗ Sample Point
- * Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

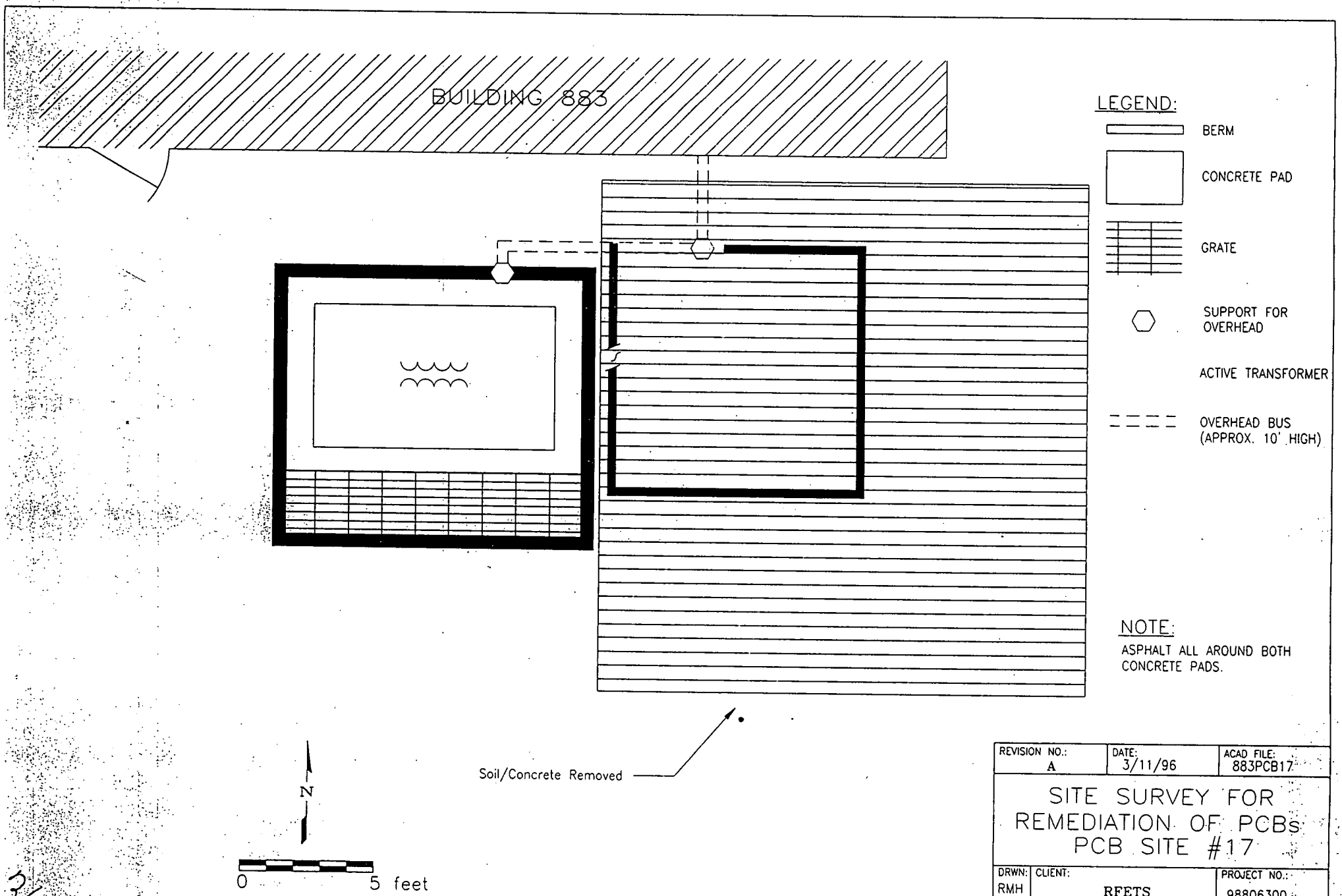
0 2.5 5 feet

REV. NO.	DATE:	FILENAME:
A	8/20/96	661MRI6

MRI GRID LAYOUT
PCB-12/13 (Substation 661/675)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	38811800

35

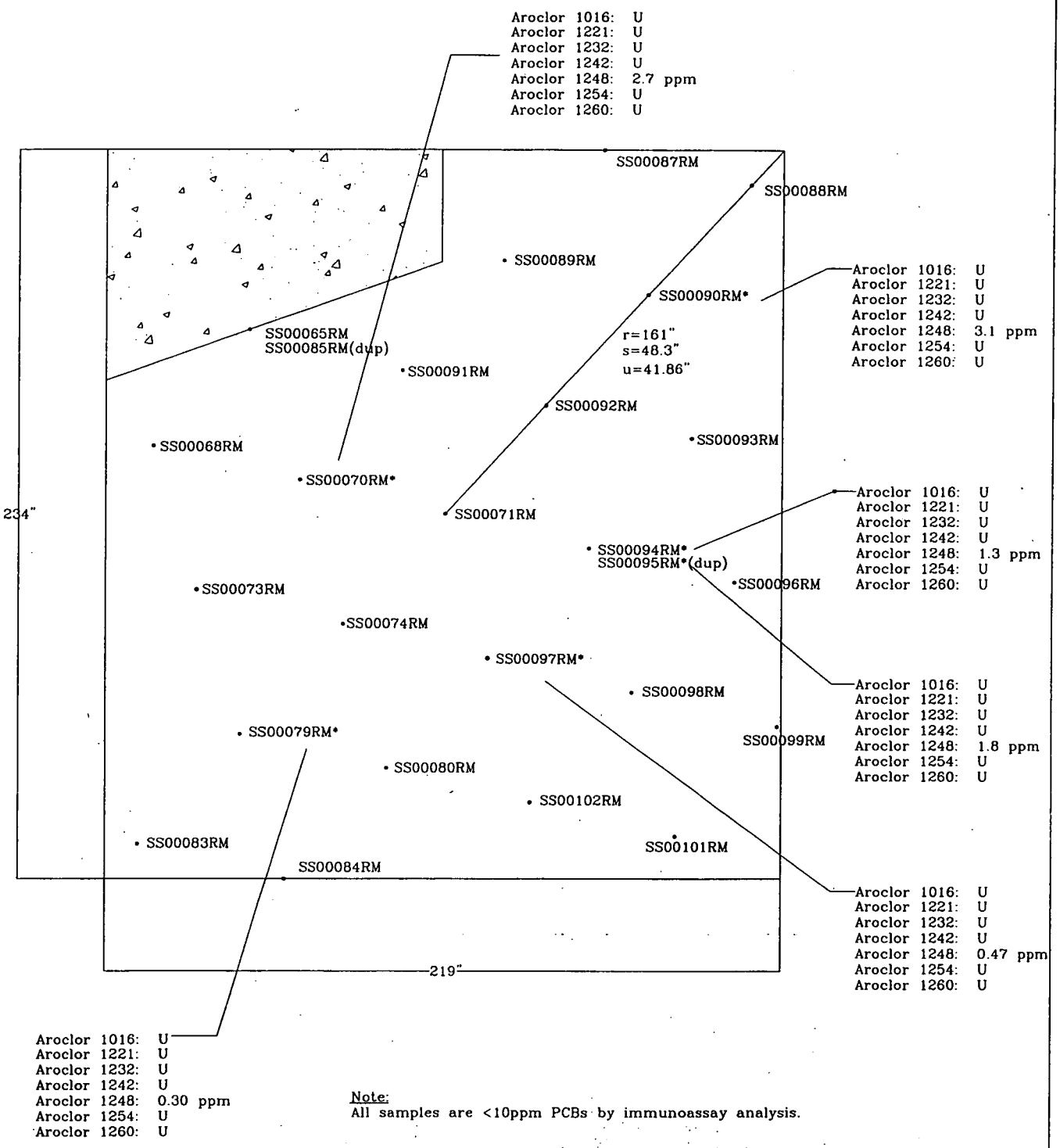


REVISION NO.: A	DATE: 3/11/96	ACAD FILE: 883PCB17

SITE SURVEY FOR REMEDIATION OF PCBs PCB SITE #17

DRWN: RMH	CLIENT: RFETS	PROJECT NO.: 98806300
CHKD: CLB	LOCATION: GOLDEN, CO	FIGURE NO.:

36



Note:
All samples are <10ppm PCBs by immunoassay analysis.

N

LEGEND:

- ● Sample Point
- * Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

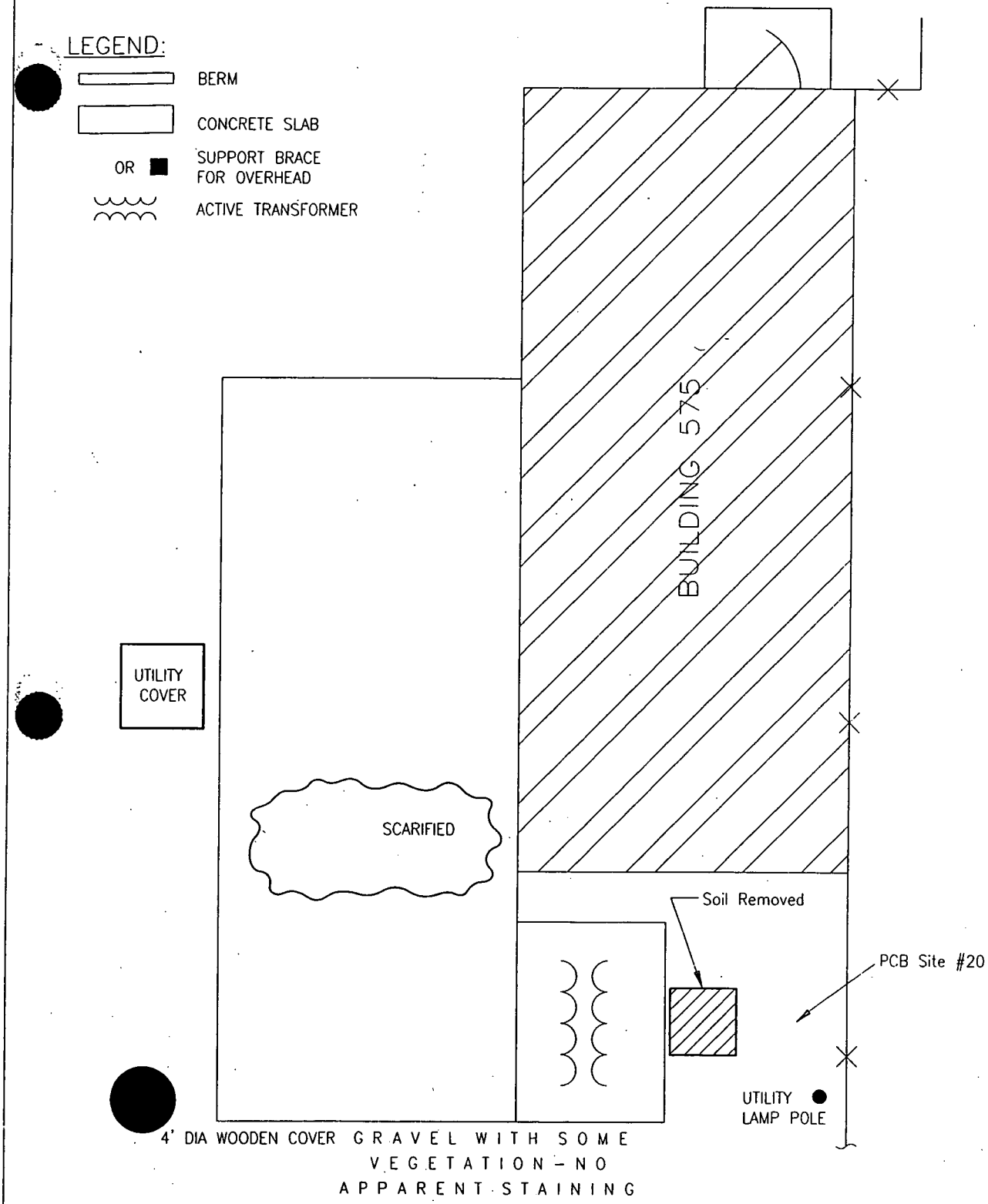
0 2.5' 5 feet

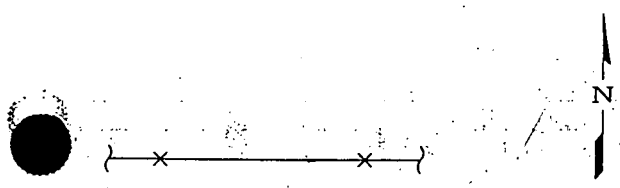
REV. NO.	DATE:	FILENAME:
A	3/5/96	883MRI

MRI GRID LAYOUT
PCB-17 (Bldg. 883)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	98806300

37



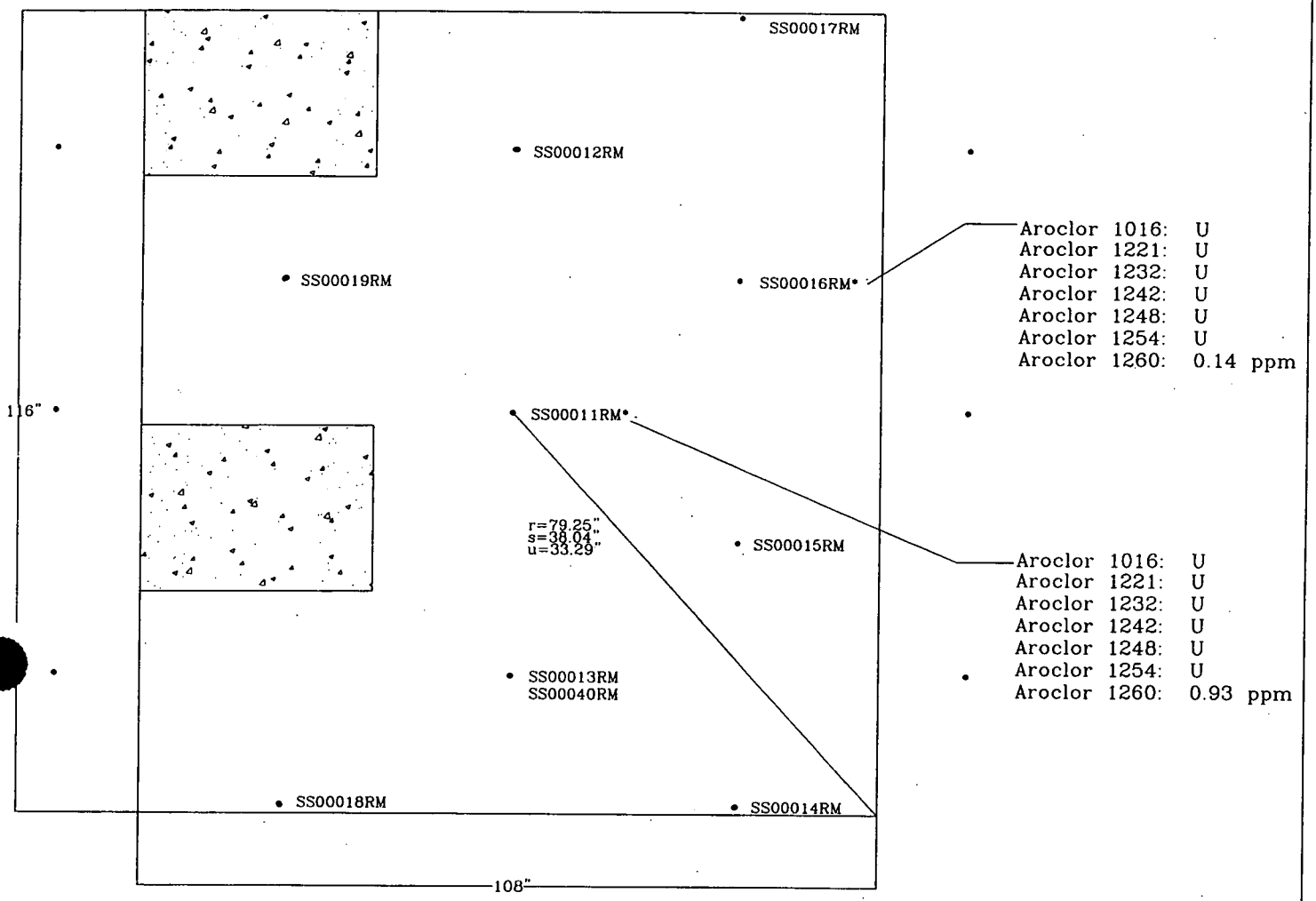


REVISION NO.:	DATE:	ACAD FILE:
A	3/12/96	515PCB2032

SOIL REMOVED FROM PCB SITE #20

DET'D:	CLIENT:	PROJECT NO.:
RMH	RFETS	98806300
CHK'D:	LOCATION:	FIGURE NO.:
CLB	GOLDEN, CO	

38



Note:
All samples are <10ppm PCBs by immunoassay analysis.

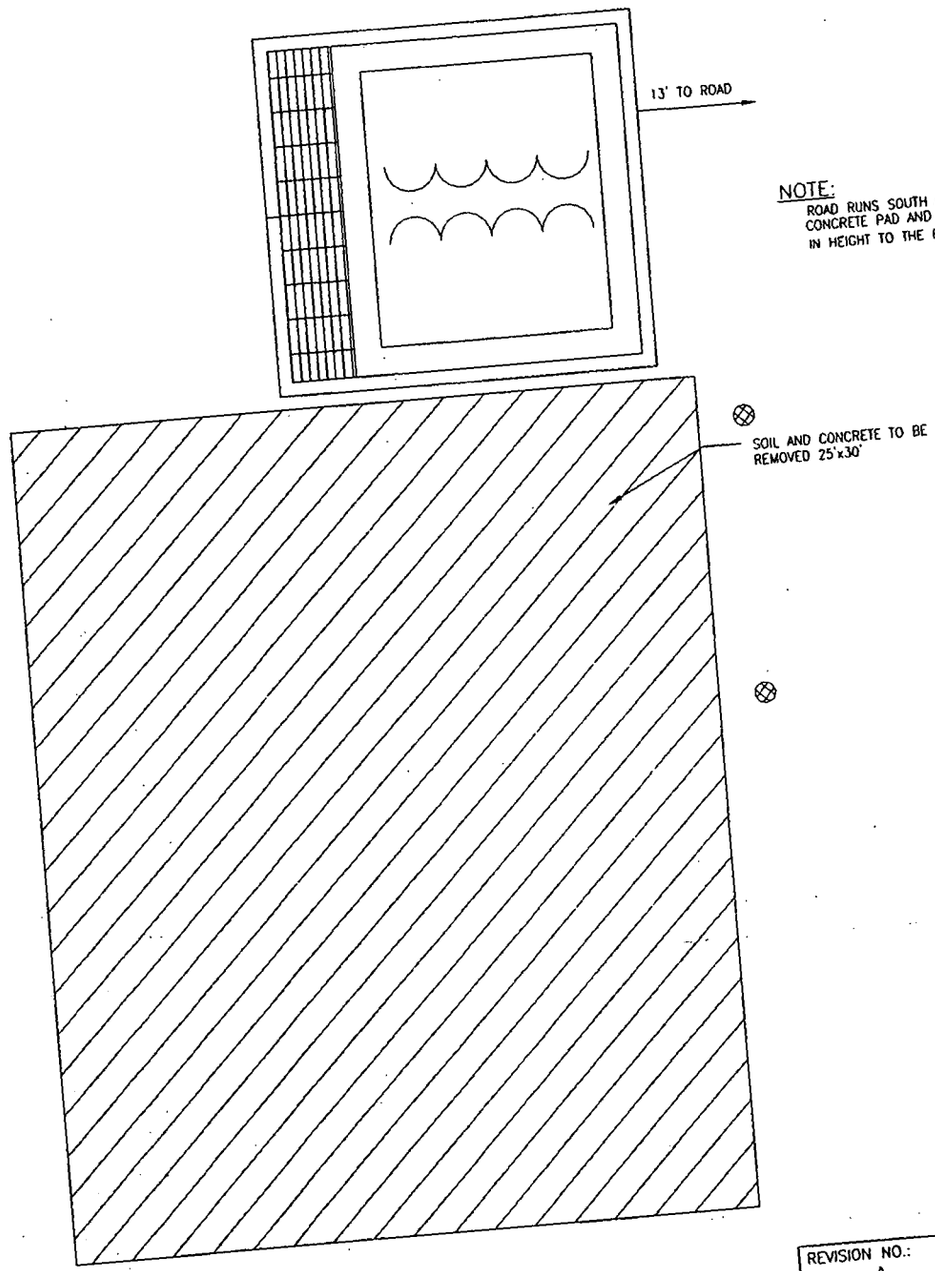
LEGEND:

- ⊗ Sample Point
- * Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

REV. NO.	DATE:	FILENAME:
A	3/11/96	515MRI

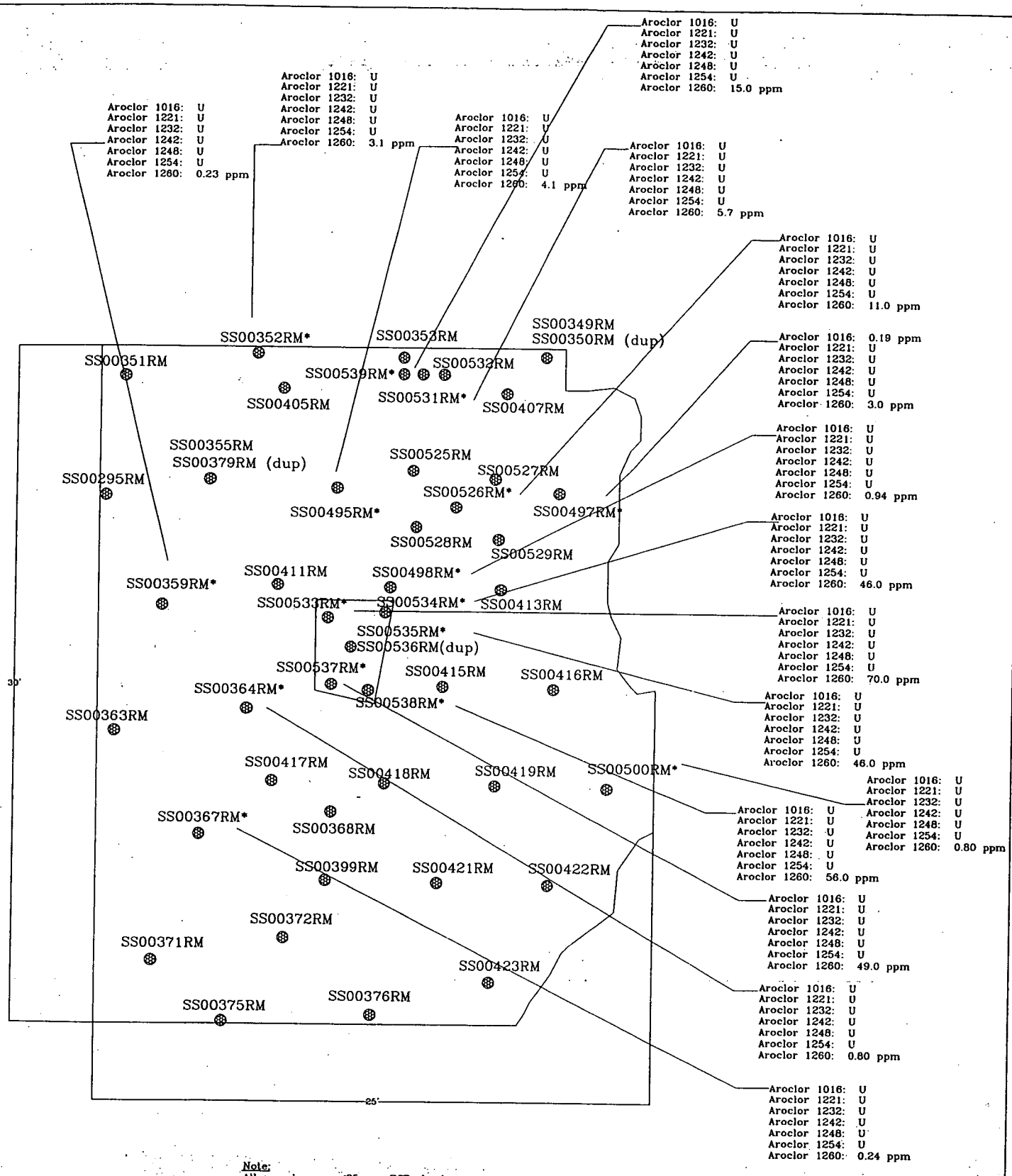
MRI GRID LAYOUT
PCB-20 (515/516 Substation)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	98806300



REVISION NO.: A	DATE: 08/19/96	ACAD FILE: 776PCB21
Soil to Be Removed PCB SITE #21 (NW of Bldg 776)		
DRWN: RMH	CLIENT: RFETS	PROJECT NO.: 98806300
CHKD: CLB	LOCATION: GOLDEN, CO	FIGURE NO.:

40



Note:
All samples are <25ppm PCBs by immunoassay analysis unless otherwise noted.

N

LEGEND:
- Sample Point
- Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

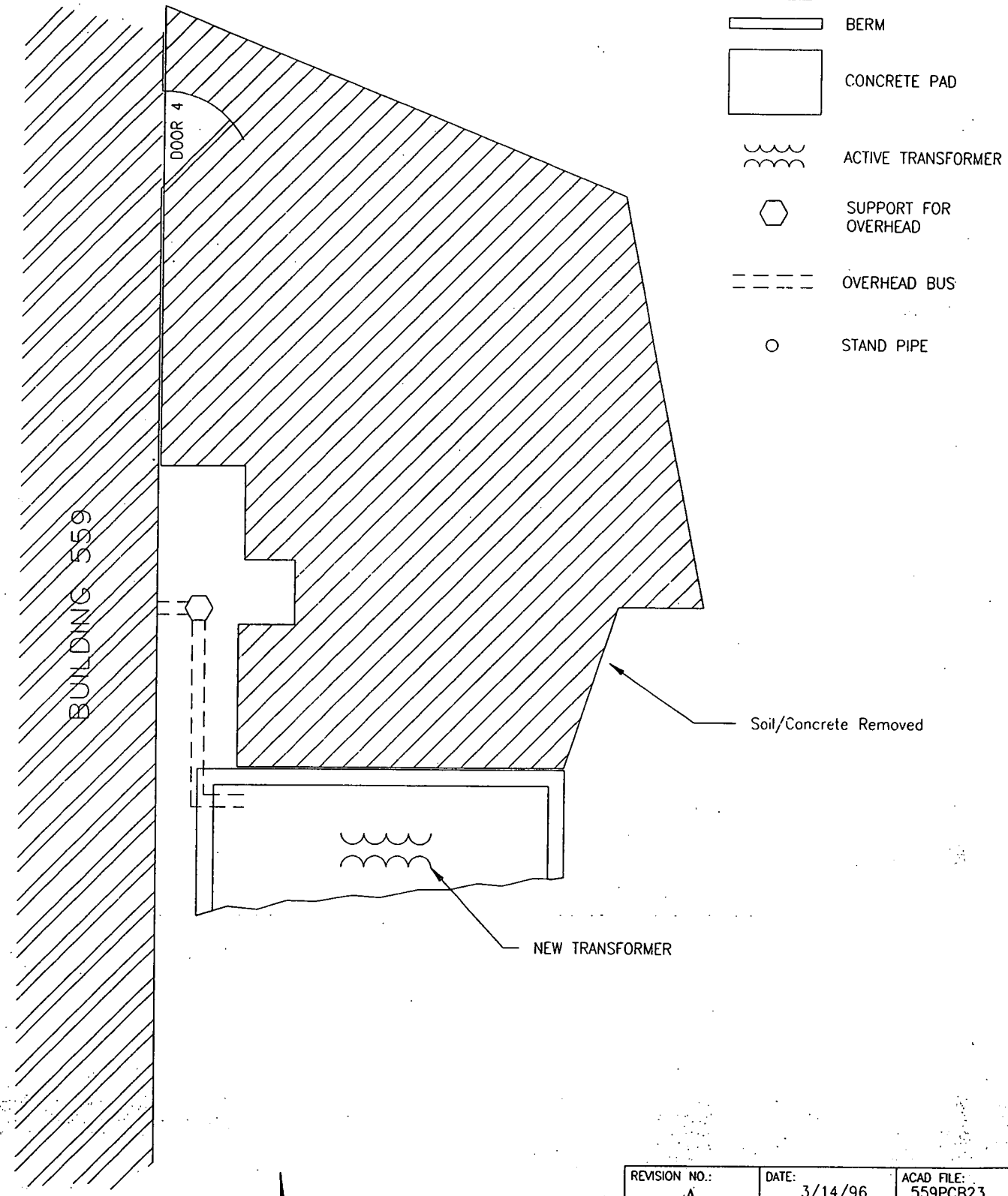
0 5 feet

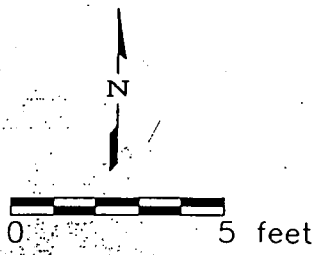
REV. NO.	DATE:	FILENAME:
A	8/13/96	776MRI

MRI GRID LAYOUT
PCB-21 (NW of Bldg. 776)

DRWN:	CHKD:	CHARGE NO.
RMH	CLB	98806300

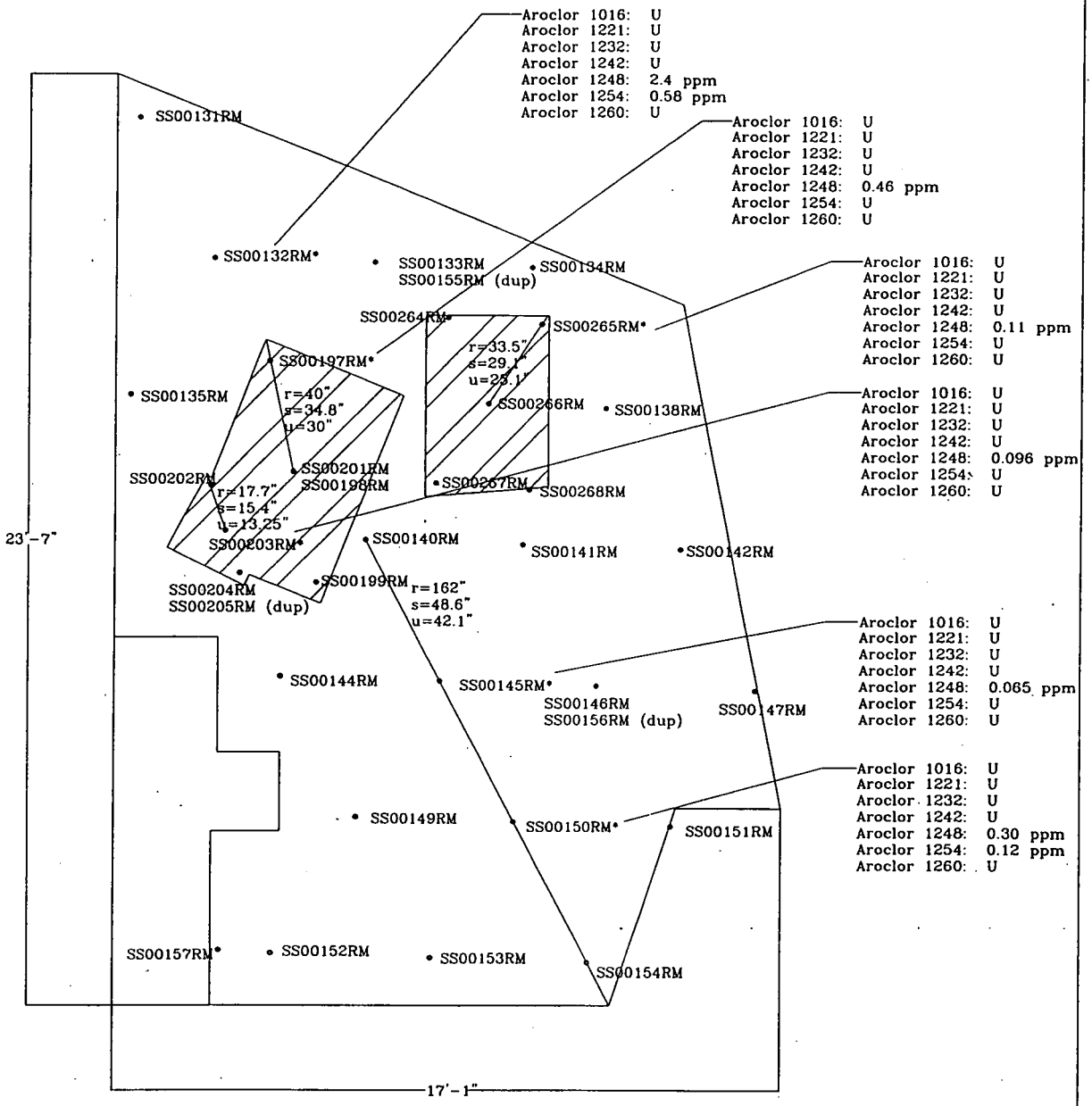
41





REVISION NO.: A	DATE: 3/14/96	ACAD FILE: 559PCB23
SITE SURVEY FOR REMEDIATION OF PCBs PCB SITE #23		
DRWN: RMH	CLIENT: RFETS	PROJECT NO.: 98806300
CHKD: CLB	LOCATION: GOLDEN, CO	FIGURE NO.:

42



All Samlpes are <10 ppm PCB's by Immunoassay analysis

N

LEGEND:

- ⊕ Sample Point
- * Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

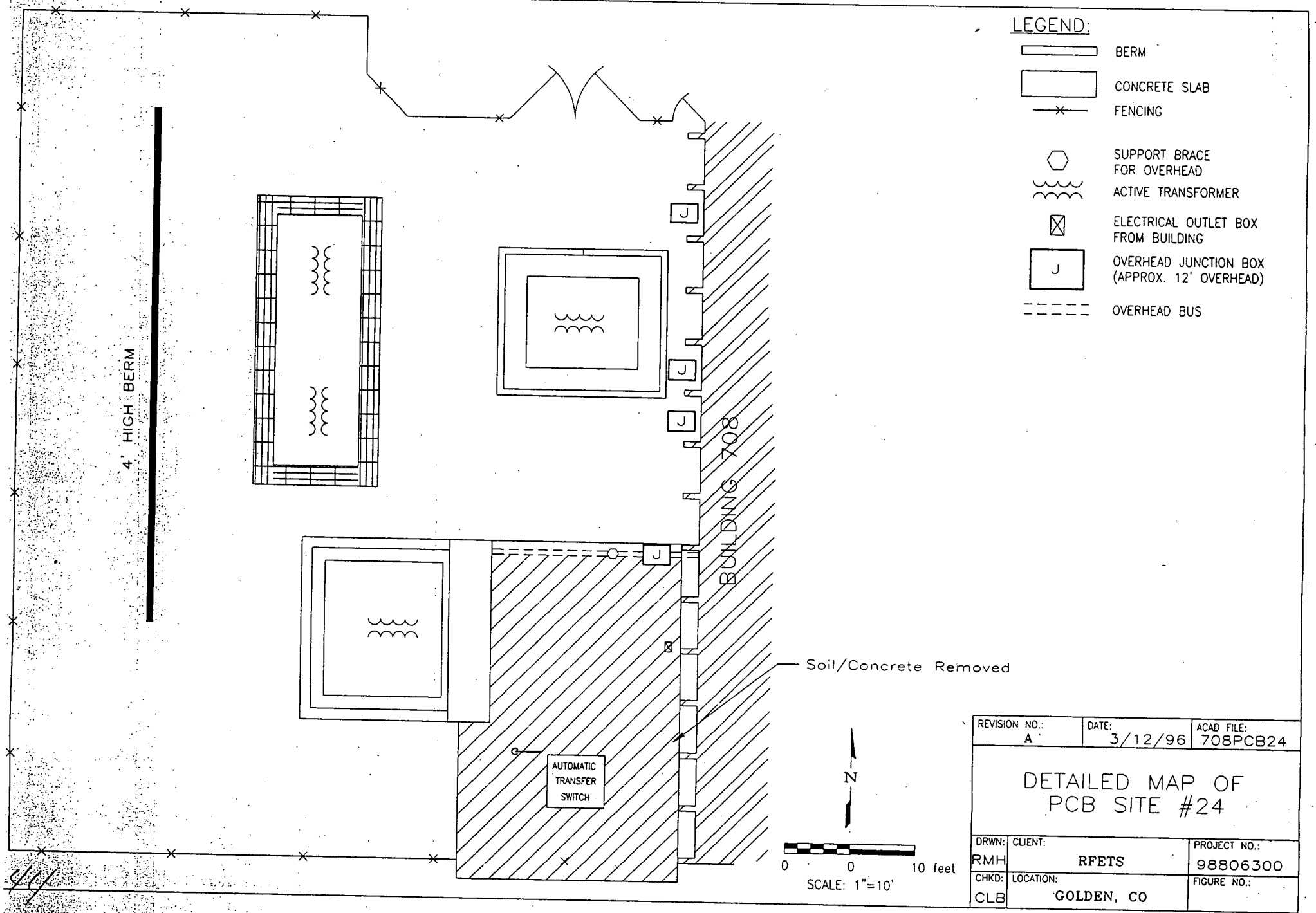
0 2.5' 5 feet

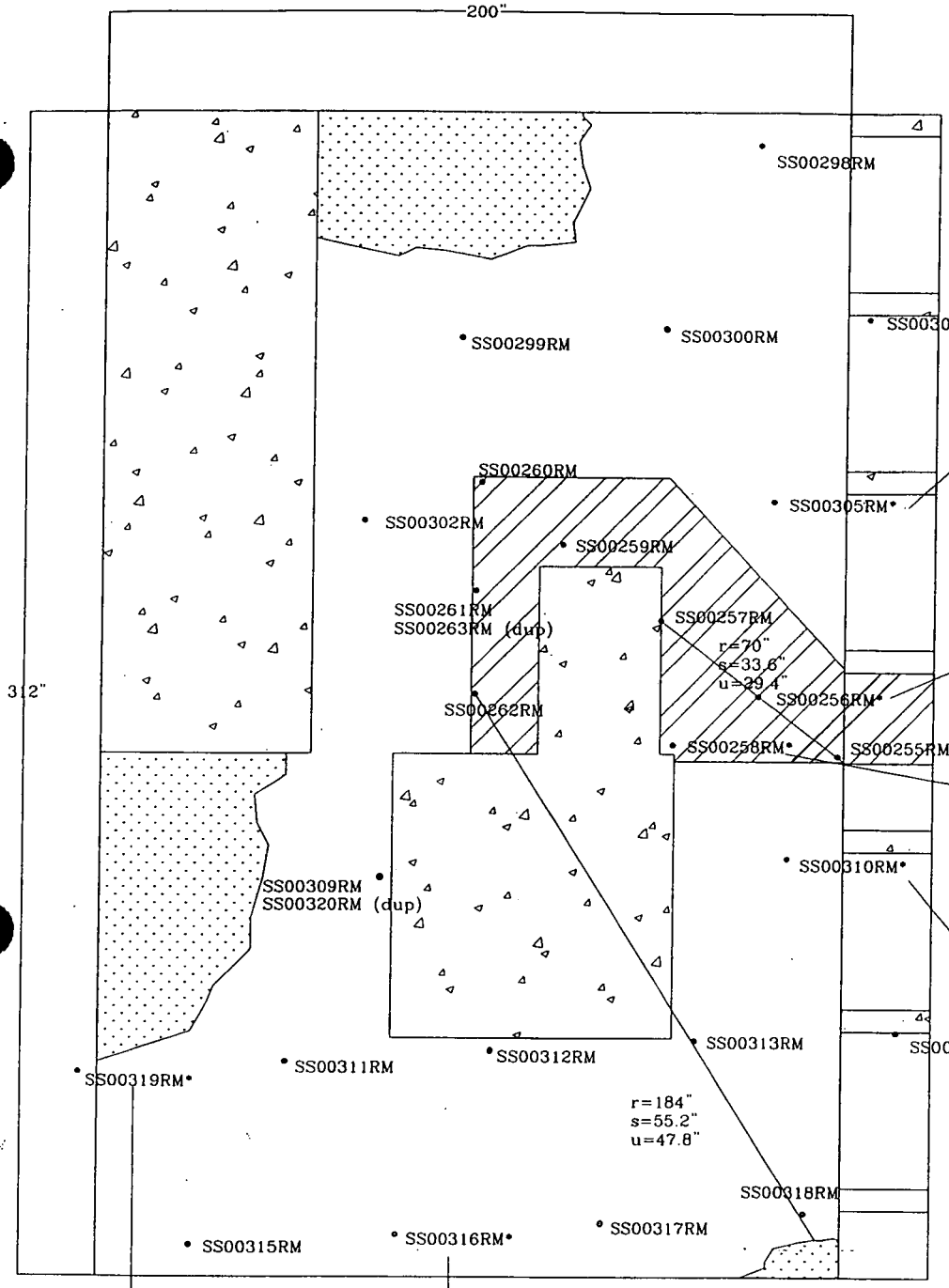
REV. NO.	DATE:	FILENAME:
A	3/14/96	559MRI

MRI GRID LAYOUT
PCB-23 (Bldg. 559)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	98806300

43


LEGEND:
BERM
CONCRETE SLAB
FENCING
SUPPORT BRACE FOR OVERHEAD
ACTIVE TRANSFORMER
ELECTRICAL OUTLET BOX FROM BUILDING
OVERHEAD JUNCTION BOX (APPROX. 12' OVERHEAD)
OVERHEAD BUS
4' HIGH BERM
BUILDING 708
J
Soil/Concrete Removed
AUTOMATIC TRANSFER SWITCH
N
0 0 10 feet
SCALE: 1"=10'
REVISION NO.: A
DATE: 3/12/96
ACAD FILE: 708PCB24
DETAILED MAP OF PCB SITE #24
DRWN: RMH
CLIENT: RFETS
PROJECT NO.: 98806300
CHKD: CLB
LOCATION: GOLDEN, CO
FIGURE NO.:



Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: 3.2 ppm
Aroclor 1260: U

Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: 2.1 ppm
Aroclor 1260: U

Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: 0.04 ppm
Aroclor 1260: U

Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: U

Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: 0.32 ppm
Aroclor 1260: U

Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: 0.58 ppm
Aroclor 1260: U

Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: U

Note:
All samples are <10ppm PCBs by immunoassay analysis.
Concentrated sample points indicate
additional soil removal after first 12" of soil.

N

LEGEND:

- ⊕ Sample Point
- • Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

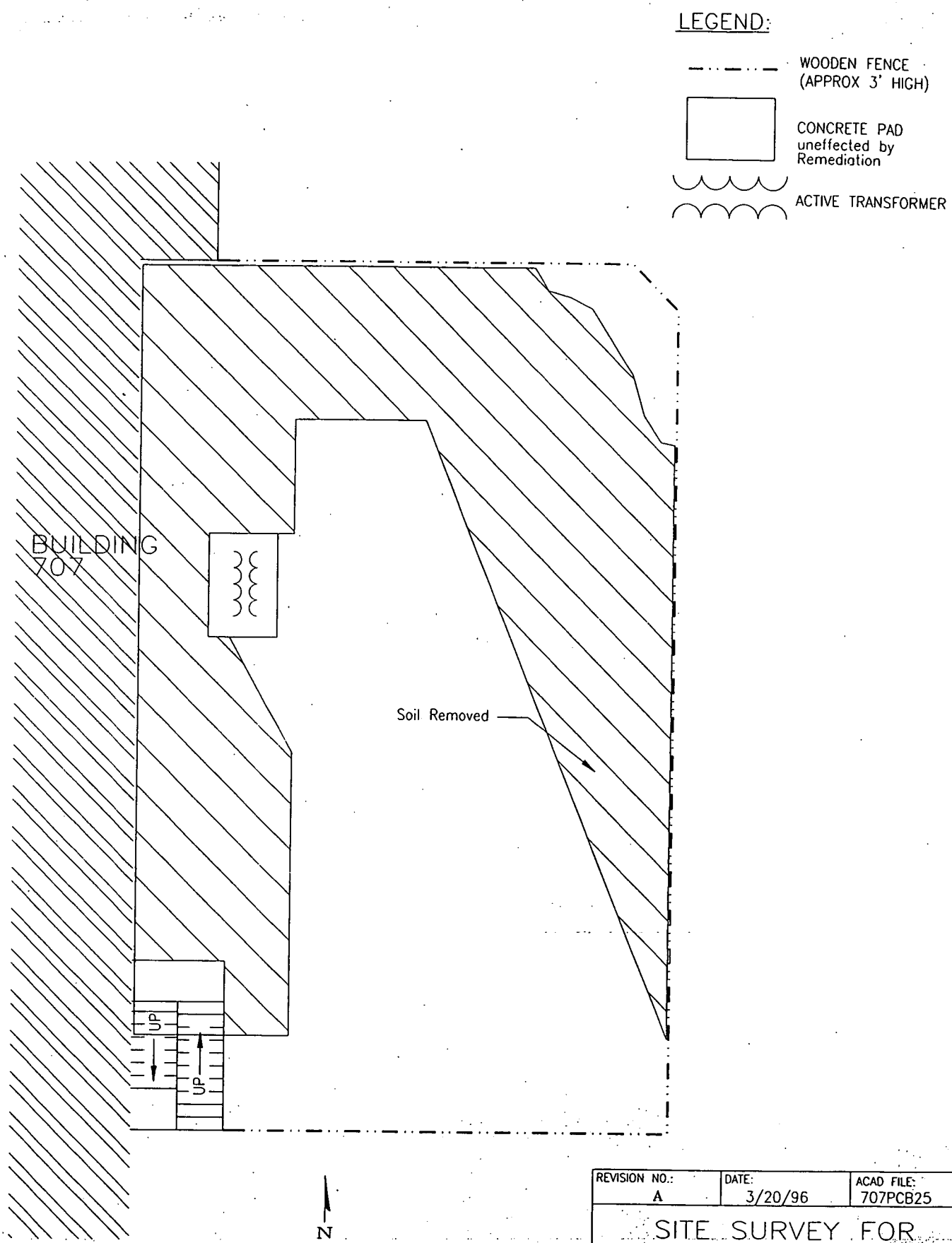
0 2.5' 5 feet

REV. NO.	DATE:	FILENAME:
A	3/12/96	708MRI

MRI GRID LAYOUT
PCB-24 (Bldg. 708)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	98806300

45

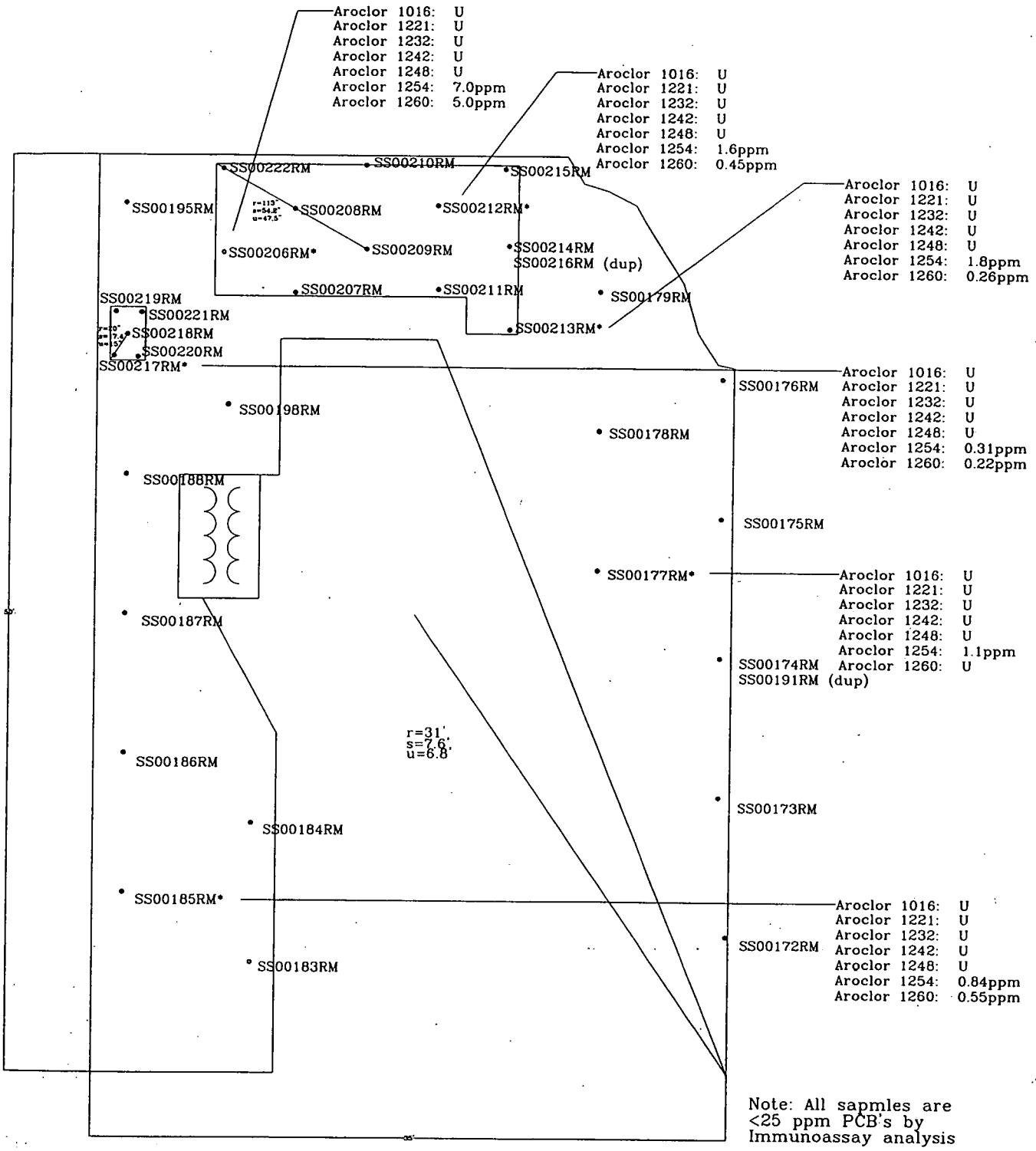


REVISION NO.:	DATE:	ACAD FILE:
A	3/20/96	707PCB25

SITE SURVEY FOR REMEDIATION OF PCBs PCB SITE #25

DRWN:	CLIENT:	PROJECT NO.:
RMH	RFETS	98806300
CHKD:	LOCATION:	FIGURE NO.:
CLB	GOLDEN, CO	

466



LEGEND:

⊕ Sample Point

* Split Sample

U Not detected

SS.....RM are RFEDS sample numbers

N

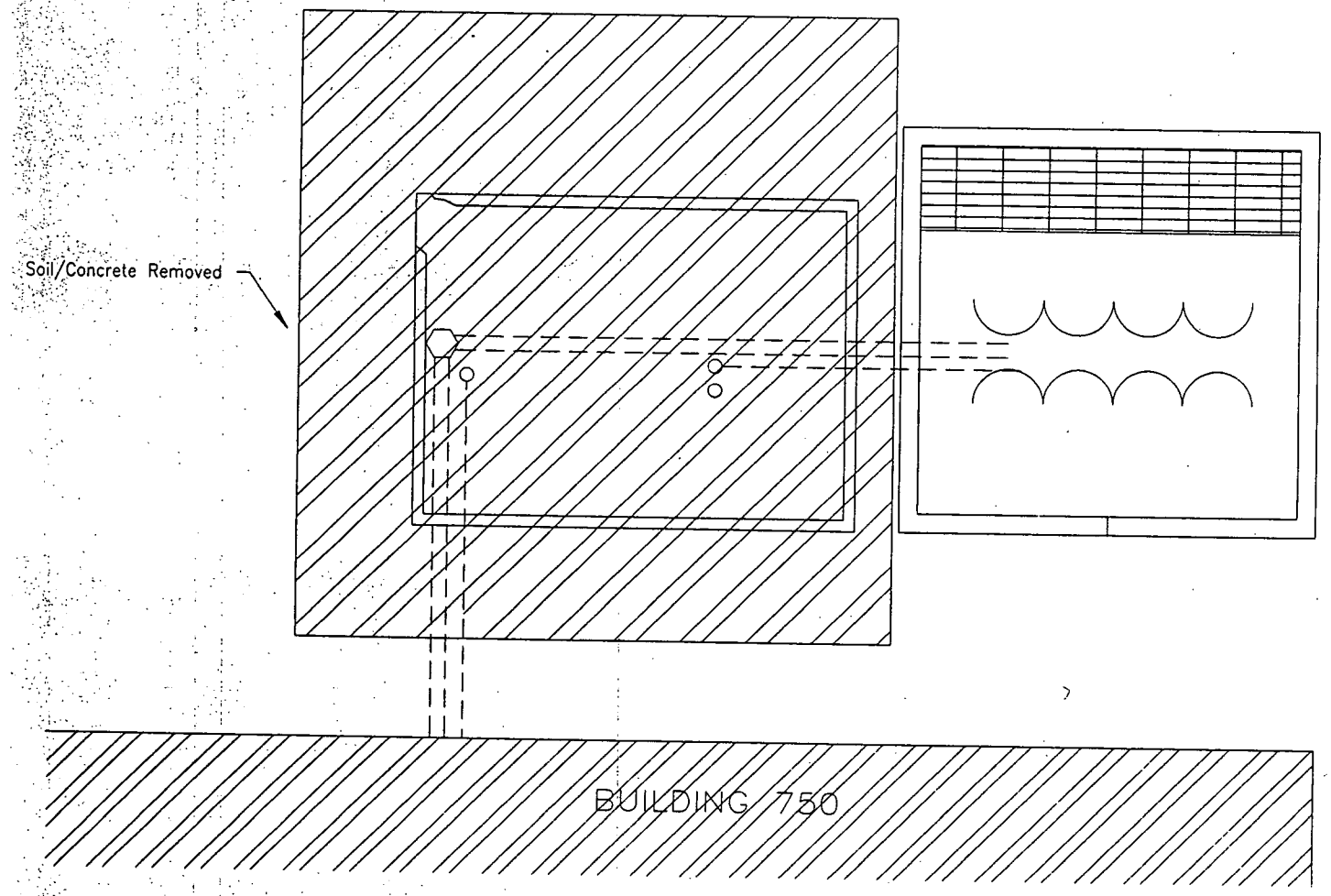
0 5.0' 10 feet

REV. NO.	DATE:	FILENAME:
A	3/20/96	707MRI

MRI GRID LAYOUT
PCB-25 (Bldg. 707)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	98806300

47



LEGEND:

- BERM
- CONCRETE PAD
- GRATE
- CONDUIT STUBS
- SUPPORT FOR OVERHEAD
- ACTIVE TRANSFORMER
- OVERHEAD BUS (APPROX. 10' HIGH)
- UNDERGROUND CONDUIT

N

0 5 feet

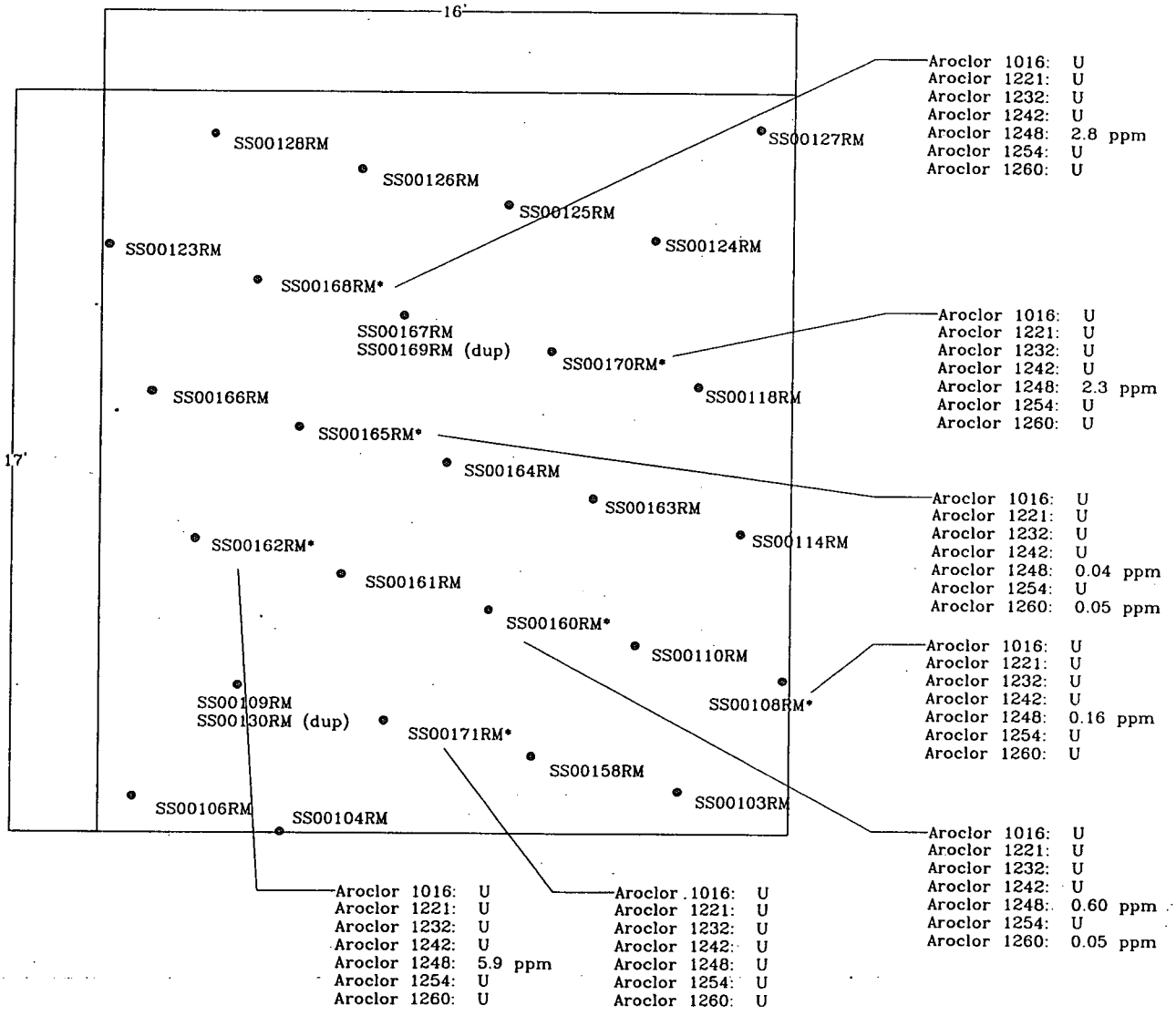
SCALE: 1"=5'

REVISION NO.: A	DATE: 3/19/96	ACAD FILE: 750PCB26

SITE SURVEY FOR REMEDIATION OF PCBs PCB SITE #26

DRWN: RMH	CLIENT: RFETS	PROJECT NO.: 98806300
CHKD: CLB	LOCATION: GOLDEN, CO	FIGURE NO.:

48



Note:
All samples are <10ppm PCBs by immunoassay analysis.

N

LEGEND:

- ⊗ Sample Point
- * Split Sample
- U Not detected
- SS....RM are RFEDS sample numbers

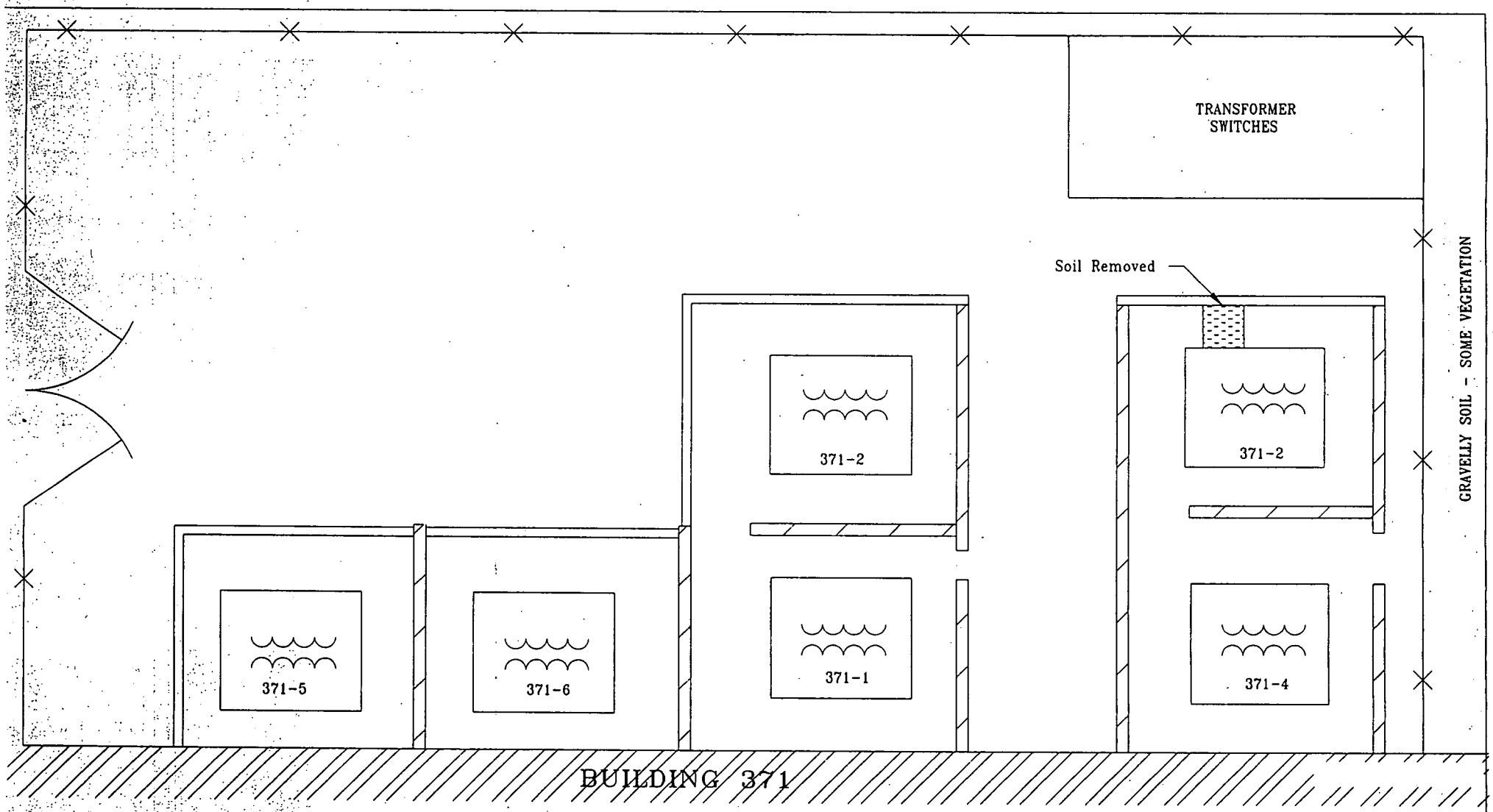
0 2.5' 5 feet

REV. NO.	DATE:	FILENAME:
A	3/19/96	750MRI

MRI GRID LAYOUT
PCB-26 (Bldg. 750)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	98806300

49



N

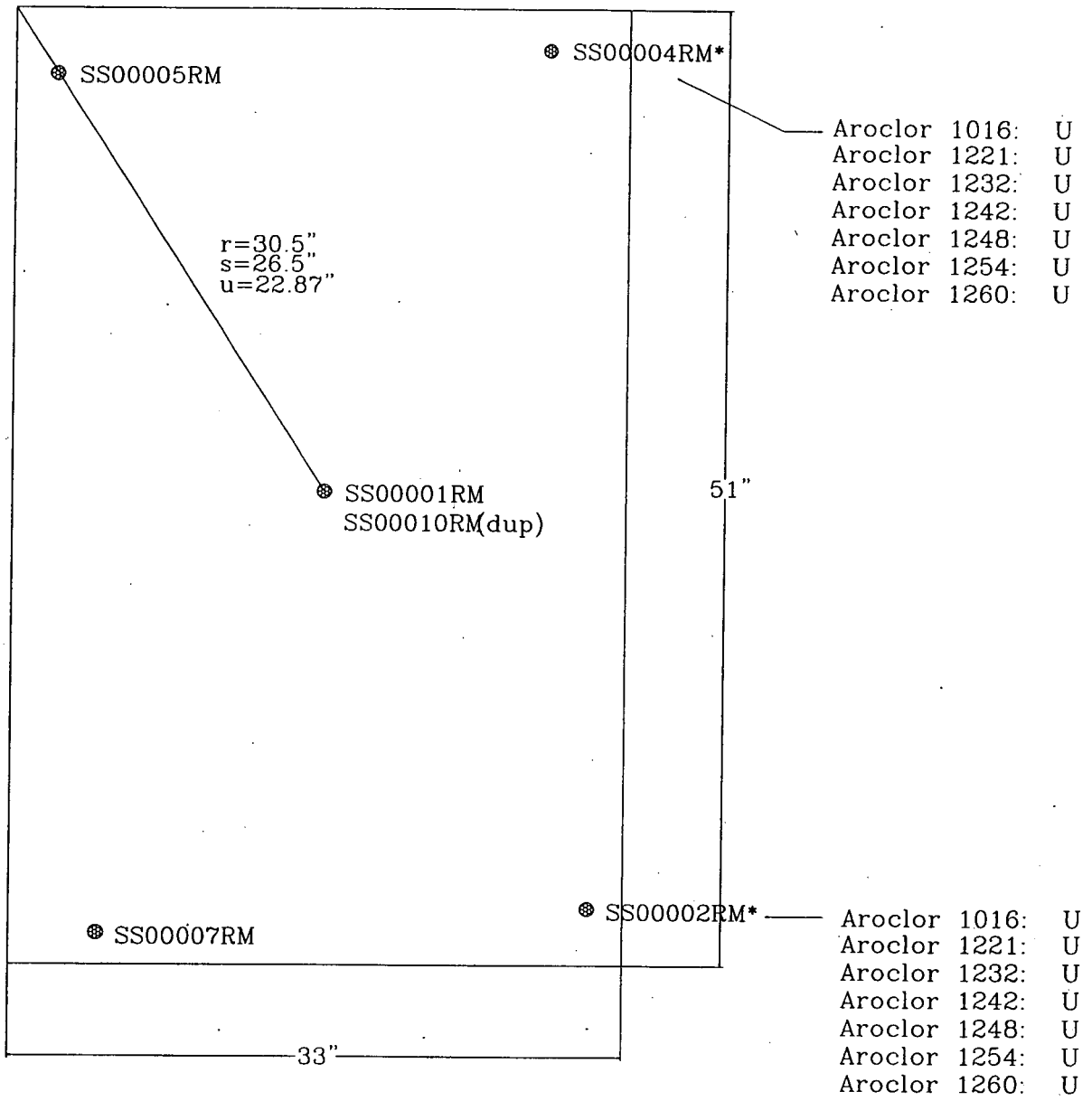
LEGEND:

- BERM
- WALL
- CONCRETE PAD
- FENCING
- ACTIVE TRANSFORMER

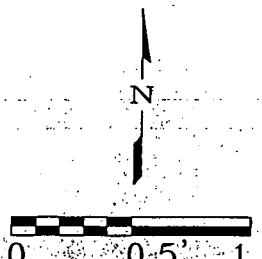
REVISION NO.:	DATE:	ACAD FILE:
A	3/7/96	371PCB33

SITE SURVEY FOR REMEDIATION OF PCBs PCB SITE #33

DRWN:	CLIENT:	PROJECT NO.:
RMH	RFETS	98806300
CHKD:	LOCATION:	FIGURE NO.:
CLB	GOLDEN, CO	



Note:
All samples are <10ppm PCBs by immunoassay analysis.



LEGEND:

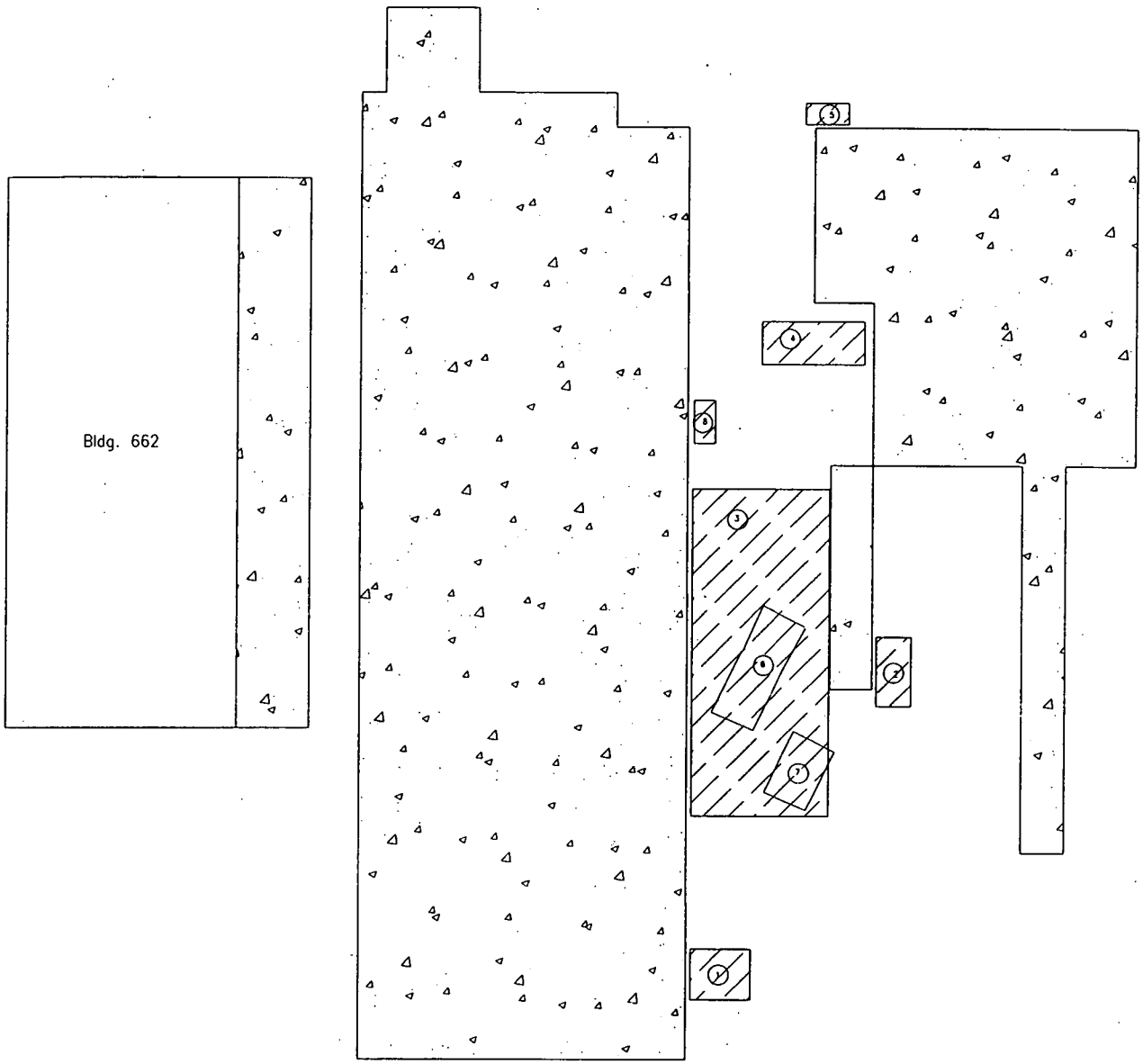
- Sample Point
- * Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

REV. NO.	DATE:	FILENAME:
A	3/5/96	371MRI

MRI GRID LAYOUT
PCB-33 (Bldg. 371)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	98806300

51



LEGEND:

N

Soil Removed

Concrete

MRI grid number

0 25 feet

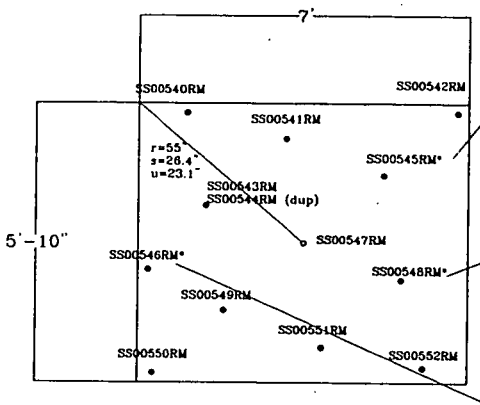
REV. NO.	DATE:	FILENAME:
A	7/25/96	662MRI

MRI GRID LAYOUT
PCB-37 (Bldg. 662)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	98806300

52

1

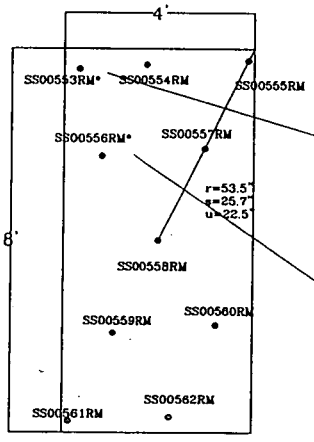


Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: U

Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: U

Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: 0.38 ppm

2



Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: 0.11 ppm

Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: U

Note:
All samples are <25ppm PCBs by immunoassay analysis.

LEGEND:

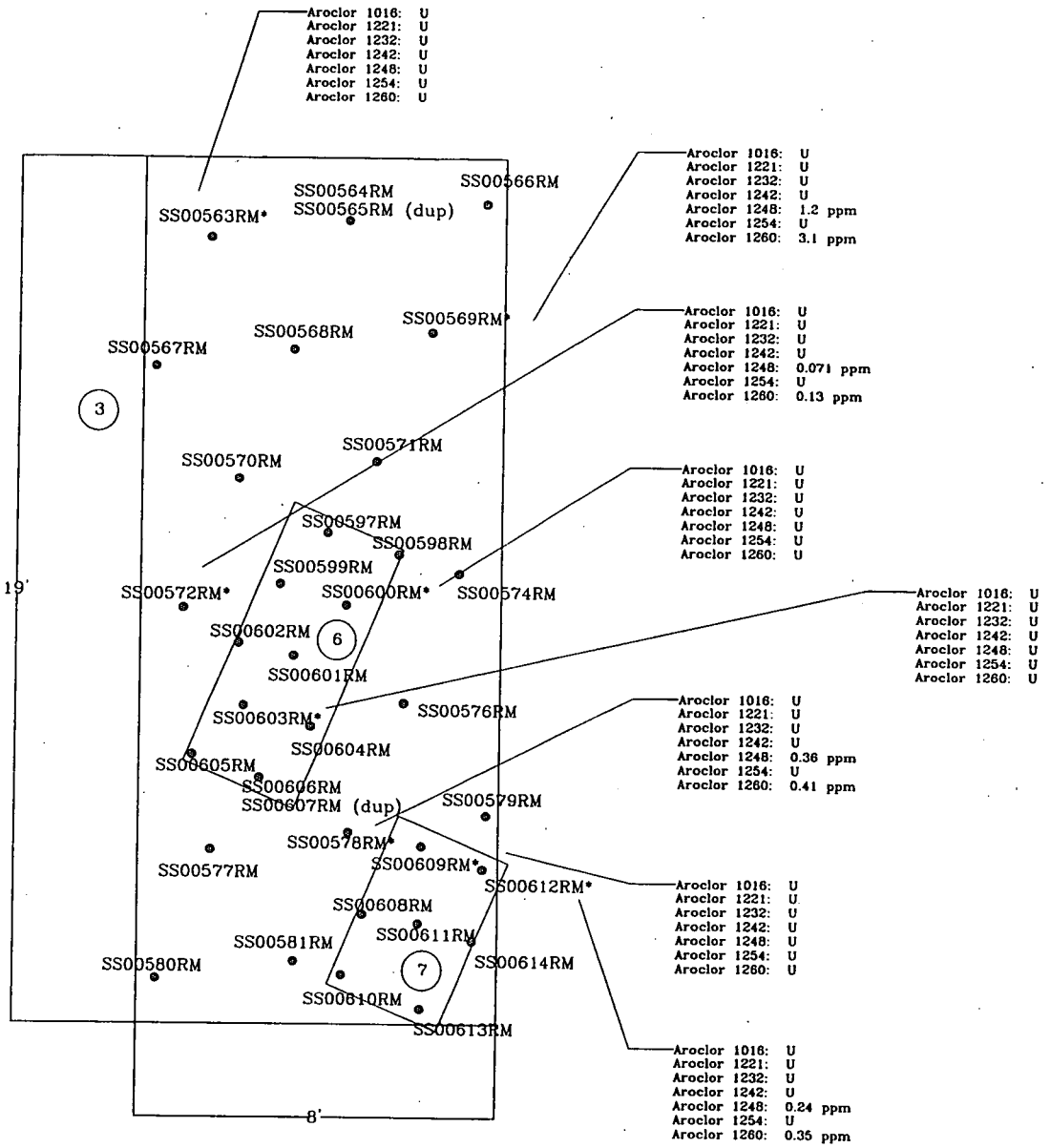
- ⊕ Sample Point
- * Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

REV. NO.	DATE:	FILENAME:
A	8/5/96	662MRI12

MRI GRID LAYOUT
PCB-37 (Bldg. 662)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	98806300

53



Note:
All samples are <25 ppm PCBs by immunoassay analysis.

LEGEND:

- ⊕ Sample Point
- • Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

N

0 5 feet

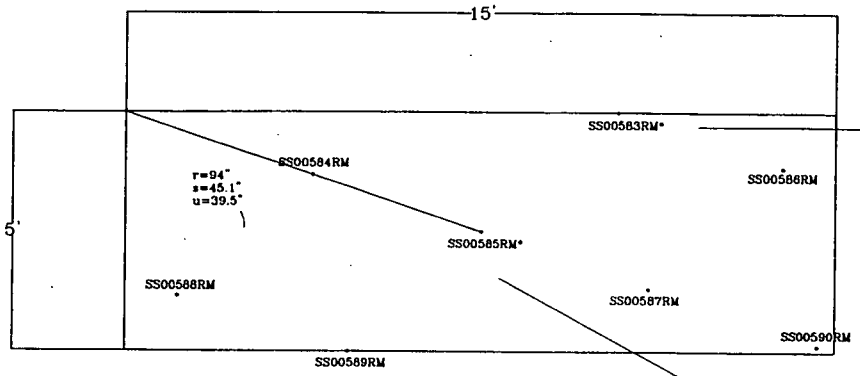
REV. NO.	DATE:	FILENAME:
A	8/2/96	662MRI3

MRI GRID LAYOUT
PCB-37 (Bldg. 662)

DRWN:	CHKD:	CHARGE NO.
RMH	CLB	98806300

54

4

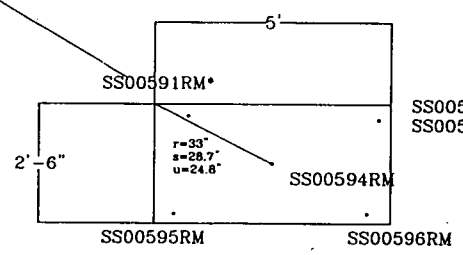


Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: 0.24 ppm

Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: 0.10 ppm

5

Aroclor 1016: U
Aroclor 1221: U
Aroclor 1232: U
Aroclor 1242: U
Aroclor 1248: U
Aroclor 1254: U
Aroclor 1260: U



Note:
All samples are <25ppm PCBs by immunoassay analysis.

LEGEND:

- ⊗ Sample Point
- * Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

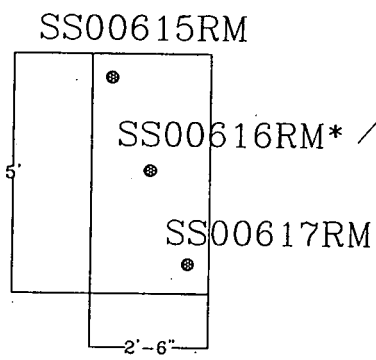
REV. NO.	DATE:	FILENAME:
A	8/5/96	662MRI45

MRI GRID LAYOUT
PCB-37 (Bldg. 662)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	98806300

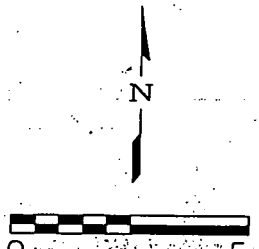
55

8



Aroclor 1016:	U
Aroclor 1221:	U
Aroclor 1232:	U
Aroclor 1242:	U
Aroclor 1248:	U
Aroclor 1254:	2.5 ppm
Aroclor 1260:	0.56 ppm

Note:
All samples are <25ppm PCBs by immunoassay analysis.



LEGEND:
- ⊗ Sample Point
- * Split Sample
- U Not detected
- SS.....RM are RFEDS sample numbers

REV. NO.	DATE:	FILENAME:
A	8/2/96	662MRI89

MRI GRID LAYOUT
PCB-37 (Bldg. 662)

DRWN:	CHKD:	CHARGE NO.:
RMH	CLB	98806300

56

Appendix B

Method 8080
PCB Cleanup Verification Data

Best Available Copy

FAX

Quanterra
Environmental Services

13715 Rider Trail North
Earth City, MO 63045-1205

Date 4-18-96

Number of pages including cover sheet 12

To:
Rebecca
Rocky Flats

Phone 303-966-5756
Fax Phone 4046
CC:

From:
Barbara S. Dill

Phone (314) 298-8566
Fax Phone (314) 298-8757

REMARKS:

☐ Urgent ☑ For your review ☐ Reply ASAP ☐ Please comment

Data Summary for login 8914

CT00021EG
25

CT00027EG
28

58

3F

SOIL PCB MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: ____ SDG No.: S1103

Matrix Spike - EPA Sample No.: CT00021EG Level: (low/med) LOW

COMPOUND	SPIKE ADDED (ug/kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
Aroclor-1254	170	0	270	162 *	29-131

COMPOUND	SPIKE ADDED (ug/kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD	QC LIMITS RPD	QC LIMITS REC.
Aroclor 1254	170	190	117	32	ND	29-131

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

ND: Not determined

RPD: _____ out of _____ outside limits
Spike Recovery: 1 out of 2 outside limits

COMMENTS:

FORM III PEST-2

4C
PCB METHOD BLANK SUMMARY

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: SAS No.: SDG No.: S1103

Lab Sample ID: BLK 73338 Lab File ID:

Matrix: (soil/water) SOLID Level (low/med) LOW

Date Extracted: 07-22-95 Extraction: (SepF/Cont/Sonc) SONC

Date Analyzed (1): 07-24-95 Date Analyzed (2): 07-24-95

Time Analyzed (1): 11:54 Time Analyzed (2): 11:54

Instrument ID (1): GCA Instrument ID (2): GCA

GC Column ID (1): DB-608 GC Column ID (2): DB-5MS

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	DATE ANALYZED 2
01	PSPK01	SPK73338	07-24-95	07-24-95
02	CT00021EG	8914-001	07-24-95	07-24-95
03	CT00021EGMS	8914-001MS	07-24-95	07-24-95
04	CT00021EGMSD	8914-001MSD	07-24-95	07-24-95
05	CT00022EG	8914-002	07-24-95	07-24-95
06	CT00023EG	8914-003	07-24-95	07-24-95
07	CT00024EG	8914-004	07-24-95	07-24-95
08	CT00025EG	8914-005	07-24-95	07-24-95
09	CT00027EG	8914-006	07-24-95	07-24-95
10	CT00028EG	8914-007	07-24-95	07-24-95
11				
12				

COMMENTS:

FORM IV PEST

Rev.

60

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00021EG

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1103

Matrix: (soil/water) SOIL Lab Sample ID: 8914-001

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-21-95

% Moisture: not dec. _____ dec. _____ Date Extracted: 07-22-95

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-24-95

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	33	U
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	33	U

U: Concentration of analyte is less than the value given.

FORM I PEST

1D

PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00022EG

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1103

Matrix: (soil/water) SOIL Lab Sample ID: 8914-002

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-21-95

% Moisture: not dec. _____ dec. _____ Date Extracted: 07-22-95

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-24-95

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	33	U
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	33	U

U: Concentration of analyte is less than the value given.

FORM I PEST

62

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00023EG

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1103

Matrix: (soil/water) SOIL Lab Sample ID: 8914-003

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-21-95

% Moisture: not dec. _____ dec. _____ Date Extracted: 07-22-95

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-24-95

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	33	U
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	33	U

U: Concentration of analyte is less than the value given.

FORM I PEST

63

1D

PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00024EG

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: SAS No.: SDG No.: S1103

Matrix: (soil/water) SOIL Lab Sample ID: 8914-004

Sample wt/vol: 30.0 (g/ml) g Lab File ID:

Level: (low/med) LOW Date Sampled: 07-21-95

% Moisture: not dec. dec. Date Extracted: 07-22-95

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-24-95

GPC Cleanup: (Y/N) N pH: Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	33	U
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	47	

U: Concentration of analyte is less than the value given.

FORM I PEST

64

1D

PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00025EG

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1103

Matrix: (soil/water) SOIL Lab Sample ID: 8914-005

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-21-95

% Moisture: not dec. _____ dec. _____ Date Extracted: 07-22-95

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-24-95

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	33	U
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	33	U

U: Concentration of analyte is less than the value given.

FORM I PEST

65

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00027EG

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1103

Matrix: (soil/water) SOIL Lab Sample ID: 8914-006

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-21-95

% Moisture: not dec. _____ dec. _____ Date Extracted: 07-22-95

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-24-95

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	33	U
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	230	

U: Concentration of analyte is less than the value given.

FORM I PEST

66

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00028EG

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1103

Matrix: (soil/water) SOIL Lab Sample ID: 8914-007

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-21-95

% Moisture: not dec. _____ dec. _____ Date Extracted: 07-22-95

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-24-95

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	33	U
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	430	

U: Concentration of analyte is less than the value given.

FORM I PEST

67

3F

SOIL PCB SPIKE BLANK(LCS) RECOVERY

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: SAS No.: SDG No.: S1103

Spike Blank No.: SPK 73338

COMPOUND	SPIKE ADDED (ug/Kg)	SPIKE CONCENTRATION (ug/Kg)	SPK % REC #	QC LIMITS REC.
Aroclor-1254	170	120	74	29-131

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

ND: not determined

Spike Recovery: 0 out of 1 outside limits

COMMENTS:

FORM III PEST-2

68

2F
PCB SURROGATE RECOVERY

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: SAS No.: SDG No.: S1103

Level: (low/med) LOW

	EPA SAMPLE NO.	S1 (DBC) #	S2 (TCMX) #
01	PBLK01	61	90
02	PSPK01	64	93
03	CT00021EG	46	125
04	CT00021EGMS	71	180
05	CT00021EGMSD	44	111
06	CT00022EG	49	119
07	CT00023EG	52	113
08	CT00024EG	54	118
09	CT00025EG	26	90
10	CT00027EG	40	99
11	CT00028EG	33	91
12			
13			
14			
15			

	ADVISORY QC LIMITS
S1 (DBC) = Dibutylchlorendate	(D-165)
S2 (TCMX) = Tetrachlorom-m-xylene	(D-267)

Column to be used to flag recovery values

* Values outside of QC limits

D Surrogates diluted out

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00037RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 51170

Matrix: (soil/water) SOIL Lab Sample ID: 10048-001

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 12-22-95

% Moisture: not dec. 3 dec. _____ Date Extracted: 01-03-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-08-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

70

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00038RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1170

Matrix: (soil/water) SOIL Lab Sample ID: 10048-002

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 12-22-95

% Moisture: not dec. 6 dec. _____ Date Extracted: 01-03-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-08-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	36	U
11104-28-2	Aroclor-1221	36	U
11141-16-5	Aroclor-1232	36	U
53469-21-9	Aroclor-1242	36	U
12672-29-6	Aroclor-1248	36	U
11097-69-1	Aroclor-1254	36	U
11096-82-5	Aroclor-1260	36	U

U: Concentration of analyte is less than the value given.

FORM I PEST

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00039RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 61170

Matrix: (soil/water) SOIL Lab Sample ID: 10048-003

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 12-22-95

% Moisture: not dec. 6 dec. _____ Date Extracted: 01-03-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-08-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	35	U
11104-28-2	Aroclor-1221	35	U
11141-16-5	Aroclor-1232	35	U
53469-21-9	Aroclor-1242	35	U
12672-29-6	Aroclor-1248	35	U
11097-69-1	Aroclor-1254	35	U
11096-82-5	Aroclor-1260	73	

U: Concentration of analyte is less than the value given.

FORM I PEST

72

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00040RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1170

Matrix: (soil/water) SOIL Lab Sample ID: 10048-004

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 12-22-95

% Moisture: not dec. 4 dec. _____ Date Extracted: 01-03-96

Extraction: (SepF/Cont/Sono) SONC Date Analyzed: 01-08-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	35	U
11104-28-2	Aroclor-1221	35	U
11141-16-5	Aroclor-1232	35	U
53469-21-9	Aroclor-1242	35	U
12672-29-6	Aroclor-1248	35	U
11097-69-1	Aroclor-1254	35	U
11096-82-5	Aroclor-1260	35	U

U: Concentration of analyte is less than the value given.

FORM I PEST

13

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00041RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 61170

Matrix: (soil/water) SOIL Lab Sample ID: 10048-005

Sample wt/vol: 30.2 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 12-22-95

% Moisture: not dec. 4 dec. _____ Date Extracted: 01-03-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-08-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00042RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 81170

Matrix: (soil/water) SOIL Lab Sample ID: 10048-006

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 12-22-95

% Moisture: not dec. 4 dec. _____ Date Extracted: 01-03-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-08-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00076RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1180

Matrix: (soil/water) SOIL Lab Sample ID: 10311-001

Sample wt/vol: 15.09 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-05-96

% Moisture: not dec. 3.32 dec. _____ Date Extracted: 02-12-96

Extraction: (SepF/Cont/Sonc) SEPF Date Analyzed: 02-13-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	33	U
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	86	

U: Concentration of analyte is less than the value given.

FORM I PEST

76

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00081RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1180

Matrix: (soil/water) SOIL Lab Sample ID: 10311-002

Sample wt/vol: 15.12 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-05-96

% Moisture: not dec. _____ dec. _____ Date Extracted: 02-12-96

Extraction: (SepF/Cont/Sonc) SEPF Date Analyzed: 02-13-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	33	U
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	33	U

U: Concentration of analyte is less than the value given.

FORM I PEST

77

Quanterra
Environmental Services

PCB RESULTS

Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK73293	33 U	33 U	33 U	33 U	33 U	33 U	33 U
CT00001EG	33 U	33 U	33 U	33 U	33 U	33 U	33 U
CT00002EG	33 U	33 U	33 U	33 U	33 U	33 U	100
CT00003EG	33 U	33 U	33 U	33 U	33000 U	33000 U	56000
CT00004EG	33 U	33 U	33 U	33 U	33 U	33 U	41
CT00005EG	33 U	33 U	33 U	33 U	33 U	33 U	33 U
CT00006EG	33 U	33 U	33 U	33 U	33 U	33 U	33 U
CT00007EG	33 U	33 U	33 U	33 U	33 U	33 U	33 U
CT00008EG	33 U	33 U	33 U	33 U	33 U	33 U	33 U
CT00009EG	33 U	33 U	33 U	33 U	33 U	33 U	33 U
CT00010EG	33 U	33 U	33 U	33 U	33 U	33 U	33 U
CT00011EG	33 U	33 U	33 U	33 U	33 U	33 U	33 U
CT00012EG	33 U	33 U	33 U	33	33 U	33 U	33 U
CT00013EG	33 U	33 U	33 U	33 U	33 U	33 U	33 U
CT00014EG	33 U	33 U	33 U	120	33 U	33 U	33 U
CT00015EG	33 U	33 U	33 U	130	33 U	33 U	33 U
CT00016EG	33 U	33 U	33 U	33 U	2500	980	130
CT00017EG	33 U	33 U	33 U	33 U	33 U	33 U	120
CT00018EG	33 U	33 U	33 U	33 U	33 U	33 U	33 U
CT00019EG	33 U	33 U	33 U	33 U	33 U	33 U	33 U
CT00020EG	33 U	33 U	33 U	33 U	33 U	33 U	33 U

U: Undetected at stated detection limit

Quanterra
Environmental Services

To: Wayne Sprolles/Nick Demos
Fax Number: (303) 966-8704
Phone Number: (303) 966-8598

From: John Powell
Fax Number: (314) 298-8757
Phone Number: (314) 298-8566

PCB RESULTS

Lab ID	Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK76880	QCBLK76880	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9229-001	CT00029EG	34 U	34 U	34 U	210	34 U	34 U	34 U
9229-002	CT00030EG	34 U	34 U	34 U	1300	34 U	34 U	34 U
9229-003	CT00031EG	34 U	34 U	34 U	210	34 U	34 U	34 U
9229-004	CT00032EG	34 U	34 U	34 U	34 U	34 U	34 U	34 U
9229-005	CT00033EG	34 U	34 U	34 U	34 U	34 U	34 U	34 U
9229-006	CT00034EG	34 U	34 U	34 U	34 U	34 U	34 U	34 U
9229-007	CT00035EG	34 U	34 U	34 U	730	34 U	34 U	34 U
9229-008	CT00036EG	34 U	34 U	34 U	860	34 U	34 U	34 U
9229-001MS	CT000029EG MS	34 U	34 U	34 U	270	34 U	107% Rec	34 U
9229-001MSD	CT000029EG-MS	37 U	37 U	37 U	280	37 U	97% Rec	37 U

U: Not detected at the detection limit stated

79

80

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00051RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: UTMO Case No.:

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: SAS No.: SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-001

Sample wt/vol: 15.0 (g/ml) G Lab File ID:

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 3 dec. Date Extracted: 01-11-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: Dilution Factor: 0.5

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

81

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00052RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-002

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-11-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

82

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00053RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-003

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-11-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

83

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00054RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-004

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-11-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

84

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00055RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-005

Sample wt/vol: 30.1 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 7 dec. _____ Date Extracted: 01-11-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	36	U
11104-28-2	Aroclor-1221	36	U
11141-16-5	Aroclor-1232	36	U
53469-21-9	Aroclor-1242	36	U
12672-29-6	Aroclor-1248	36	U
11097-69-1	Aroclor-1254	94	
11096-82-5	Aroclor-1260	150	

U: Concentration of analyte is less than the value given.

FORM I PEST

85

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00056RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-006

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-11-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

86

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00057RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-007

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 3 dec. _____ Date Extracted: 01-11-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	200	
11096-82-5	Aroclor-1260		SD

SD: See dilution.
U: Concentration of analyte is less than the value given.

FORM I PEST

87

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00057RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-007

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 3 dec. _____ Date Extracted: 01-11-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-19-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 10

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	340	U
11104-28-2	Aroclor-1221	340	U
11141-16-5	Aroclor-1232	340	U
53469-21-9	Aroclor-1242	340	U
12672-29-6	Aroclor-1248	340	U
11097-69-1	Aroclor-1254	340	U
11096-82-5	Aroclor-1260	1200	

U: Concentration of analyte is less than the value given.

FORM I PEST

88

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00058RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-008

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-11-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

89

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00059RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-009

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-11-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

90

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00060RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-010

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-11-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

91

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00061RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-011

Sample wt/vol: 30.1 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 3 dec. _____ Date Extracted: 01-11-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

92

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00062RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-012

Sample wt/vol: 30.2 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 3 dec. _____ Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

93

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00063RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-013

Sample wt/vol: 30.1 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 4 dec. _____ Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	35	U
11104-28-2	Aroclor-1221	35	U
11141-16-5	Aroclor-1232	35	U
53469-21-9	Aroclor-1242	35	U
12672-29-6	Aroclor-1248	35	U
11097-69-1	Aroclor-1254	35	U
11096-82-5	Aroclor-1260	35	U

U: Concentration of analyte is less than the value given.

FORM I PEST

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00064RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-014

Sample wt/vol: 30.2 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 4 dec. _____ Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

95

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00065RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-015

Sample wt/vol: 30.2 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 4 dec. _____ Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00066RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-016

Sample wt/vol: 30.2 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

97

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00067RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-017

Sample wt/vol: 30.1 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

98

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00068RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-018

Sample wt/vol: 30.2 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

99

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00069RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-019

Sample wt/vol: 30.2 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

COO

101

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00070RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Name: QUANTERRA,MO Contract: 262-01 CT00070RM

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1171

Matrix: (soil/water) SOIL Lab Sample ID: 10123-020

Sample wt/vol: 30.2 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

102

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00071RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1172

Matrix: (soil/water) SOIL Lab Sample ID: 10123-021

Sample wt/vol: 30.1 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 3 dec. _____ Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

103

1D

PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00072RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: SAS No.: SDG No.: S1172

Matrix: (soil/water) SOIL Lab Sample ID: 10123-022

Sample wt/vol: 30.0 (g/ml) G Lab File ID:

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

104

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00073RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1172

Matrix: (soil/water) SOIL Lab Sample ID: 10123-023

Sample wt/vol: 30.1 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 4 dec. _____ Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	35	U
11104-28-2	Aroclor-1221	35	U
11141-16-5	Aroclor-1232	35	U
53469-21-9	Aroclor-1242	35	U
12672-29-6	Aroclor-1248	35	U
11097-69-1	Aroclor-1254	35	U
11096-82-5	Aroclor-1260	35	U

U: Concentration of analyte is less than the value given.

FORM I PEST

005

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

CT00074RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 81172

Matrix: (soil/water) SOIL Lab Sample ID: 10123-024

Sample wt/vol: 30.1 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 01-09-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 01-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 01-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1.0

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

106

Quanterra
Environmental Services

To: Wayne Sprolles/Nick Demos
Fax Number: (303) 966-8774
Phone Number: (303) 966-8598

From: John Powell
Fax Number: (314) 298-8757
Phone Number: (314) 298-8566

PCB RESULTS

Lab ID	Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK76880	QCBLK76880	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9218-001	SS00002RM	34 U	34 U	34 U	34 U	34 U	34 U	34 U
9218-002	SS00004RM	34 U	34 U	34 U	34 U	34 U	34 U	34 U
9218-003	SS00011RM	34 U	34 U	34 U	34 U	34 U	34 U	934
9218-004	SS00016RM	36 U	36 U	36 U	36 U	36 U	36 U	141
9218-005	SS00020RM	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9218-005MS	SS00002RM-MS	33 U	33 U	33 U	33 U	33 U	79% Rec	33 U
9218-005MSD	SS00002RM-MSD	33 U	33 U	33 U	33 U	33 U	73% Rec	33 U

U: Not detected at the detection limit stated

107

Quanterra
Environmental Services

To: Wayne Sprolles/Nick Demos
Fax Number: (303) 966-8704
Phone Number: (303) 966-8598

From: John Powell
Fax Number: (314) 298-8757
Phone Number: (314) 298-8566

PCB RESULTS

Lab ID	Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK77490	QCBLK77490	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9268-001	SS00026RM	36 U	36 U	36 U	36 U	36 U	36 U	56
9268-002	SS00028RM	36 U	36 U	36 U	36 U	36 U	36 U	36 U
9268-003	SS00033RM	39 U	39 U	39 U	39 U	39 U	39 U	1300

U: Not detected at the detection limit stated

108

QUANTERRA
(Formerly ITAS - St. Louis)
ST. LOUIS, MO

FAX TRANSMISSION

TO: N. Demoo	
COMPANY: RMRS	
FAX NUMBER: 1-303-966-5198	
SENDER: Barbara S. Dahl	
DATE: 2-23-96	OPERATOR:
TIME: 3:00	NUMBER OF PAGES: (INCLUDES COVER) 12

St. Louis Laboratory

Fax Number: (314) 298-8757

If You Experience Trouble, Call (314) 298-8566

PCB results

109

Quanterra
Environmental Services

To: Wayne Sprolles/Nick Demos
Fax Number: (303) 966-8704
Phone Number: (303) 966-8598

From: John Powell
Fax Number: (314) 298-8757
Phone Number: (314) 298-8566

Date: 9/18/95

PCB RESULTS

Lab ID	Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK78083	QCBLK78083	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9325-001	SS00070RM	36 U	36 U	36 U	36 U	2700	36 U	36 U
9325-002	SS00079RM	35 U	35 U	35 U	35 U	300	35 U	35 U
9325-003	SS00090RM	37 U	37 U	37 U	37 U	3100	37 U	37 U
9325-004	SS00094RM	38 U	38 U	38 U	38 U	1300	38 U	38 U
9325-005	SS00095RM	38 U	38 U	38 U	38 U	1800	38 U	38 U
9325-006	SS00095RM	35 U	35 U	35 U	35 U	470	35 U	35 U

U: Not detected at the detection limit stated

110

Quanterra
Environmental Services

To: Wayne Sprolles/Nick Demos
Fax Number: (303) 966-8774
Phone Number: (303) 966-8598

From: John Powell
Fax Number: (314) 298-8757
Phone Number: (314) 298-8566

PCB RESULTS

Lab ID	Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK79526	QCBLK79526	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9458-001	SS00132RM	37 U	37 U	37 U	37 U	2400	680	37U
9458-002	SS00137RM	35 U	35 U	35 U	35 U	35 U	14000	35 U
9458-003	SS00145RM	37 U	37 U	37 U	37 U	65	37 U	37 U
9458-004	SS00150RM	35 U	35 U	35 U	35 U	300	120	35 U
9458-005	SS00197RM	37 U	37 U	37 U	37 U	460	37 U	37 U
9458-006	SS00203RM	37 U	37 U	37 U	37 U	98	37 U	37 U
9458-007	SS00177RM	34 U	34 U	34 U	34 U	34 U	1100	34 U
9458-008	SS00185RM	34 U	34 U	34 U	34 U	34 U	840	550
9458-001MS	SS00132RM-MS	37 U	37 U	37 U	37 U	3100	229%	37 U
9458-001MSD	SS00132RM-MSD	37 U	37 U	37 U	37 U	4300	527%	37 U

U: Not detected at the detection limit stated

10/06/95 08:02 ☎314 298 8757 QUANTERRA ☑001

Quanterra
Environmental Services

To: Wayne Sprolles/Nick Demos
Fax Number: (303) 966-8774
Phone Number: (303) 966-8598

From: John Powell
Fax Number: (314) 298-8757
Phone Number: (314) 298-8566

PCB RESULTS

Lab ID	Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK79323	QCBLK79323	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9437-001	SS00108RM	37 U	37 U	37 U	37 U	160	37 U	37 U
9437-002	SS00171RM	38 U	38 U	38 U	38 U	38 U	38 U	38 U
9437-003	SS00160RM	36 U	36 U	36 U	36 U	600	36 U	54
9437-004	SS00162RM	38 U	38 U	38 U	38 U	5900	38 U	38 U
9437-005	SS00165RM	39 U	39 U	39 U	39 U	44	39 U	52
9437-006	SS00168RM	37 U	37 U	37 U	37 U	2800	37 U	37 U
9437-007	SS00170RM	37 U	37 U	37 U	37 U	2300	37 U	37 U
9437-001MS	SS00108RM-MS	37 U	37 U	37 U	37 U	320	108%	37 U
9437-001MSD	SS00108RM-MSD	37 U	37 U	37 U	37 U	300	109%	37 U

U: Not detected at the detection limit stated

Units = UG/KG

112

100

Quanterra
Environmental Services

To: Wayne Sprolles/Nick Demos
Fax Number: (303) 966-8774
Phone Number: (303) 966-8598

From: John Powell
Fax Number: (314) 298-8757
Phone Number: (314) 298-8566

PCB RESULTS

Lab ID	Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK79696	QCBLK79696	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9468-001	SS00206RM	720 U	720 U	720 U	720 U	720 U	7000	5000
9468-002	SS00212RM	36 U	36 U	36 U	36 U	36 U	1600	450
9468-003	SS00213RM	38 U	38 U	38 U	38 U	38 U	1800	260
9468-004	SS00217RM	35 U	35 U	35 U	35 U	35 U	310	220
9468-001MS	SS00206RM-MS	720 U	720 U	720 U	720 U	720 U	3998%	11000
9468-001MSD	SS00206RM-MSD	720 U	720 U	720 U	720 U	720 U	2387%	6300

U: Not detected at the detection limit stated

Units UG/KG

113

Quanterra
Environmental Services

To: Wayne Sprolles/Nick Demos
Fax Number: (303) 966-5198 6533
Phone Number: (303) 966-5790

To: Laura Johnson
Fax Number: (303) 966-3400

From: John Powell
Fax Number: (314) 298-8757
Phone Number: (314) 298-8566

FAXED

PCB RESULTS

Lab ID	Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK80123	QCBLK80123	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9509-001	SS00234RM	340 U	340 U	340 U	340 U	340 U	3200	340 U
9509-002	SS00243RM	34 U	34 U	34 U	34 U	34 U	320	34 U
9509-003	SS00249RM	34 U	34 U	34 U	34 U	34 U	34 U	34 U
9509-004	SS00252RM	34 U	34 U	34 U	34 U	34 U	580	34 U
9509-005	SS00254RM	33 U	33 U	33 U	33 U	33 U	33 U	33 U

U: Not detected at the detection limit stated
Units: UG/KG

124

Quanterra
Environmental Services

To: Wayne Sprolles/Nick Demos
Fax Number: (303) 966-5198
Phone Number: (303) 966-5790

To: Laura Johnson
Fax Number: (303) 966-3400

From: John Powell
Fax Number: (314) 298-8757
Phone Number: (314) 298-8566

PCB RESULTS

Lab ID	Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK80123	QCBLK80123	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9509-001	SS00234RM	340 U	340 U	340 U	340 U	340 U	3200	340 U
9509-002	SS00243RM	34 U	34 U	34 U	34 U	34 U	320	34 U
9509-003	SS00249RM	34 U	34 U	34 U	34 U	34 U	34 U	34 U
9509-004	SS00252RM	34 U	34 U	34 U	34 U	34 U	580	34 U
9509-005	SS00254RM	33 U	33 U	33 U	33 U	33 U	33 U	33 U

U: Not detected at the detection limit stated
Units: UG/KG

125

Quanterra
Environmental Services

To: Wayne Sprolles/Nick Demos
Fax Number: (303) 966-~~5198~~ 6533
Phone Number: (303) 966-5790

FAXED

To: Laura Johnson
Fax Number: (303) 966-3400

From: John Powell
Fax Number: (314) 298-8757
Phone Number: (314) 298-8566

PCB RESULTS

Lab ID	Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK80444	QCBLK80444	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9546-001	SS00256RM	35 U	35 U	35 U	35 U	35 U	47	35 U
9546-002	SS00258RM	40 U	40 U	40 U	40 U	40 U	40 U	40 U
9546-003	SS00265RM	40 U	40 U	40 U	40 U	110	40 U	40 U
9546-004	SS00305RM	34 U	34 U	34 U	34 U	34 U	2100	34 U

U: Not detected at the detection limit stated
Units: UG/KG

116

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00430RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1181

Matrix: (soil/water) SOIL Lab Sample ID: 10377-001

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-15-96

% Moisture: not dec. 14 dec. _____ Date Extracted: 02-21-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-22-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	38	U
11104-28-2	Aroclor-1221	38	U
11141-16-5	Aroclor-1232	38	U
53469-21-9	Aroclor-1242	38	U
12672-29-6	Aroclor-1248	38	U
11097-69-1	Aroclor-1254	38	U
11096-82-5	Aroclor-1260	120	

U: Concentration of analyte is less than the value given.

FORM I PEST

117

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00430RMMS

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1181

Matrix: (soil/water) SOIL Lab Sample ID: 10377-001MS

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-15-96

% Moisture: not dec. 14 dec. _____ Date Extracted: 02-21-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-22-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	180	
11104-28-2	Aroclor-1221	38	U
11141-16-5	Aroclor-1232	38	U
53469-21-9	Aroclor-1242	38	U
12672-29-6	Aroclor-1248	38	U
11097-69-1	Aroclor-1254	38	U
11096-82-5	Aroclor-1260	300	

U: Concentration of analyte is less than the value given.

FORM I PEST

118

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

S600430RMMSD

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1181

Matrix: (soil/water) SOIL Lab Sample ID: 10377-001MSD

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-15-96

% Moisture: not dec. 14 dec. _____ Date Extracted: 02-21-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-22-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	190	U
11104-28-2	Aroclor-1221	38	U
11141-16-5	Aroclor-1232	38	U
53469-21-9	Aroclor-1242	38	U
12672-29-6	Aroclor-1248	38	U
11097-69-1	Aroclor-1254	38	U
11096-82-5	Aroclor-1260	260	

U: Concentration of analyte is less than the value given.

FORM I PEST

129

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00434RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 61181

Matrix: (soil/water) SOIL Lab Sample ID: 10377-002

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-15-96

% Moisture: not dec. 11 dec. _____ Date Extracted: 02-21-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-22-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	37	U
11104-28-2	Aroclor-1221	37	U
11141-16-5	Aroclor-1232	37	U
53469-21-9	Aroclor-1242	37	U
12672-29-6	Aroclor-1248	37	U
11097-69-1	Aroclor-1254	37	U
11096-82-5	Aroclor-1260	460	

U: Concentration of analyte is less than the value given.

FORM I PEST

120

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

S800437RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1181

Matrix: (soil/water) SOIL Lab Sample ID: 10377-006

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-15-96

% Moisture: not dec. 11 dec. _____ Date Extracted: 02-21-96

Extraction: (SepF/Cont/Sono) SONC Date Analyzed: 02-22-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	37	U
11104-28-2	Aroclor-1221	37	U
11141-16-5	Aroclor-1232	37	U
53469-21-9	Aroclor-1242	37	U
12672-29-6	Aroclor-1248	37	U
11097-69-1	Aroclor-1254	37	U
11096-82-5	Aroclor-1260	440	

U: Concentration of analyte is less than the value given.

FORM I PEST

121

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

PBLK01

Lab Name: QUANTERRA.MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1182

Matrix: (soil/water) SOIL Lab Sample ID: BLK92501

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: 02-23-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-28-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	33	U
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	33	U

U: Concentration of analyte is less than the value given.

FORM I PEST

1D

PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

PSPK01

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1182

Matrix: (soil/water) SOIL Lab Sample ID: SPK92501

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: 02-23-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-28-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	160	
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	170	

U: Concentration of analyte is less than the value given.

FORM I PEST

123

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00463RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1182

Matrix: (soil/water) SOIL Lab Sample ID: 10394-001

Sample wt/vol: 30.2 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-21-96

% Moisture: not dec. 3 dec. _____ Date Extracted: 02-23-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-28-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	420	

Concentration of analyte is less than the value given.

124

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00464RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1182

Matrix: (soil/water) SOIL Lab Sample ID: 10394-002

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-21-96

% Moisture: not dec. 7 dec. _____ Date Extracted: 02-23-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-28-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	36	U
11104-28-2	Aroclor-1221	36	U
11141-16-5	Aroclor-1232	36	U
53469-21-9	Aroclor-1242	36	U
12672-29-6	Aroclor-1248	36	U
11097-69-1	Aroclor-1254	36	U
11096-82-5	Aroclor-1260	270	

U: Concentration of analyte is less than the value given.

FORM I PEST

125

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00473RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1182

Matrix: (soil/water) SOIL Lab Sample ID: 10394-003

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-21-96

% Moisture: not dec. 13 dec. _____ Date Extracted: 02-23-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-28-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	38	U
11104-28-2	Aroclor-1221	38	U
11141-16-5	Aroclor-1232	38	U
53469-21-9	Aroclor-1242	38	U
12672-29-6	Aroclor-1248	38	U
11097-69-1	Aroclor-1254	38	U
11096-82-5	Aroclor-1260	280	

U: Concentration of analyte is less than the value given.

FORM I PEST

126

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00473RMMS

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1182

Matrix: (soil/water) SOIL Lab Sample ID: 10394-003MS

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-21-96

% Moisture: not dec. 13 dec. _____ Date Extracted: 02-23-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-28-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	140	
11104-28-2	Aroclor-1221	38	U
11141-16-5	Aroclor-1232	38	U
53469-21-9	Aroclor-1242	38	U
12672-29-6	Aroclor-1248	38	U
11097-69-1	Aroclor-1254	38	U
11096-82-5	Aroclor-1260	390	

U: Concentration of analyte is less than the value given.

FORM I PEST

127

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00473RMMSD

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 81182

Matrix: (soil/water) SOIL Lab Sample ID: 10394-003MSD

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-21-96

% Moisture: not dec. 13 dec. _____ Date Extracted: 02-23-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-28-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	140	
11104-28-2	Aroclor-1221	38	U
11141-16-5	Aroclor-1232	38	U
53469-21-9	Aroclor-1242	38	U
12672-29-6	Aroclor-1248	38	U
11097-69-1	Aroclor-1254	38	U
11096-82-5	Aroclor-1260	350	

U: Concentration of analyte is less than the value given.

FORM I PEST

128

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00477RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1182

Matrix: (soil/water) SOIL Lab Sample ID: 10394-004

Sample wt/vol: 30.2 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-21-96

% Moisture: not dec. 5 dec. _____ Date Extracted: 02-23-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-28-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	35	U
11104-28-2	Aroclor-1221	35	U
11141-16-5	Aroclor-1232	35	U
53469-21-9	Aroclor-1242	35	U
12672-29-6	Aroclor-1248	35	U
11097-69-1	Aroclor-1254	35	U
11096-82-5	Aroclor-1260	130	

U: Concentration of analyte is less than the value given.

FORM I PEST

129

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00481RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1182

Matrix: (soil/water) SOIL Lab Sample ID: 10394-005

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-21-96

% Moisture: not dec. 6 dec. _____ Date Extracted: 02-23-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-28-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	35	U
11104-28-2	Aroclor-1221	35	U
11141-16-5	Aroclor-1232	35	U
53469-21-9	Aroclor-1242	35	U
12672-29-6	Aroclor-1248	35	U
11097-69-1	Aroclor-1254	35	U
11096-82-5	Aroclor-1260	340	

U: Concentration of analyte is less than the value given.

FORM I PEST

130

QUANTERRA
(Formerly ITAS - St. Louis)
ST. LOUIS, MO

FAX TRANSMISSION

TO: RM HINSCH	
COMPANY: RMRS	
FAX NUMBER: 303-966-4046	
SENDER: Barbara S. Dahl	
DATE: 7-11-96	OPERATOR: BSP
TIME: 9:40	NUMBER OF PAGES: (INCLUDES COVER) 7

St. Louis Laboratory

Fax Number: (314) 298-8757

If You Experience Trouble, Call (314) 298-8566

131

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00438RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1181

Matrix: (soil/water) SOIL Lab Sample ID: 10377-003

Sample wt/vol: 30.2 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-15-96

% Moisture: not dec. 6 dec. _____ Date Extracted: 02-21-96

Extraction: (SepF/Cont/Sono) SONC Date Analyzed: 02-22-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	35	U
11104-28-2	Aroclor-1221	35	U
11141-16-5	Aroclor-1232	35	U
53469-21-9	Aroclor-1242	35	U
12672-29-6	Aroclor-1248	35	U
11097-69-1	Aroclor-1254	35	U
11096-82-5	Aroclor-1260	180	

U: Concentration of analyte is less than the value given.

FORM I PEST

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00441RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1181

Matrix: (soil/water) SOIL Lab Sample ID: 10377-004

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-15-96

% Moisture: not dec. 18 dec. _____ Date Extracted: 02-21-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-22-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	40	U
11104-28-2	Aroclor-1221	40	U
11141-16-5	Aroclor-1232	40	U
53469-21-9	Aroclor-1242	40	U
12672-29-6	Aroclor-1248	40	U
11097-69-1	Aroclor-1254	40	U
11096-82-5	Aroclor-1260	40	U

U: Concentration of analyte is less than the value given.

FORM I PEST

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00447RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1181

Matrix: (soil/water) SOIL Lab Sample ID: 10377-005

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-15-96

% Moisture: not dec. 8 dec. _____ Date Extracted: 02-21-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-22-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	36	U
11104-28-2	Aroclor-1221	36	U
11141-16-5	Aroclor-1232	36	U
53469-21-9	Aroclor-1242	36	U
12672-29-6	Aroclor-1248	36	U
11097-69-1	Aroclor-1254	36	U
11096-82-5	Aroclor-1260	270	

U: Concentration of analyte is less than the value given.

FORM I PEST

134

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00450RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1181

Matrix: (soil/water) SOIL Lab Sample ID: 10377-007

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-15-96

% Moisture: not dec. 11 dec. _____ Date Extracted: 02-21-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-22-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	37	U
11104-28-2	Aroclor-1221	37	U
11141-16-5	Aroclor-1232	37	U
53469-21-9	Aroclor-1242	37	U
12672-29-6	Aroclor-1248	37	U
11097-69-1	Aroclor-1254	37	U
11096-82-5	Aroclor-1260	37	U

U: Concentration of analyte is less than the value given.

FORM I PEST

135

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00455RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1181

Matrix: (soil/water) SOIL Lab Sample ID: 10377-008

Sample wt/vol: 30.2 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-16-96

% Moisture: not dec. 10 dec. _____ Date Extracted: 02-21-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-22-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	37	U
11104-28-2	Aroclor-1221	37	U
11141-16-5	Aroclor-1232	37	U
53469-21-9	Aroclor-1242	37	U
12672-29-6	Aroclor-1248	37	U
11097-69-1	Aroclor-1254	37	U
11096-82-5	Aroclor-1260	670	

U: Concentration of analyte is less than the value given.

FORM I PEST

136

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00460RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 81181

Matrix: (soil/water) SOIL Lab Sample ID: 10377-009

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-16-96

% Moisture: not dec. 8 dec. _____ Date Extracted: 02-21-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02-22-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	36	U
11104-28-2	Aroclor-1221	36	U
11141-16-5	Aroclor-1232	36	U
53469-21-9	Aroclor-1242	36	U
12672-29-6	Aroclor-1248	36	U
11097-69-1	Aroclor-1254	36	U
11096-82-5	Aroclor-1260	110	

U: Concentration of analyte is less than the value given.

FORM I PEST

Quanterra
Environmental Services

To: Wayne Sprolles/Nick Demos
Fax Number: (303) 966-6704
Phone Number: (303) 966-6598

From: John Powell
Fax Number: (314) 298-8757
Phone Number: (314) 298-8566

Date: 9/18/95

PCB RESULTS

Lab ID	Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK78083	QCBLK78083	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9325-001	SS00070RM	36 U	36 U	36 U	36 U	2700	36 U	36 U
9325-002	SS00078RM	35 U	35 U	35 U	35 U	300	35 U	35 U
9325-003	SS00080RM	37 U	37 U	37 U	37 U	3100	37 U	37 U
9325-004	SS00084RM	38 U	38 U	38 U	38 U	1300	38 U	38 U
9325-005	SS00095RM	38 U	38 U	38 U	38 U	1800	38 U	38 U
9325-006	SS00085RM	35 U	35 U	35 U	35 U	470	35 U	35 U

U: Not detected at the detection limit stated

138

Quanterra
Environmental Services

To: Wayne Sprolles/Nick Demos
Fax Number: (303) 966-8774
Phone Number: (303) 966-8598

From: John Powell
Fax Number: (314) 298-8757
Phone Number: (314) 298-8566

PCB RESULTS

Lab ID	Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
QCBLK76880	QCBLK76880	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9218-001	SS00002RM	34 U	34 U	34 U	34 U	34 U	34 U	34 U
9218-002	SS00004RM	34 U	34 U	34 U	34 U	34 U	34 U	34 U
9218-003	SS00011RM	34 U	34 U	34 U	34 U	34 U	34 U	934
9218-004	SS00016RM	36 U	36 U	36 U	36 U	36 U	36 U	141
9218-005	SS00020RM	33 U	33 U	33 U	33 U	33 U	33 U	33 U
9218-005MS	SS00002RM-MS	33 U	33 U	33 U	33 U	33 U	79% Rec	33 U
9218-005MSD	SS00002RM-MSD	33 U	33 U	33 U	33 U	33 U	73% Rec	33 U

U: Not detected at the detection limit stated

139

FAX

Quanterra Environmental Services

13715 Rider Trail North
Earth City, MO 63045-1205

Date 01-22-96

Number of pages including cover sheet 5

To: Nick Demos

Phone

Fax Phone (303) 966-5198

CC:

From: John Powell

Phone (314) 298-8566

Fax Phone (314) 298-8757

REMARKS:

☒ Urgent ☐ For your review ☐ Reply ASAP ☐ Please comment

PCB Results you requested.

140

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00352RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1165

Matrix: (soil/water) SOIL Lab Sample ID: 9990-001

Sample wt/vol: 30.4 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 12-05-95

% Moisture: not dec. 4 dec. _____ Date Extracted: 12-18-95

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 12-20-95

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 10

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	340	U
11104-28-2	Aroclor-1221	340	U
11141-16-5	Aroclor-1232	340	U
53469-21-9	Aroclor-1242	340	U
12672-29-6	Aroclor-1248	340	U
11097-69-1	Aroclor-1254	340	U
11096-82-5	Aroclor-1260	3100	

U: Concentration of analyte is less than the value given.

FORM I PEST

141

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00359RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1165

Matrix: (soil/water) SOIL Lab Sample ID: 9990-002

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 12-05-95

% Moisture: not dec. 6 dec. _____ Date Extracted: 12-18-95

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 12-20-95

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	35	U
11104-28-2	Aroclor-1221	35	U
11141-16-5	Aroclor-1232	35	U
53469-21-9	Aroclor-1242	35	U
12672-29-6	Aroclor-1248	35	U
11097-69-1	Aroclor-1254	35	U
11096-82-5	Aroclor-1260	230	

U: Concentration of analyte is less than the value given.

FORM I PEST

142

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00364RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1165

Matrix: (soil/water) SOIL Lab Sample ID: 9990-003

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 12-05-95

% Moisture: not dec. 8 dec. _____ Date Extracted: 12-18-95

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 12-20-95

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 2

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	72	U
11104-28-2	Aroclor-1221	72	U
11141-16-5	Aroclor-1232	72	U
53469-21-9	Aroclor-1242	72	U
12672-29-6	Aroclor-1248	72	U
11097-69-1	Aroclor-1254	72	U
11096-82-5	Aroclor-1260	800	

U: Concentration of analyte is less than the value given.

FORM I PEST

143

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00367RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1165

Matrix: (soil/water) SOIL Lab Sample ID: 9990-004

Sample wt/vol: 30.3 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 12-05-95

% Moisture: not dec. 3 dec. _____ Date Extracted: 12-18-95

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 12-20-95

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	240	

U: Concentration of analyte is less than the value given.

FORM I PEST

144

QUANTERRA
(Formerly ITAS - St. Louis)
ST. LOUIS, MO

FAXED

FAX TRANSMISSION

TO: DEMOS / Rebecca	
COMPANY: RMRS	
FAX NUMBER: 1-303-966-4046	
SENDER: Barbara S. Dietl	
DATE: 5-8-96	OPERATOR: BSD
TIME: 3:40	NUMBER OF PAGES: (INCLUDES COVER) 20

St. Louis Laboratory

Fax Number: (314) 298-8757

If You Experience Trouble, Call (314) 298-8566

PCB's results

145

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00486RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-001

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 14 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 10

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	380	U
11104-28-2	Aroclor-1221	380	U
11141-16-5	Aroclor-1232	380	U
53469-21-9	Aroclor-1242	380	U
12672-29-6	Aroclor-1248	380	U
11097-69-1	Aroclor-1254	380	U
11096-82-5	Aroclor-1260	8600	

U: Concentration of analyte is less than the value given.

FORM I PEST

146

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00486RMMS

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-001MS

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 14 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 10

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	260	J
11104-28-2	Aroclor-1221	390	U
11141-16-5	Aroclor-1232	390	U
53469-21-9	Aroclor-1242	390	U
12672-29-6	Aroclor-1248	390	U
11097-69-1	Aroclor-1254	390	U
11096-82-5	Aroclor-1260	7200	

U: Concentration of analyte is less than the value given.

FORM I PEST

147

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00486RMMSD

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-001MSD

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 14 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 10

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	290	J
11104-28-2	Aroclor-1221	390	U
11141-16-5	Aroclor-1232	390	U
53469-21-9	Aroclor-1242	390	U
12672-29-6	Aroclor-1248	390	U
11097-69-1	Aroclor-1254	390	U
11096-82-5	Aroclor-1260	9100	

U: Concentration of analyte is less than the value given.

FORM I PEST

148

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00487RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL . Lab Sample ID: 11002-002

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 13 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 10

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	380	U
11104-28-2	Aroclor-1221	380	U
11141-16-5	Aroclor-1232	380	U
53469-21-9	Aroclor-1242	380	U
12672-29-6	Aroclor-1248	380	U
11097-69-1	Aroclor-1254	380	U
11096-82-5	Aroclor-1260	5300	

U: Concentration of analyte is less than the value given.

FORM I PEST

149

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00488RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-003

Sample wt/vol: 30.4 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 12 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 50

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	1900	U
11104-28-2	Aroclor-1221	1900	U
11141-16-5	Aroclor-1232	1900	U
53469-21-9	Aroclor-1242	1900	U
12672-29-6	Aroclor-1248	1900	U
11097-69-1	Aroclor-1254	1900	U
11096-82-5	Aroclor-1260	20000	

U: Concentration of analyte is less than the value given.

FORM I PEST

150

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00489RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-004

Sample wt/vol: 30.9 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 12 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-06-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	37	U
11104-28-2	Aroclor-1221	37	U
11141-16-5	Aroclor-1232	37	U
53469-21-9	Aroclor-1242	37	U
12672-29-6	Aroclor-1248	37	U
11097-69-1	Aroclor-1254	37	U
11096-82-5	Aroclor-1260	73	

U: Concentration of analyte is less than the value given.

FORM I PEST

151

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00490RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-005

Sample wt/vol: 30.7 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 14 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 10

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	380	U
11104-28-2	Aroclor-1221	380	U
11141-16-5	Aroclor-1232	380	U
53469-21-9	Aroclor-1242	380	U
12672-29-6	Aroclor-1248	380	U
11097-69-1	Aroclor-1254	380	U
11096-82-5	Aroclor-1260	2400	

U: Concentration of analyte is less than the value given.

FORM I PEST

152

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00491RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-006

Sample wt/vol: 30.5 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 13 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 50

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	1900	U
11104-28-2	Aroclor-1221	1900	U
11141-16-5	Aroclor-1232	1900	U
53469-21-9	Aroclor-1242	1900	U
12672-29-6	Aroclor-1248	1900	U
11097-69-1	Aroclor-1254	1900	U
11096-82-5	Aroclor-1260	33000	

U: Concentration of analyte is less than the value given.

FORM I PEST

153

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00492RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-007

Sample wt/vol: 30.5 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 11 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	37	U
11104-28-2	Aroclor-1221	37	U
11141-16-5	Aroclor-1232	37	U
53469-21-9	Aroclor-1242	37	U
12672-29-6	Aroclor-1248	37	U
11097-69-1	Aroclor-1254	37	U
11096-82-5	Aroclor-1260	750	

U: Concentration of analyte is less than the value given.

FORM I PEST

154

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00493RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-008

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 15 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 10

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	390	U
11104-28-2	Aroclor-1221	390	U
11141-16-5	Aroclor-1232	390	U
53469-21-9	Aroclor-1242	390	U
12672-29-6	Aroclor-1248	390	U
11097-69-1	Aroclor-1254	390	U
11096-82-5	Aroclor-1260	3700	

U: Concentration of analyte is less than the value given.

FORM I PEST

155

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00494RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-009

Sample wt/vol: 30.6 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-16-96

% Moisture: not dec. 12 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 50

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	1900	U
11104-28-2	Aroclor-1221	1900	U
11141-16-5	Aroclor-1232	1900	U
53469-21-9	Aroclor-1242	1900	U
12672-29-6	Aroclor-1248	1900	U
11097-69-1	Aroclor-1254	1900	U
11096-82-5	Aroclor-1260	17000	

U: Concentration of analyte is less than the value given.

FORM I PEST

156

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00495RM

Lab Name: QUANTERRA,NO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-010

Sample wt/vol: 30.6 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 7 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 10

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	350	U
11104-28-2	Aroclor-1221	350	U
11141-16-5	Aroclor-1232	350	U
53469-21-9	Aroclor-1242	350	U
12672-29-6	Aroclor-1248	350	U
11097-69-1	Aroclor-1254	350	U
11096-82-5	Aroclor-1260	4100	

U: Concentration of analyte is less than the value given.

FORM I PEST

157

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00496RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-011

Sample wt/vol: 30.6 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 6 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 100

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	3500	U
11104-28-2	Aroclor-1221	3500	U
11141-16-5	Aroclor-1232	3500	U
53469-21-9	Aroclor-1242	3500	U
12672-29-6	Aroclor-1248	3500	U
11097-69-1	Aroclor-1254	3500	U
11096-82-5	Aroclor-1260	86000	

U: Concentration of analyte is less than the value given.

FORM I PEST

158

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00497RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-012

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 12 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 5

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	190	
11104-28-2	Aroclor-1221	188	U
11141-16-5	Aroclor-1232	188	U
53469-21-9	Aroclor-1242	188	U
12672-29-6	Aroclor-1248	188	U
11097-69-1	Aroclor-1254	188	U
11096-82-5	Aroclor-1260	3000	

U: Concentration of analyte is less than the value given.

FORM I PEST

159

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00498RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-013

Sample wt/vol: 30.2 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 11 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	37	U
11104-28-2	Aroclor-1221	37	U
11141-16-5	Aroclor-1232	37	U
53469-21-9	Aroclor-1242	37	U
12672-29-6	Aroclor-1248	37	U
11097-69-1	Aroclor-1254	37	U
11096-82-5	Aroclor-1260	940	

U: Concentration of analyte is less than the value given.

FORM I PEST

160

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00499RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-014

Sample wt/vol: 30.4 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 05-01-96

% Moisture: not dec. 10 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 50

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	1800	U
11104-28-2	Aroclor-1221	1800	U
11141-16-5	Aroclor-1232	1800	U
53469-21-9	Aroclor-1242	1800	U
12672-29-6	Aroclor-1248	1800	U
11097-69-1	Aroclor-1254	1800	U
11096-82-5	Aroclor-1260	30000	

U: Concentration of analyte is less than the value given.

FORM I PEST

Uel

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00500RM

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: 11002-015

Sample wt/vol: 30.1 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: 02-16-96

% Moisture: not dec. 7 dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-07-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	36	U
11104-28-2	Aroclor-1221	36	U
11141-16-5	Aroclor-1232	36	U
53469-21-9	Aroclor-1242	36	U
12672-29-6	Aroclor-1248	36	U
11097-69-1	Aroclor-1254	36	U
11096-82-5	Aroclor-1260	800	

U: Concentration of analyte is less than the value given.

FORM I PEST

162

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

PBLK01

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: BLK99429

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-06-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	33	U
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	33	U

U: Concentration of analyte is less than the value given.

FORM I PEST

463

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

PSPK01

Lab Name: QUANTERRA,MO Contract: 262.01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1185

Matrix: (soil/water) SOIL Lab Sample ID: SPK99429

Sample wt/vol: 30.0 (g/ml) g Lab File ID: _____

Level: (low/med) LOW Date Sampled: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: 05-06-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05-06-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	140	
11104-28-2	Aroclor-1221	33	U
11141-16-5	Aroclor-1232	33	U
53469-21-9	Aroclor-1242	33	U
12672-29-6	Aroclor-1248	33	U
11097-69-1	Aroclor-1254	33	U
11096-82-5	Aroclor-1260	140	

U: Concentration of analyte is less than the value given.

FORM I PEST

1364

QUANTERRA
(Formerly ITAS - St. Louis)
ST. LOUIS, MO

FAX TRANSMISSION

TO: Rebeca Henrich	
COMPANY: RMRS	
FAX NUMBER: 303-966-4046	
SENDER: Barbara S. Dale	
DATE: 8-15-96	OPERATOR: BSD
TIME: 8:45	NUMBER OF PAGES: (INCLUDES COVER) 4

St. Louis Laboratory

Fax Number: (314) 298-8757

If You Experience Trouble, Call (314) 298-8566

165

QUANTERRA
(Formerly ITAS - St. Louis)
ST. LOUIS, MO

FAX TRANSMISSION

TO: ~~N~~ S DEMOS / Rebecca Hinsch	
COMPANY: RMRS	
FAX NUMBER: 303-966-4046	
SENDER: Barbara S. Dibel	
DATE: 9-9-96	OPERATOR: BSD
TIME: 3:45	NUMBER OF PAGES: (INCLUDES COVER) 3

St. Louis Laboratory

Fax Number: (314) 298-8757

If You Experience Trouble, Call (314) 298-8566

* Refax to Rebecca Hinsch on 8-15-96 @ 8:45
303-966-4046

166

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00526RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1211

Matrix: (soil/water) SOIL Lab Sample ID: 11444-001

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 06-21-96

% Moisture: not dec. 13 dec. _____ Date Extracted: 07-02-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-03-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 100

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	380	U
11104-28-2	Aroclor-1221	380	U
11141-16-5	Aroclor-1232	380	U
53469-21-9	Aroclor-1242	380	U
12672-29-6	Aroclor-1248	380	U
11097-69-1	Aroclor-1254	380	U
11096-82-5	Aroclor-1260	11000	

U: Concentration of analyte is less than the value given.
*: Not reported due to AR 1260 interference

FORM I PEST

00006

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00531RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1211

Matrix: (soil/water) SOIL Lab Sample ID: 11444-002

Sample wt/vol: 30.2 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 06-21-96

% Moisture: not dec. 14 dec. _____ Date Extracted: 07-02-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-03-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 100

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	380	U
11104-28-2	Aroclor-1221	380	U
11141-16-5	Aroclor-1232	380	U
53469-21-9	Aroclor-1242	380	U
12672-29-6	Aroclor-1248	380	U
11097-69-1	Aroclor-1254	380	U
11096-82-5	Aroclor-1260	5700	

U: Concentration of analyte is less than the value given.
*: Not reported due to AR 1260 interference

FORM I PEST

1368

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00533RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1212

Matrix: (soil/water) SOIL Lab Sample ID: 11455-001

Sample wt/vol: 30.1 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 06-24-96

% Moisture: not dec. 11 dec. _____ Date Extracted: 07-02-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-03-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 100

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	3700	U
11104-28-2	Aroclor-1221	3700	U
11141-16-5	Aroclor-1232	3700	U
53469-21-9	Aroclor-1242	3700	U
12672-29-6	Aroclor-1248	3700	U
11097-69-1	Aroclor-1254	3700	U
11096-82-5	Aroclor-1260	70000	

U: Concentration of analyte is less than the value given.

FORM I PEST

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00534RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1212

Matrix: (soil/water) SOIL Lab Sample ID: 11455-002

Sample wt/vol: 30.3 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 06-24-96

% Moisture: not dec. 10 dec. _____ Date Extracted: 07-02-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-03-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 100

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	3700	U
11104-28-2	Aroclor-1221	3700	U
11141-16-5	Aroclor-1232	3700	U
53469-21-9	Aroclor-1242	3700	U
12672-29-6	Aroclor-1248	3700	U
11097-69-1	Aroclor-1254	3700	U
11096-82-5	Aroclor-1260	46000	

U: Concentration of analyte is less than the value given.

FORM I PEST

170

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00535RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1212

Matrix: (soil/water) SOIL Lab Sample ID: 11455-003

Sample wt/vol: 30.2 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 06-24-96

% Moisture: not dec. 11 dec. _____ Date Extracted: 07-02-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-03-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 100

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	3700	U
11104-28-2	Aroclor-1221	3700	U
11141-16-5	Aroclor-1232	3700	U
53469-21-9	Aroclor-1242	3700	U
12672-29-6	Aroclor-1248	3700	U
11097-69-1	Aroclor-1254	3700	U
11096-82-5	Aroclor-1260	46000	

U: Concentration of analyte is less than the value given.

FORM I PEST

171

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00537RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 81212

Matrix: (soil/water) SOIL Lab Sample ID: 11455-004

Sample wt/vol: 30.3 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 06-24-96

% Moisture: not dec. 13 dec. _____ Date Extracted: 07-02-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-03-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 100

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	3800	U
11104-28-2	Aroclor-1221	3800	U
11141-16-5	Aroclor-1232	3800	U
53469-21-9	Aroclor-1242	3800	U
12672-29-6	Aroclor-1248	3800	U
11097-69-1	Aroclor-1254	3800	U
11096-82-5	Aroclor-1260	49000	

U: Concentration of analyte is less than the value given.

FORM I PEST

172

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00538RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1212

Matrix: (soil/water) SOIL Lab Sample ID: 11455-005

Sample wt/vol: 30.3 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 06-24-96

% Moisture: not dec. 11 dec. _____ Date Extracted: 07-02-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-03-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 100

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	3700	U
11104-28-2	Aroclor-1221	3700	U
11141-16-5	Aroclor-1232	3700	U
53469-21-9	Aroclor-1242	3700	U
12672-29-6	Aroclor-1248	3700	U
11097-69-1	Aroclor-1254	3700	U
11096-82-5	Aroclor-1260	56000	

U: Concentration of analyte is less than the value given.

FORM I PEST

173

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

S800539RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1212

Matrix: (soil/water) SOIL Lab Sample ID: 11455-006

Sample wt/vol: 30.5 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 06-24-96

% Moisture: not dec. 11 dec. _____ Date Extracted: 07-02-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-03-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 100

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	3700	U
11104-28-2	Aroclor-1221	3700	U
11141-16-5	Aroclor-1232	3700	U
53469-21-9	Aroclor-1242	3700	U
12672-29-6	Aroclor-1248	3700	U
11097-69-1	Aroclor-1254	3700	U
11096-82-5	Aroclor-1260	15000	

U: Concentration of analyte is less than the value given.

FORM I PEST

174

Quanterra
13715 Rider Trail North
Earth City, MO 63045

Fax Cover Sheet

DATE:	July 23, 1996	TIME:	09:24 AM
TO:	Corine Bogert Rocky Flats	PHONE: FAX:	(303) 966-9656 (303) 966-6783
FROM:	John Powell	PHONE: FAX:	(314) 298-8566 (314) 298-8757
RE:	PCBs		

Number of pages including cover sheet: 17

Message

175

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

S800545RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 81215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-001

Sample wt/vol: 30.3 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-03-96

% Moisture: not dec. 12 dec. _____ Date Extracted: 07-12-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-15-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	37	U
11104-28-2	Aroclor-1221	37	U
11141-16-5	Aroclor-1232	37	U
53469-21-9	Aroclor-1242	37	U
12672-29-6	Aroclor-1248	37	U
11097-69-1	Aroclor-1254	37	U
11096-82-5	Aroclor-1260	37	U

U: Concentration of analyte is less than the value given.

FORM I PEST

00011

176

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00546RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-002

Sample wt/vol: 30.6 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-03-96

% Moisture: not dec. 12 dec. _____ Date Extracted: 07-12-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-15-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	37	U
11104-28-2	Aroclor-1221	37	U
11141-16-5	Aroclor-1232	37	U
53469-21-9	Aroclor-1242	37	U
12672-29-6	Aroclor-1248	37	U
11097-69-1	Aroclor-1254	37	U
11096-82-5	Aroclor-1260	380	

U: Concentration of analyte is less than the value given.

FORM I PEST

177

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00548RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1315

Matrix: (soil/water) SOIL Lab Sample ID: 11533-003

Sample wt/vol: 30.3 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-03-96

% Moisture: not dec. 12 dec. _____ Date Extracted: 07-12-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-15-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	38	U
11104-28-2	Aroclor-1221	38	U
11141-16-5	Aroclor-1232	38	U
53469-21-9	Aroclor-1242	38	U
12672-29-6	Aroclor-1248	38	U
11097-69-1	Aroclor-1254	38	U
11096-82-5	Aroclor-1260	38	U

U: Concentration of analyte is less than the value given.

FORM I PEST

178

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00553RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-004

Sample wt/vol: 30.1 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-03-96

% Moisture: not dec. 5 dec. _____ Date Extracted: 07-12-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-15-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	35	U
11104-28-2	Aroclor-1221	35	U
11141-16-5	Aroclor-1232	35	U
53469-21-9	Aroclor-1242	35	U
12672-29-6	Aroclor-1248	35	U
11097-69-1	Aroclor-1254	35	U
11096-82-5	Aroclor-1260	110	

U: Concentration of analyte is less than the value given.

FORM I PEST

179

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00556RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-005

Sample wt/vol: 30.3 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-03-96

% Moisture: not dec. 3 dec. _____ Date Extracted: 07-12-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-15-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

180

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00563RM

Lab Name: QUANTERRA.MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-006

Sample wt/vol: 30.1 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-03-96

% Moisture: not dec. 3 dec. _____ Date Extracted: 07-17-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-17-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	34	U

U: Concentration of analyte is less than the value given.

FORM I PEST

181

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00569RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-007

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-03-96

% Moisture: not dec. 2 dec. _____ Date Extracted: 07-17-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-17-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	1200	*
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	3100	*

U: Concentration of analyte is less than the value given.
*: Reported from a 1:10 dilution on 07-18-96.

FORM I PEST

182

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00572RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-008

Sample wt/vol: 30.4 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-03-96

% Moisture: not dec. 3 dec. _____ Date Extracted: 07-17-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-18-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	71	
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	130	

U: Concentration of analyte is less than the value given.

FORM I PEST

183

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00578RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-009

Sample wt/vol: 30.4 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-03-96

% Moisture: not dec. 5 dec. _____ Date Extracted: 07-17-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-18-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	35	U
11104-28-2	Aroclor-1221	35	U
11141-16-5	Aroclor-1232	35	U
53469-21-9	Aroclor-1242	35	U
12672-29-6	Aroclor-1248	360	
11097-69-1	Aroclor-1254	35	U
11096-82-5	Aroclor-1260	410	

U: Concentration of analyte is less than the value given.

FORM I PEST

184

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00583RM

Lab Name: QUANTERRA.MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-010

Sample wt/vol: 30.3 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-03-96

% Moisture: not dec. 4 dec. _____ Date Extracted: 07-12-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-15-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	35	U
11104-28-2	Aroclor-1221	35	U
11141-16-5	Aroclor-1232	35	U
53469-21-9	Aroclor-1242	35	U
12672-29-6	Aroclor-1248	35	U
11097-69-1	Aroclor-1254	35	U
11096-82-5	Aroclor-1260	240	

U: Concentration of analyte is less than the value given.

FORM I PEST

185

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

8800585RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-011

Sample wt/vol: 30.6 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-03-96

% Moisture: not dec. 4 dec. _____ Date Extracted: 07-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	34	U
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	100	

U: Concentration of analyte is less than the value given.

FORM I PEST

186

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00591RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-012

Sample wt/vol: 30.1 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-03-96

% Moisture: not dec. 10 dec. _____ Date Extracted: 07-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	37	U
11104-28-2	Aroclor-1221	37	U
11141-16-5	Aroclor-1232	37	U
53469-21-9	Aroclor-1242	37	U
12672-29-6	Aroclor-1248	37	U
11097-69-1	Aroclor-1254	37	U
11096-82-5	Aroclor-1260	37	U

U: Concentration of analyte is less than the value given.

FORM I PEST

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00600RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-013

Sample wt/vol: 30.2 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-08-96

% Moisture: not dec. 27 dec. _____ Date Extracted: 07-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	46	U
11104-28-2	Aroclor-1221	46	U
11141-16-5	Aroclor-1232	46	U
53469-21-9	Aroclor-1242	46	U
12672-29-6	Aroclor-1248	46	U
11097-69-1	Aroclor-1254	46	U
11096-82-5	Aroclor-1260	46	U

U: Concentration of analyte is less than the value given.

FORM I PEST

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00603RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-014

Sample wt/vol: 30.2 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-08-96

% Moisture: not dec. 9 dec. _____ Date Extracted: 07-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	36	U
11104-28-2	Aroclor-1221	36	U
11141-16-5	Aroclor-1232	36	U
53469-21-9	Aroclor-1242	36	U
12672-29-6	Aroclor-1248	36	U
11097-69-1	Aroclor-1254	36	U
11096-82-5	Aroclor-1260	36	U

U: Concentration of analyte is less than the value given.

FORM I PEST

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00609RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 81215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-015

Sample wt/vol: 30.4 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-08-96

% Moisture: not dec. 21 dec. _____ Date Extracted: 07-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	42	U
11104-28-2	Aroclor-1221	42	U
11141-16-5	Aroclor-1232	42	U
53469-21-9	Aroclor-1242	42	U
12672-29-6	Aroclor-1248	42	U
11097-69-1	Aroclor-1254	42	U
11096-82-5	Aroclor-1260	42	U

U: Concentration of analyte is less than the value given.

FORM I PEST

190

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00612RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1215

Matrix: (soil/water) SOIL Lab Sample ID: 11533-016

Sample wt/vol: 30.4 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-08-96

% Moisture: not dec. 4 dec. _____ Date Extracted: 07-15-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 07-16-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
12674-11-2	Aroclor-1016	34	U
11104-28-2	Aroclor-1221	34	U
11141-16-5	Aroclor-1232	34	U
53469-21-9	Aroclor-1242	34	U
12672-29-6	Aroclor-1248	240	
11097-69-1	Aroclor-1254	34	U
11096-82-5	Aroclor-1260	350	

U: Concentration of analyte is less than the value given.

FORM I PEST

191

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

SS00616RM

Lab Name: QUANTERRA,MO Contract: 262-01

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: S1220

Matrix: (soil/water) SOIL Lab Sample ID: 11690-001

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: 07-30-96

% Moisture: not dec. 8 dec. _____ Date Extracted: 08-01-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 08-02-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NO.	Compound		Q
12674-11-2	Aroclor-1016	36	U
11104-28-2	Aroclor-1221	36	U
11141-16-5	Aroclor-1232	36	U
53469-21-9	Aroclor-1242	36	U
12672-29-6	Aroclor-1248	36	U
11097-69-1	Aroclor-1254	2500	
11096-82-5	Aroclor-1260	560	

U: Concentration of analyte is less than the value given.

FORM I PEST

192

Appendix C

Midwest Research Institute (MRI) Verification of PCB Spill Cleanup by Sampling and Analysis

Best Available Copy

United States
Environmental Protection
Agency

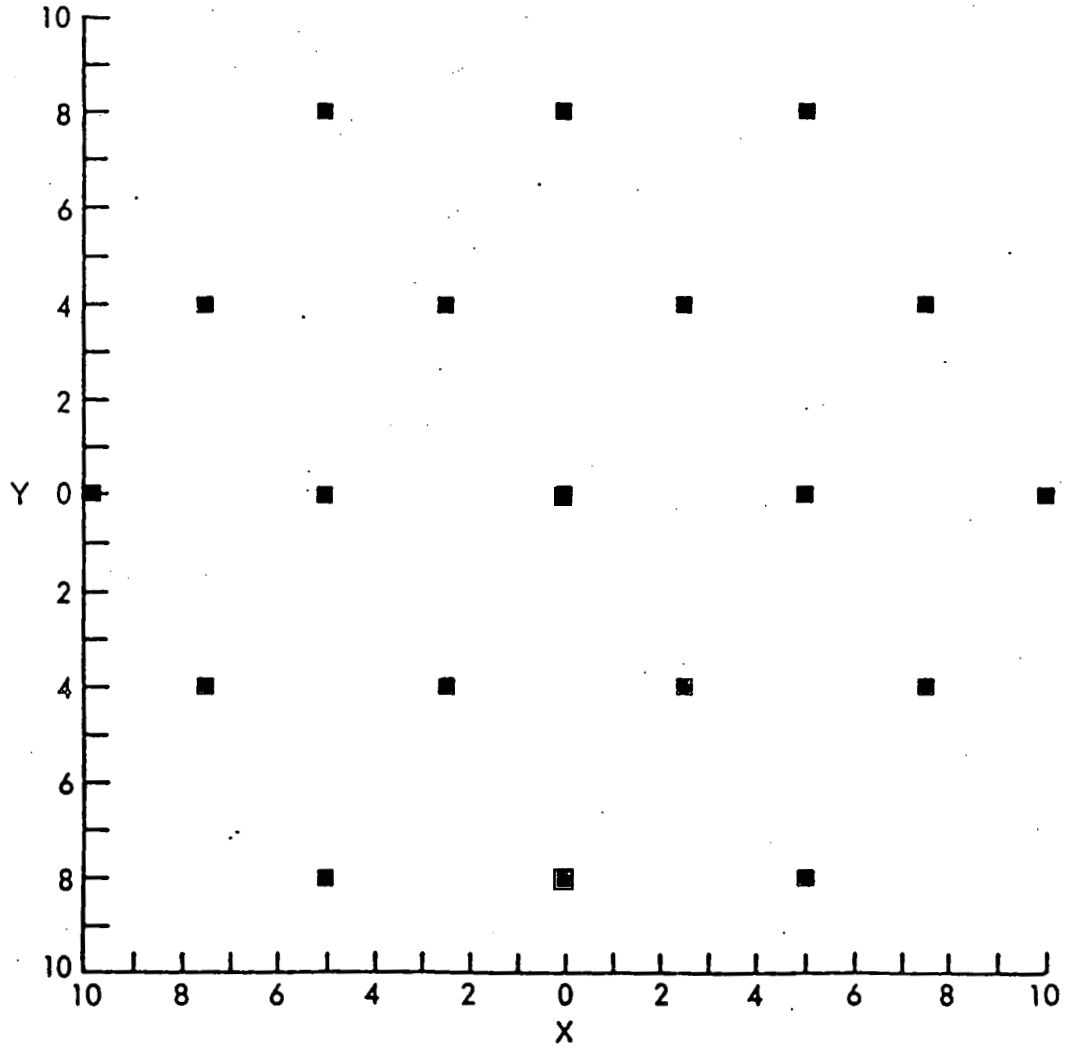
Office of
Toxic Substances
Washington DC 20460

EPA-560/5-85-026
August, 1985

Toxic Substances

EPA

VERIFICATION OF PCB SPILL CLEANUP BY SAMPLING AND ANALYSIS



194

VERIFICATION OF PCB SPILL CLEANUP BY SAMPLING AND ANALYSIS

By

Bruce A. Boomer
Mitchell D. Erickson
Stephen E. Swanson
Gary L. Kelso
MIDWEST RESEARCH INSTITUTE

and

David C. Cox
Bradley D. Schultz
WASHINGTON CONSULTING GROUP

INTERIM REPORT NO. 2
WORK ASSIGNMENT 37

EPA Contract No. 68-02-3938
MRI Project No. 8501-A(37)

and

EPA Contract No. 68-01-6721
WCG Subcontract to Battelle Columbus Laboratories
No. F4138(8149)435

Prepared for:

U.S. Environmental Protection Agency
Office of Toxic Substances
Exposure Evaluation Division (TS-798)
401 M Street, S.W.
Washington, DC 20460

Attn: Mr. Daniel T. Heggem, Work Assignment Manager
Dr. Joseph J. Breen, Project Officer
Richard A. Levy, Work Assignment Manager
Joseph S. Carra, Project Officer

195

PREFACE

This Interim Report was prepared for the Environmental Protection Agency under EPA Contract No. 68-02-3938, Work Assignment 37. The work assignment is being directed by Mitchell D. Erickson. This report was prepared by Dr. Erickson, Bruce A. Boomer, Gary L. Kelso, and Steve E. Swanson of Midwest Research Institute (MRI). The sampling design (Section IV.A) was written by David C. Cox and Bradley D. Schultz of the Washington Consulting Group, 1625 I Street, N.W., Washington, D.C. 20006, under subcontract to Battelle Columbus Laboratories, Subcontract No. F4138(8149)435, EPA Contract No. 68-01-6721 with the Design and Development Branch, Exposure Evaluation Division. The EPA Task Managers, Daniel T. Heggem, Richard A. Levy and John H. Smith, as well as Joseph J. Breen, Joseph S.Carra, and Martin P. Halper, of the Office of Toxic Substances, provided helpful guidance and technical information.

MIDWEST RESEARCH INSTITUTE

Clarence L. Haile
Deputy Program Manager

John E. Going
Program Manager

Approved:

James L. Spigarelli, Director
Chemical and Biological Sciences
Department

196

TABLE OF CONTENTS

		Page
I.	Introduction	1
II.	Summary	1
III.	Overview of PCB Spills and Cleanup Activities	3
	A. Introduction to PCB Spills and Cleanup	3
	1. Current Trends	3
	2. Limitations of This Overview	3
	B. Components of the Cleanup Process	4
	1. Health and Safety	4
	2. Reporting the Spill	4
	3. Quick Response/Securing the Site	6
	4. Determination of Materials Spilled/Cleanup Plan	6
	5. Cleanup Procedures	6
	6. Proper Disposal of Removed PCB Materials	7
	7. Sampling and Analysis	7
	8. Remedial Action	8
	9. Site Restoration	8
	10. Records	8
	11. Miscellaneous Considerations	8
IV.	Guidelines on Sampling and Analysis	9
	A. Sampling Design	9
	1. Proposed Sampling Design	9
	2. Sample Size and Design Layout in the Field	16
	3. Judgemental Sampling	20
	4. Compositing Strategy for Analysis of Samples	23
	5. Calculations of Average Number of Analyses, and Error Probabilities	24
	B. Sampling Techniques	40
	1. Solids Sampling	40
	2. Water Sampling	41
	3. Surface Sampling	41
	4. Vegetation Sampling	42
	C. Analytical Techniques	42
	1. Gas Chromatography (GC)	42
	2. Thin-Layer Chromatography (TLC)	49
	3. Total Organic Halide Analyses	50

197

TABLE OF CONTENTS (concluded)

Page

D. Selection of Appropriate Methods 50

1. Criteria for Selection. 50
2. Selection of Instrumental Techniques. 50
3. Selection of Methods. 51
4. Implementation of Methods 53

E. Quality Assurance. 54

1. Quality Assurance Plan. 54
2. Quality Control 55

F. Documentation and Records. 58
G. Reporting Results. 59

V. References. 60

198

I. INTRODUCTION

The U.S. Environmental Protection Agency (EPA) under the authority of the Toxic Substances Control Act (TSCA) Section 6(e) and 40 CFR Section 761.60(d), has determined that polychlorinated biphenyl (PCB) spills must be controlled and cleaned up. The Office of Toxic Substances (OTS) has been requested to provide written guidelines for cleaning up PCB spills, with particular emphasis on the sampling design and sampling and analysis methods to be used for the cleanup of PCB spills.

This work assignment is divided into two phases. The reports of Phase I are presented in Draft Interim Report No. 1, Revision No. 1, "Cleanup of PCB Spills from Capacitors and Transformers," by Gary L. Kelso, Mitchell D. Erickson, Bruce A. Boomer, Stephen E. Swanson, David C. Cox, and Bradley D. Schultz, submitted to EPA on January 9, 1985. Phase I consists of a review and technical evaluation of the available documentation on PCB spill cleanup, contacts with EPA Regional Offices and industry experts, and preparation of preliminary guidelines for the cleanup of PCB spills. The document was aimed at providing guidance in all aspects of spill cleanup for those organizations which do not already have working PCB spill cleanup programs.

Phase II, reported in this document, reviews the available sampling and analysis methodology for assessing the extent of spill cleanup by EPA enforcement officials. This report includes some of the information from the Phase I report, incorporates comments on the Phase I report and the general issue which were received at a working conference on February 26-27, 1985, and addresses the issue from the perspective of developing legally defensible data for enforcement purposes.

This report, intended primarily for EPA enforcement personnel, outlines specific sampling and analysis methods to determine compliance with EPA policy on the cleanup of PCB spills. The sampling and analysis methods can be used to determine the residual levels of PCBs at a spill site following the completion of cleanup activities. Although the methodologies outlined in this document are applicable to PCB spills in general, specific incidents may require special efforts beyond the scope of this report. Future changes in EPA policy may affect some of the information presented in this document.

Following a summary of the report (Section II), Section III presents an overview of PCB spills and cleanup activities. The guidelines on sampling and analysis (Section IV) includes discussion of sampling design, sampling techniques, analysis, and quality assurance.

II. SUMMARY

This report presents the results of Phase II of this work assignment. Phase I consisted of a review and technical evaluation of the available documentation on PCB spill cleanup, contacts with EPA Regional Offices, and preparation of preliminary guidelines for the cleanup of PCB spills.

199

Phase II (this document) reviews the available sampling and analysis methodology for assessing the extent of spill cleanup by EPA enforcement officials. The report incorporates some of the information from the Phase I report and general issues received at a working conference on PCB spills.

The EPA has set reporting requirements for PCB spills and views PCB spills as improper disposal of PCBs. Cleanup activities have not been standardized since PCB spills are generally unique situations evaluated on a case-by-case basis by both the PCB owner (or his contractor) and the responsible EPA Regional Office. Components of the cleanup process may include protecting the health and safety of workers; reporting the spill; quick response/securing the site; determination of materials spilled; cleanup procedures; proper disposal of removed PCB materials; and sampling and analysis. The level of action required is dependent on the amount of spilled liquid, PCB concentration, spill area and dispersion potential, and potential human exposure.

A sampling design is proposed for use by EPA enforcement staff in detecting residual PCB contamination above a designated limit after a spill site has been cleaned. The proposed design involves sampling on a hexagonal grid which is centered on the cleanup area and extends just beyond its boundaries. Guidance is provided for centering the design on the spill site, for staking out the sampling locations, and for taking possible obstacles into account. Additional samples can be collected at the discretion of the sampling crew.

Compositing strategies, in which several samples are pooled and analyzed together, are recommended for each of the three proposed designs. Since an enforcement finding of noncompliance must be legally defensible, the sampling design emphasizes the control of the false positive rate, the probability of concluding that PCBs are present above the allowable limit when, in fact, they are not.

Sampling and analysis techniques are described for PCB-contaminated solids (soil, sediment, etc.), water, oils, surface wipes, and vegetation. A number of analytical methods are referenced; appropriate enforcement methods were selected based on reliability. Since GC/ECD is highly reliable, widely used, and is included in many standard methods, it is a primary recommended method for most samples. Secondary methods may be useful for confirmatory analyses or for special situations when the primary method is not applicable.

Quality assurance (QA) must be applied throughout the entire monitoring program. Quality control (QC) measures, including protocols, certification and performance checks, procedural QC, sample QC, and sample custody as appropriate, should be stipulated in a QA plan.

200

III. OVERVIEW OF PCB SPILLS AND CLEANUP ACTIVITIES

A. Introduction to PCB Spills and Cleanup

The EPA has established requirements for reporting PCB spills based on the amount of material spilled and disposal requirements for the spilled PCBs and materials contaminated by the spill. Under TSCA regulations [40 CFR 761.30(a)(1)(iii) and 40 CFR 761.60d], PCB spills are viewed as improper disposal of PCBs. Although specific PCB cleanup requirements are not established in the TSCA regulations, each regional administrator is given authority by policy to enforce adequate clean-up of PCB spills to protect human health and the environment.

1. Current Trends

Due to regional variations in PCB spill policy and the lack of a national PCB cleanup policy, PCB cleanup activities have not been standardized. Individual companies owning PCB equipment and contract cleanup companies have developed their own procedures and policies for PCB cleanup activities keyed to satisfying the requirements of the appropriate EPA Regional Office. In addition, the EPA Regional Offices typically have provided suggestions for companies unfamiliar with PCB cleanup.

PCB spills are generally viewed as unique situations to be evaluated on a case-by-case basis by both the PCB owner (or his contractor) and the EPA Regional Office. However, a general framework is often used to approach the problem. Most cleanup activities involve quick response, removal or cleaning of suspected contaminated material, and post-cleanup sampling to document adequate cleanup. Major considerations involved in the cleanup process include minimizing environmental dispersion, minimizing any present or future human exposure to PCBs, protecting the health and safety of the cleanup crew, and properly disposing contaminated materials.

In general, the involvement of EPA Regional Offices is limited to phone conversations often including a follow-up call to receive the analytical results of the post-cleanup sampling. If the EPA representative is not satisfied with the reported data, additional documentation, sampling and analysis, or cleanup (followed by further sampling and analysis) may be requested.

In cases of special concern (e.g., large spills), EPA Regional Offices may work more closely with the PCB owner or contractor in planning the cleanup, sampling and analysis activities, and on-site inspections.

2. Limitations of This Overview

The general discussion in this chapter refers to the procedures, policy, and considerations that seem to be widely used at present by PCB owners and spill cleanup contractors in meeting the requirements of the EPA Regional Offices. The activities described do not involve EPA regulations or policy except where indicated, since the EPA has not established requirements on PCB cleanup procedures.

201

Table 1 categorizes PCB spills into approximate levels of action for PCB spill cleanup based on concern. Potential environmental problems increase with increases in PCB concentrations, amount of spilled liquid, spill area and dispersion potential, and potential human exposure. The three spill types presented in Table 1 are based on very rough estimates. "Severity" in one key item such as human exposure could raise a spill to a Type 3 (i. e., requiring special attention). On the other hand a spill of a large volume of liquid may be considered a Type 2 spill due to a relatively low concentration of PCBs. The three categories are only approximate and are intended to demonstrate the flexibility needed in responding to PCB spills. EPA Regional Offices should provide guidance on spill cleanup activities whenever questions develop.

The situations described in this chapter are limited to recent PCB spills of similar magnitude to the reported spills associated with PCB oil transformers and capacitors (i.e., Type 2 in Table 1). Unusually severe spill incidents (Type 3 in Table 1) involving large volumes of PCBs, a large spill area, a high probability of significant human exposure, and/or severe environmental or transportation scenarios may require special considerations, beyond the scope of this discussion.

All spills from regulated equipment are typically subject to the detail of effort outlined in this chapter. Although cleanup of smaller spills (Type 1 in Table 1) is required if the concentration of PCBs in the spilled material is 50 ppm or greater, the spill and the cleanup activities normally are not reported to EPA.

Future changes in EPA policy may invalidate some of the discussions appearing in this chapter. For example, if EPA adopts any type of formal categorization scheme for PCB spills, some of the assumptions made in this chapter may become inappropriate.

B. Components of the Cleanup Process

1. Health and Safety

Protection of the health and safety of the clean-up crew during the PCB cleanup operation is an important concern. References discussing health and safety considerations relevant to some PCB spill incidents include NIOSH Criteria for A Recommended Standard for Exposure to Polychlorinated Biphenyls (PCBs) (1977c) and Health Hazards and Evaluation Report No. 80-85-745 (NIOSH 1980). The appropriate level of health and safety protection is dependent upon the specifics of the spill.

2. Reporting the Spill

If the regulatory limits are exceeded, the spill must be reported to Federal, State, and local authorities as applicable. Under EPA regulations [Fed. Reg. 50:13456-13475], spills over 10 lb must be reported to The National Response Center. The toll free phone number is (800) 424-8802.

202

Table 1. Approximate Levels of Action for PCB Spill Cleanup Based on Concern

	Categories of increasing concern		
	Type 1	Type 2	Type 3
Approximate gallons of spilled liquid	< 1	> 1	> 5
Area of spill (sq ft)	< 125	250 (avg.)	> 1,000
PCB concentration in spilled liquid (ppm)	< 500	≥ 50	Variable or high
Types of spilled liquid	Mineral oil (or variable)	Variable	Variable, Askarel
Exposure scenario	Various	Various	Special concern for high exposure situations

Notes:
- Type 1 spill is usually not reported.
- Type 2 spill is reported and discussed in this chapter.
- Type 3 spill is not discussed in this chapter and may require special EPA assistance.
- "Severity" in one key item may raise the spill to a higher risk category.

203

3. Quick Response/Securing the Site

Quick response is desirable to mitigate the dispersion of the spilled material and to secure the site. Federal regulations require that cleanup actions commence within 48 hr of discovery of a spill [40 CFR 761.30(a)(1) (iii)]. More rapid response is highly preferable.

A quick response allows removal or cleaning of the PCB-contaminated material before it is dispersed by wind, rain, seepage, and other natural causes or by humans or animals. In securing the site, the cleanup crew determines the spill boundaries, prevents unauthorized access to the spill site, and notifies all parties involved.

The methods used to secure the site will vary on a case-by-case basis, depending on the specific circumstances. The extent of the spill is usually determined by visual inspection with the addition of a buffer area that may include PCBs finely dispersed from splattering. Evaluating the extent of the spill involves considerable judgment, including consideration of the cause of the spill, weather conditions, and specifics of the site.

Field analysis kits may aid the crew in determining the extent of the spill in some instances. The field kits, when used properly, can serve as a screening tool. The need for quick response has limited the usefulness of the more accurate field analytical techniques such as field gas chromatography. Practical problems associated with availability of the equipment and trained staff, set-up time, and cost have limited the use of such techniques at this time.

4. Determination of Materials Spilled/Cleanup Plan

After securing the site, the response crew will either (a) immediately proceed with the cleanup operation, or (b) identify the materials spilled and formulate an appropriate cleanup plan. A suitable cleanup plan can be developed by identifying the type of PCB material (i.e., mineral oil, PCB oil, Askarel) and considering such factors as the volume spilled, area of the spill, and site characteristics.

Based on reasoning similar to Table 1, the crew leader can determine the necessary level of effort in accordance with the policy of the PCB owner and the EPA Regional Office. He can determine if additional guidance is needed, plan the sampling and analysis, and make other decisions related to the level of effort and procedures needed.

5. Cleanup Procedures

The cleanup procedure may include, but may not necessarily be limited to, the following activities:

- Removal or repair of failed/damaged PCB equipment,
- Physical removal of contaminated vegetation;

204

- Physical removal of contaminated soils, liquids, etc.,
- Decontamination or physical removal (as appropriate) of contaminated surfaces, and
- Decontamination or removal of all equipment potentially contaminated during the cleanup procedures.
- Encapsulation may be employed only with EPA approval.

The specific procedures used in a cleanup are selected by the PCB owner or the cleanup contractor. Key considerations include removal of PCBs from the site to achieve the standards required by the EPA region, company, or other applicable control authority; avoidance of unintentional cross contamination or dispersion of PCBs from workers' shoes, contaminated equipment, spilled cleaning solvents, rags, and other sources; and protection of workers' health.

The cleanup crew shall make every possible effort to keep the spilled PCBs out of sewers and waterways. If this has already occurred, the crew needs to contact the local authorities. Water is never used for cleaning equipment or the spill site.

A simple PCB spill cleanup may involve the removal of the leaking equipment, removal of contaminated sod and soil by shovel, cleaning pavement with an absorbant material and solvents, and decontamination or disposal of the workers' equipment (shovels, shoes, gloves, rags, plastic sheets, etc.). More complicated situations may include decontamination of cars, fences, buildings, trees and shrubs, electrical equipment, or water (in pools or bodies of water).

In some cases, adequate decontamination of surfaces (pavements, walls, etc.) may not be possible. An alternate to physical removal of the surface material is encapsulation of the contaminated area under a coating impervious to PCBs. (EPA approval would be required.)

6. Proper Disposal of Removed PCB Materials

All PCB-contaminated materials removed from the spill site, must be shipped and disposed in accordance with relevant Federal, State, and local regulations. TSCA Regulations [40 CFR 761.60] outline the requirements for the disposal of PCBs, PCB articles, and PCB containers in an incinerator, high efficiency boiler, chemical waste landfill, or an approved alternative method. Facility requirements for incineration and chemical waste landfills are presented in 40 CFR 761.70 and 40 CFR 761.75, respectively. Applicable Department of Transportation regulations are listed in 49 CFR 172.101.

7. Sampling and Analysis

Although sampling and analysis will be discussed in detail in Chapter IV, this discussion gives an overview of applicable considerations and current practice. Sampling and analysis may not always be needed (especially for the spills described as Type 1 in Table 1), but enforcement authorities or property owners may ask for proof that the spill site has been adequately

205

decontaminated. This can be accomplished by taking a number of samples representative of the area contaminated by the spill. Samples should represent the full extent of the spill, both horizontal and vertical, as well as the types of materials in the spill area (soil, surfaces, water, etc.).

Sampling design and technique as well as sample handling and preservation should incorporate acceptable procedures for each matrix to be sampled and concern for the adequacy and accuracy for the samples in the final analysis.

Analysis of the samples for PCB content should be performed by trained personnel using acceptable procedures with due consideration of quality assurance and quality control.

Further discussion of sampling and analysis (applicable to EPA enforcement activities) appears in Chapter IV.

8. Remedial Action

If the analysis results indicate the cleanup was not in compliance with designated cleanup levels, additional cleanup is needed. Additional sampling can pinpoint the location of remaining contaminated areas if the original sampling plan was not designed to identify contaminated sub-areas within the spill site. If additional cleanup is needed, the cleanup crew will continue as before, removing more material or cleaning surfaces more thoroughly. Remedial action will be followed by additional sampling and analysis to verify the adequacy of the cleanup.

9. Site Restoration

This is not addressed under TSCA and is a matter to be settled between the company responsible for the PCB spill and the property owner.

10. Records

Although there are no TSCA requirements for records of PCB cleanup activities except for documentation of PCBs stored or transported for disposal [40 CFR 761.80(a)], the PCB owner should keep records of the spill cleanup in case of future questions or concern. Relevant information may include dates, a description of the activities, records of shipment and disposal of PCB-contaminated materials, and a report of collected samples and results of analysis.

11. Miscellaneous Considerations

a. Expeditious and effective action are desired throughout the cleanup process to minimize the concern of the public, especially residents near the site or individuals with a special interest in the site. Likewise, speed and effectiveness in the cleanup may prevent any future concern or action related to the PCB spill.

b. Education and training of the spill response crews and responsible staff members is a constant concern. The employees need sufficient training to make proper judgements and to know when additional assistance or guidance is needed.

106

IV. GUIDELINES ON SAMPLING AND ANALYSIS

Reliable analytical measurements of environmental samples are an essential ingredient of sound decisions for safeguarding public health and improving the quality of the environment. Effective enforcement monitoring should follow the general operational model for conducting analytical measurements of environmental samples, including: planning, quality assurance/quality control, verification and validation, precision and accuracy, sampling, measurements, documentation, and reporting. Although many options are available when analyzing environmental samples, differing degrees of reliability, dictated by the objectives, time, and resources available, influence the protocol chosen for enforcement monitoring. The following section outlines the factors critically influencing the outcome and reliability of enforcement monitoring of PCB spill cleanup.

A. Sampling Design

This section presents a sampling scheme, for use by EPA enforcement staff, for detecting residual PCB contamination above a limit designated by EPA-OPTS after the site has been cleaned up. Two types of error traceable to sampling and analysis are possible. The first is false positive, i.e., concluding that PCBs are present at levels above the allowable limit when, in fact, they are not. The false positive rate for the present situation should be low, because an enforcement finding of noncompliance must be legally defensible; that is, a violator must not be able to claim that the sampling results could easily have been obtained by chance alone. Moreover, all sampling designs used must be documented or referenced.

The second type of error possible is a false negative, i.e., failure to detect the presence of PCB levels above the allowable limit. The false negative rate will depend on the size of the contaminated area and on the level of contamination. For large areas contaminated at levels well above the allowable limit, the false negative rate must, of course, be low to ensure that the site is brought into compliance. The false negative rate can increase as the area or level of contamination decrease.

1. Proposed Sampling Design

In practice, the contaminated area from a spill will be irregular in shape. In order to standardize sample design and layout in the field, and to protect against underestimation of the spill area by the cleanup crew, sampling within a circular area surrounding the contaminated area is proposed. Guidance on choosing the center and radius of the circle, as well as the number of sample points to be used is provided in Section 2 below.

The detection problem was modeled as follows: try to detect a circular area of uniform residual contamination whose center is randomly placed within the sampling circle. Figure 1 illustrates the model. The figure depicts a sampling circle of 10 ft centered on a utility pole (site of the spill). After cleanup, a residually contaminated circle remains. However, in choosing locations at which to sample, the sampler has no knowledge of either the location of the circle or the level of contamination. This

207

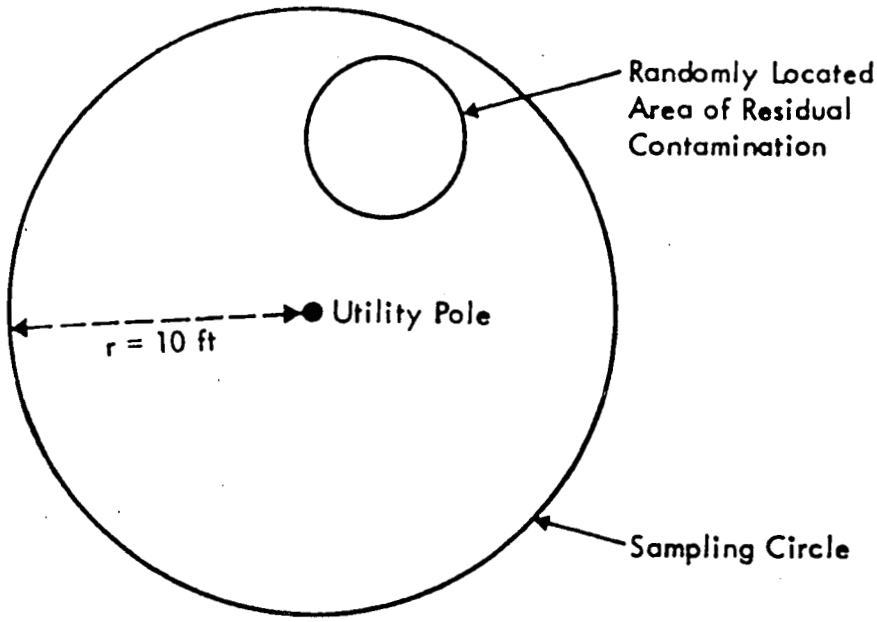


Figure 1. Randomly located area of residual contamination within the sampling circle.

208

lack of knowledge was modeled by treating the sampling locations as fixed and the center of the contaminated circle as a randomly located point in the circle of radius 10 ft. The implicit assumption that residual contamination is equally likely to be present anywhere within the sampling area is reasonable, at least as a first approximation (Lingle 1985). This is because more effort is likely to have been expended in cleaning up the areas which were obviously highly contaminated.

Two general types of design are possible for this detection problem: grid designs and random designs. Random designs have two disadvantages compared to grid designs for this application. First, random designs are more difficult to implement in the field, since the sampling crew must be trained to generate random locations onsite, and since the resulting pattern is irregular. Second, grid designs are more efficient for this type of problem than random designs. A grid design is certain to detect a sufficiently large contaminated area while some random designs are not. For example, the suggested design with a sample size of 19 has a 100% chance to detect a contaminated area of radius 2.8 ft within a sampling circle of radius 10 ft. By contrast, a design based on a simple random sample of 19 points has only a 79% chance of detecting such an area.

Therefore, a grid design is proposed. A hexagonal grid based on equilateral triangles has two advantages for this problem. First, such a grid minimizes the circular area certain to be detected (among all grids with the same number of points covering the same area). Second, some previous experience (Mason 1982; Matern 1960) suggests that the hexagonal grid performs well for certain soil sampling problems. The hexagonal grid may, at first sight, appear to be complicated to lay out in the field. Guidance is provided in Section 2 below and shows that the hexagonal grid is quite practical in the field and is not significantly more difficult to deploy than other types of grid.

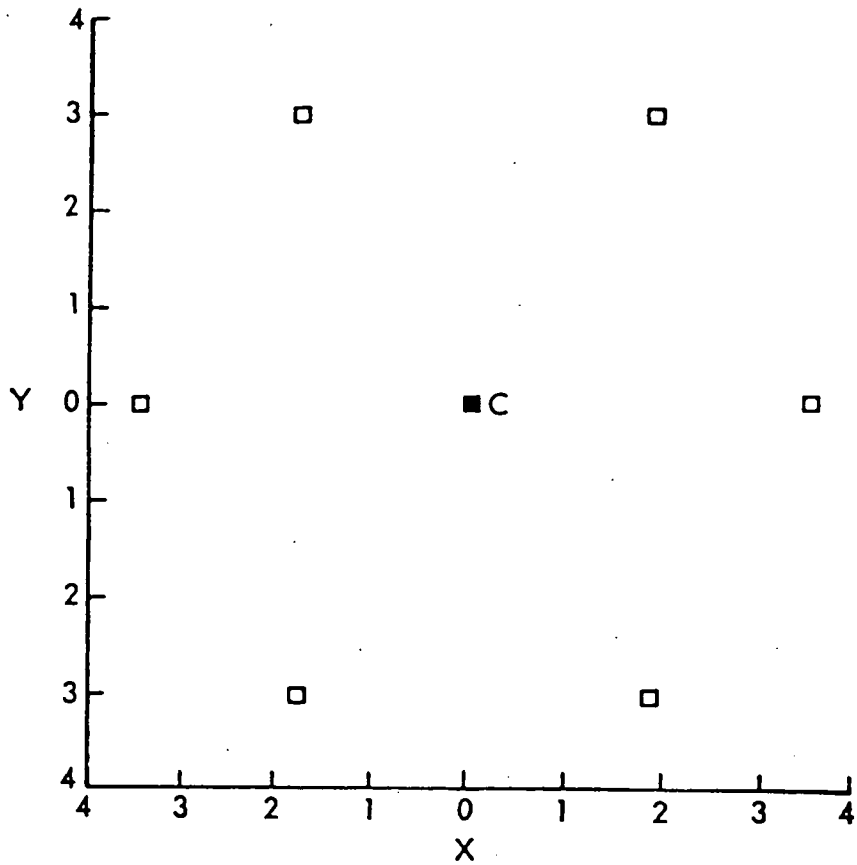
The smallest hexagonal grid has 7 points, the next 19 points, the third 37 points as shown in Figures 2 through 4. In general, the grid has $3n^2 + 3n + 1$ points. To completely specify a hexagonal grid, the distance between adjacent points, s, must be determined. The distance s was chosen to minimize, as far as possible, the size of the residual contaminated circle which is certain to be sampled. Values of s so chosen, together with number of sampling points and radius of smallest circle certain to be sampled are shown in Table 2. For example, the grid spacing for a circle of radius 20 ft for the 7-point design is $s = (0.87)(20) = 17.4$ ft. For a given size circle, the more points on the grid, the smaller the residual contamination area which can be detected with a given probability.

209

Table 2. Parameters of Hexagonal Sampling Designs for a Sampling Circle of Radius r Feet

No. of points	Distance between adjacent points, s (ft)	Radius of smallest circle certain to be sampled
7	0.87r	0.5r
19	0.48r	0.28r
37	0.3r	0.19r

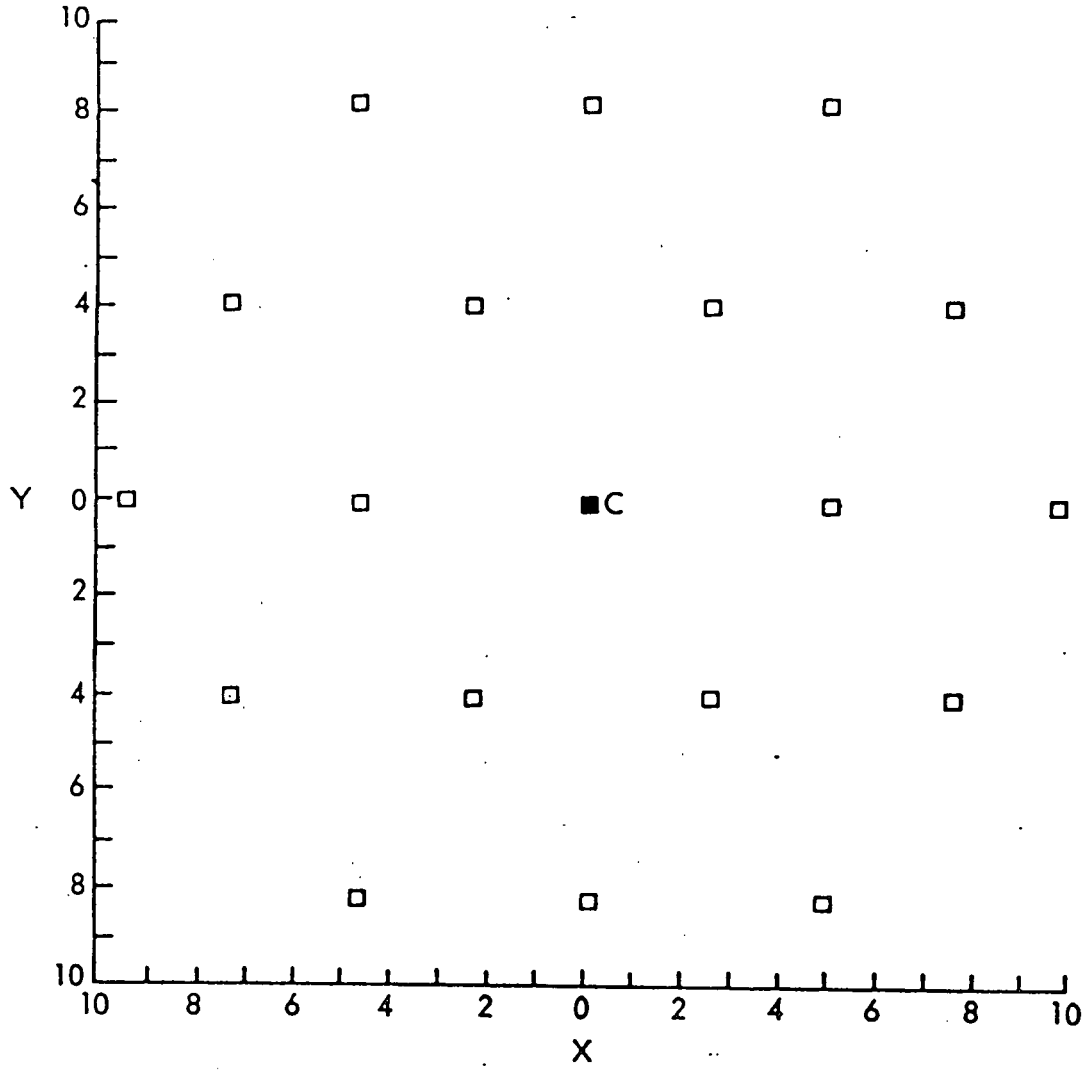
210



The outer boundary of the contaminated area is assumed to be 4 feet from the center (C) of the spill site.

Figure 2. Location of sampling points in a 7-point grid.

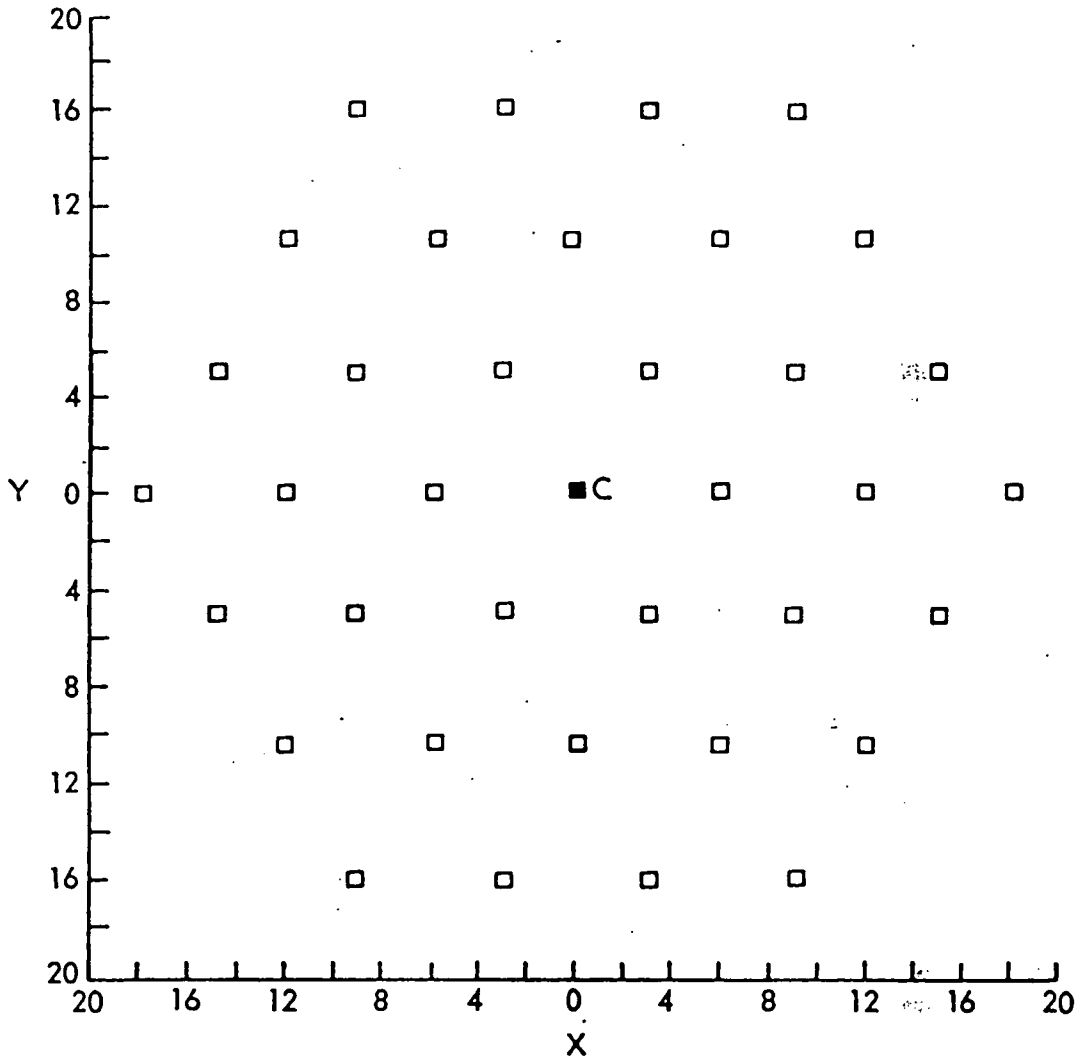
211



The outer boundary of the contaminated area is assumed to be 10 feet from the center (C) of the spill site.

Figure 3. Location of sampling points in a 19-point grid.

212



The outer boundary of the contaminated area is assumed to be 20 feet from the center (C) of the spill site.

Figure 4. Location of sampling points in a 37-point grid.

213

The first three hexagonal designs are shown in Figures 2 to 4, for a sampling circle radius of r = 10 ft. The choice of sample size depends on the cost of analyzing each sample and the reliability of detection desired for various residually contaminated areas. Subsection 2 below provides some suggested sample sizes for different spill areas, based on the distribution of spill areas provided by the Utility Solid Waste Activities Group (USWAG 1984; Lingle 1985).

2. Sample Size and Design Layout in the Field

a. Sample Size

The distribution of cleanup areas for PCB capacitor spill sites, based on data collected by USWAG (1984; Lingle 1985) is shown in Table 3. The smallest spill recorded in the USWAG database is 5 ft^2, the largest 1,700 ft^2. The median cleanup area is 100 ft, the mean 249 ft^2; the wide discrepancy between the mean and the median reflects the presence of a small percentage of relatively large spills in the database.

Recommended sample sizes are given in Table 4. Several considerations were involved in arriving at these recommendations. First, the maximum number of samples recommended for the largest spills is 37, in recognition of practical constraints on the number of samples that can be taken. Even so, it is important to note that not all samples collected will need to be analyzed. The calculations in Section 5 below show that, even for the 37 sample case, no more than 8 analyses will usually be required to reach a decision. Since the cost of chemical analyses is a substantial component of sampling and analysis costs, even the 37-sample case should not, therefore, be prohibitively expensive. Second, the typical spill will require 19 samples. Small spills, with sampling radius no greater than 4 ft, will have 7 samples, while the largest spills, with sampling radius 11.3 ft and up, will require 37 samples. It should be noted that only capacitor spills are represented in Table 3. Transformer spills, however, would be expected to be generally smaller than capacitor spills because energetic releases are less likely from transformers. Thus, one would expect the smaller sample sizes to be relatively more likely for transformer spills than capacitor spills.

244

Table 3. Distribution of PCB Capacitor Spill Cleanup Areas Based on 80 Cases

Cleanup area (ft^2)	Percent of cases
≤ 50	32.5
51-100	18.8
101-200	15.0
201-300	12.5
301-400	3.8
401-700	7.5
701-1,300	8.8
≥ 1,300	1.3

Source: Lingle 1985.

Table 4. Recommended Sample Sizes

Sampling area (ft^2)	Radius of sampling circle (ft)	Percent of PCB capacitor spills	Sample size
≤ 50	≤ 4	32.5	7
51-400	4-11.3	50.0	19
> 400	> 11.3	17.5	37

215

The final consideration in recommending sample sizes was to achieve roughly comparable detection capability for different size spills. The radius of the smallest contaminated circle certain to be sampled at least once by the sampling scheme is used for comparative purposes (see Table 2). Table 5 presents some calculations of this quantity. The absolute detection capability of the sampling scheme is seen to be relatively constant for different spill sizes. This means that a given area of residual contamination is about as likely to be detected in any sized spill.

Table 5. Detection Capability of the Recommended Sampling Schemes

Sampling area (ft^2)	Radius (ft)	Sample size	Radius of smallest circle to be sampled (ft)
50	4.0	7	2.0
150	6.9	19	1.9
400	11.3	19	3.2
875	16.7	37	3.2

b. Design Layout in the Field

Figure 5 presents a typical illustration of design layout in the field. The first step is to determine the boundaries of the original cleanup area (from records of the cleanup). Next, find the center and radius of the sampling circle which is to be drawn surrounding the cleanup area. The following approach is recommended:

(a) Draw the longest dimension, L_1, of the spill area.

(b) Determine the midpoint, P, of L_1.

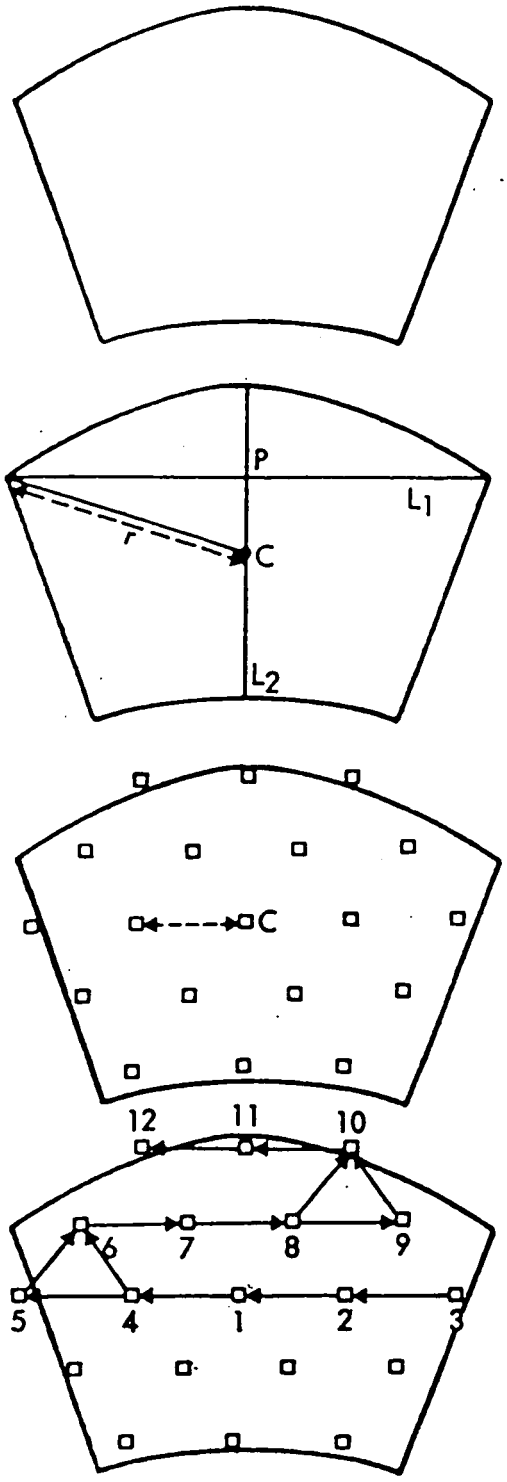
(c) Draw a second dimension, L_2, through P perpendicular to L_1.

(d) The midpoint, C, of L_2 is the required center.

(e) The distance from C to the extremes of L_1 is the required radius, r.

Figure 5 shows an example of the procedure; Figure 6 demonstrates how the center is determined for several spill shapes. Even if the center determined is slightly off, the sampling design will not be adversely affected.

246



(a) Original cleanup area

(b) Locating the center of the sampling circle

(c) Centering the hexagonal grid

(d) Staking out the grid points

Figure 5

217

Once the sampling radius, r, has been found, the sample size can be selected based on Table 4.

Example: Suppose r = 5 ft. From Table 4, a sample size of 19 should be used.

Having selected the sample size, the grid spacing can be calculated from Table 2.

Example (continued): For a 19-point design with radius r = 5, the grid spacing is s = 0.48r = (0.48)(5) = 2.4 ft.

The procedure for laying out a 19 point design is as follows. The first sampling location is the center C of the sampling circle, as shown in Figure 5. Next, draw a diameter through C and stake out locations 2 through 5 on it as shown; adjacent locations are a distance s apart. The orientation of the diameter (for example east-west) used is not important; it may be chosen at random or for the convenience of the samplers. The next 4 locations, Nos. 6-9, are laid out parallel to the first row, again a distance s apart. The only difficulty is in locating the starting point, No. 6, for this row. To accomplish this the sampler needs two pieces of rope (or surveyor's chain, or equivalent measuring device) of length s. Attach one piece of rope to the stake at each location 4 and 5. Draw the ropes taut horizontally until they touch at location 6. Once the second row is laid out, the third and final row of 3 locations in the top half of the design is found similarly, starting with number 10. In the same way, the bottom half of the design is staked out. The 7-point or 37-point designs are laid out in an analogous fashion.

Once the sampling locations are staked out the actual samples can be collected. In the example in Figure 5, three of the sampling locations fall outside the original cleanup area. Samples should be taken at these points, to detect contamination beyond the original cleanup boundaries. This verifies that the original spill boundaries were accurately assessed.

In practice, various obstacles may be encountered in laying out the sampling grid. Many "obstacles" can be handled by taking a different type of sample, e.g., if a fire hydrant is located at a point in a sampling grid otherwise consisting of soil samples, then a wipe sample should be taken at the hydrant, rather than taking a sample of nearby soil. The obstacle most likely to be encountered is a vertical surface such as a wall. To determine the sampling location on such a surface, draw taut the ropes (chains) of length s attached to two nearby stakes and find the point on the vertical surface where their common ends touch. See Figure 7 for an illustration of the procedure. If more samples from the vertical surface are called for, the same principle may be applied, always using the last two points located to find the next one.

3. Judgemental Sampling

The inspector or sampling crew may use best judgement to collect samples wherever residual PCB contamination is suspected. These samples are

218

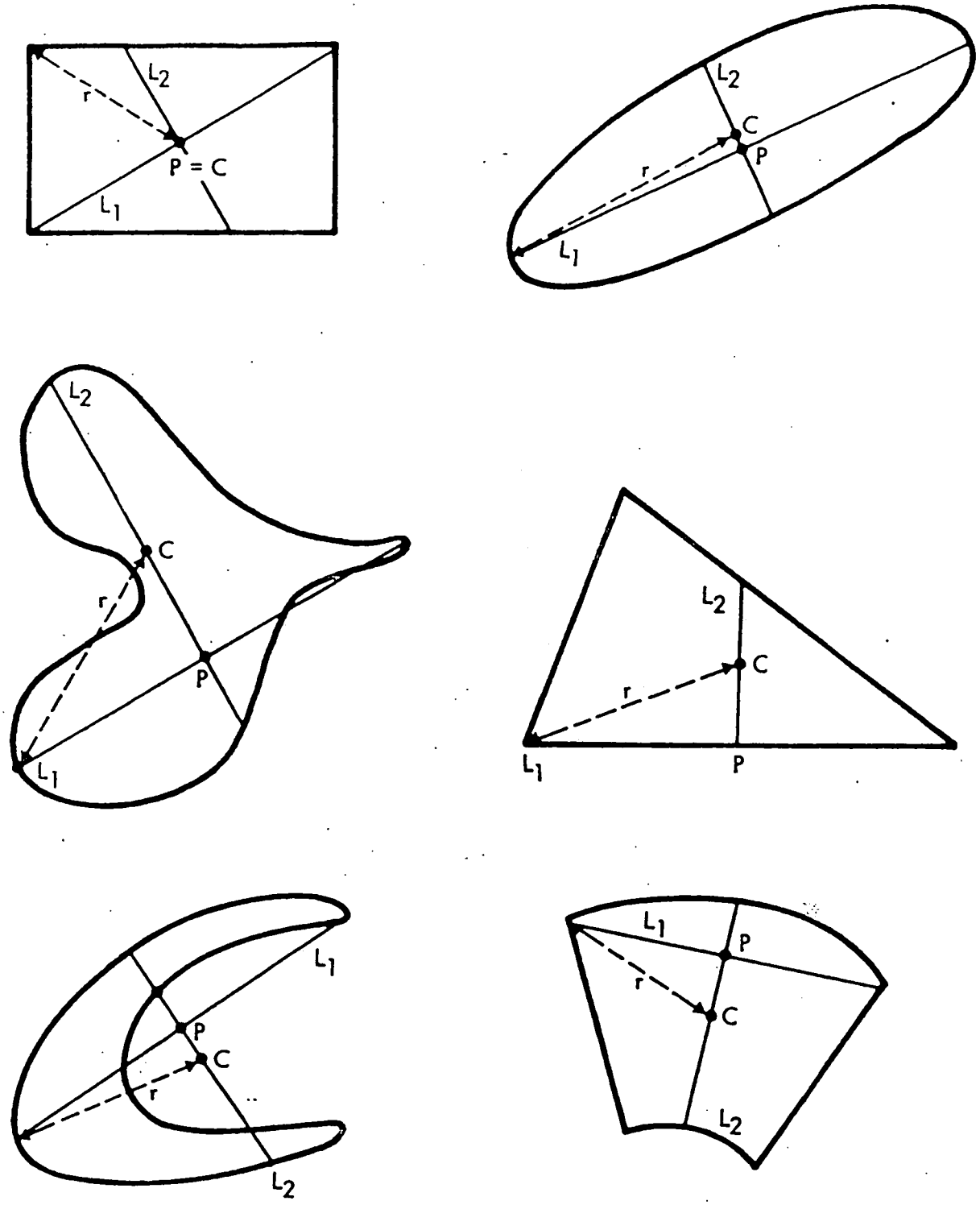


Figure 6. Locating the center and sampling circle radius of an irregularly shaped spill area.

219

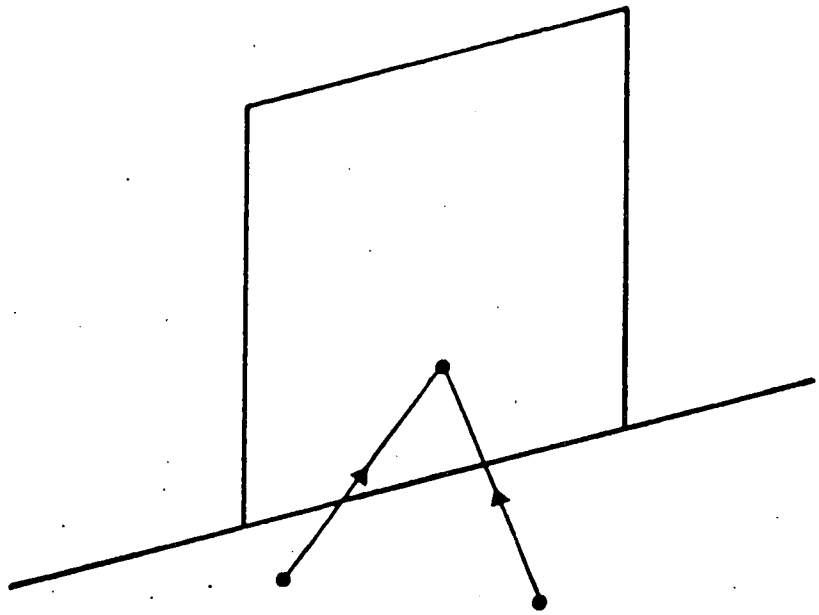


Figure 7. Location of a sampling point on a vertical surface.

220

in addition to those collected from the sampling grid. Examples of extra sampling points include suspicious stains outside the designated spill area, cracks or crevices, and any other area where the inspector suspects inadequate cleanup.

4. Compositing Strategy for Analysis of Samples

Once the samples have been collected at a site, the goal of the analysis effort is to determine whether at least one sample has a PCB concentration above the allowable limit. This sampling plan assumes the entire spill area will be recleaned if a single sample contaminated above the limit is found. Thus, it is not important to determine precisely which samples are contaminated or even exactly how many. This means that the cost of analysis can be substantially reduced by employing compositing strategies, in which groups of samples are thoroughly mixed and evaluated in a single analysis. If the PCB level in the composite is sufficiently high, one can conclude that a contaminated sample is present; if the level is low enough, all individual samples are clean. For intermediate levels, the samples from which the composite was constructed must be analyzed individually to make a determination. Thus, the number of analyses needed is greatly reduced in the presence of very high levels of contamination in a few samples or in the presence of very low levels in most samples.

For purposes of this discussion, assume that the maximum allowable PCB concentration in a single soil sample is 10 ppm. The calculations can easily be adapted for a different level or for different types of samples. Based on review of the available precision and accuracy data (Erickson 1985), method performance of 80% accuracy and 30% relative standard deviation should be attainable for soil concentrations above 1 ppm.

To protect against false positive findings due to analytical error, the measured PCB level in a single sample must exceed some cutoff greater than 10 ppm for a finding of contamination. Assume that a 0.5% false positive rate for a single sample is desired. As will be shown later, this single sample false positive rate controls the overall false positive rate of the sampling schemes to acceptable levels. Then, using standard statistical techniques, the cutoff level for a single sample is

$$(0.8)(10) + (2.576)(0.3)(0.8)(10) = 14.2 \text{ ppm},$$

where 0.8(80%) represents the accuracy of the analytical method, 10 ppm is the allowable limit for a single sample, 2.576 is a coefficient from the standard normal distribution, and 0.3(30%) is the relative standard deviation of the analytical method. Thus, if the measured level in a single sample is 14.2 ppm or greater, one can be 99.5% sure that the true level is 10 ppm or greater.

Now suppose that a composite of, say, 7 samples is analyzed. The true PCB level in the composite (assuming perfect mixing) is simply the average of the 7 levels of the individual samples. Let X ppm be the measured PCB level in the composite. If $X \leq (14.2/7) = 2.0$, then all 7 individual samples

221

are rated clean. If $X > 14.2$, then at least one individual sample must be above the 10 ppm limit. If $2.0 < X \leq 14.2$, no conclusion is possible based on analysis of the composite and the 7 samples must be analyzed individually to reach a decision. These results may be generalized to a composite of any arbitrary number of samples, subject to the limitations noted below.

The applicability of compositing is potentially limited by the size of the individual specimens and by the performance of the analytical method at low PCB levels. First, the individual specimens must be large enough so that the composite can be formed while leaving enough material for individual analyses if needed. For verification of PCB spill cleanup, adequacy of specimen sizes should not be a problem. The second limiting factor is the analytical method. Down to about 1 ppm, the performance of the stipulated analytical methods should not degrade markedly. Therefore, since the assumed permissible level is 10 ppm, no more than about 10 specimens should be composited at a time.

In compositing specimens, the location of the sampling points to be grouped should be taken into account. If a substantial residual area of contamination is present, then contaminated samples will be found close together. Thus, contiguous specimens should be composited, if feasible, in order to maximize the potential reduction in the number of analyses produced by the compositing strategy. Rather than describe a (very complicated) algorithm for choosing specimens to composite, we have graphically indicated some possible compositing strategies in Figures 8 Through 11. Based on the error probability calculations presented in Section 4 below, we recommend the compositing strategies indicated in Table 6. The recommended strategy for the 7-point design requires no explanation. The strategies for the 19- and 37-point cases are shown in Figures 9 and 11, respectively. The strategies shown in Figures 8 and 10 are used in Section 5 for comparison purposes. For details on the reduction in number of analyses expected to result (as compared to individual analyses), see the next Section, 5.

5. Calculations of Average Number of Analyses, and Error Probabilities

Estimates of expected number of analyses and probabilities of false positives (incorrectly deciding the site is contaminated above the limit), and false negatives (failure to detect residual contamination) were obtained for various scenarios. The calculations were performed by Monte Carlo simulation using 5,000 trials for each combination of sample size, compositing strategy, level, and extent of residual contamination. The computations were based on the following assumptions:

a. Only soil samples are involved. In practice other types of samples will often be obtained and analyzed. Although the results of this section are not directly applicable to such cases, they do indicate in general terms the type of accuracy obtainable and the potential cost savings from compositing.

222

A 2 GROUP COMPOSITING PLAN FOR 7 SAMPLE POINTS

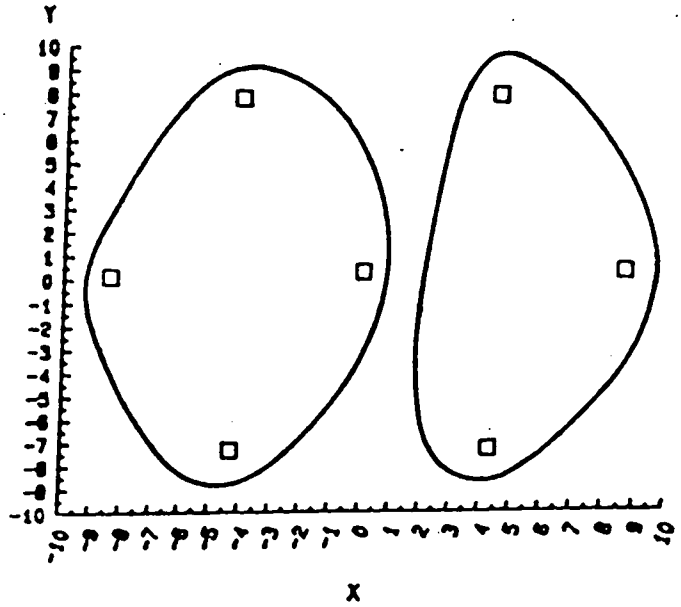


Figure 8

A 2 GROUP COMPOSITING PLAN FOR 19 SAMPLE POINTS

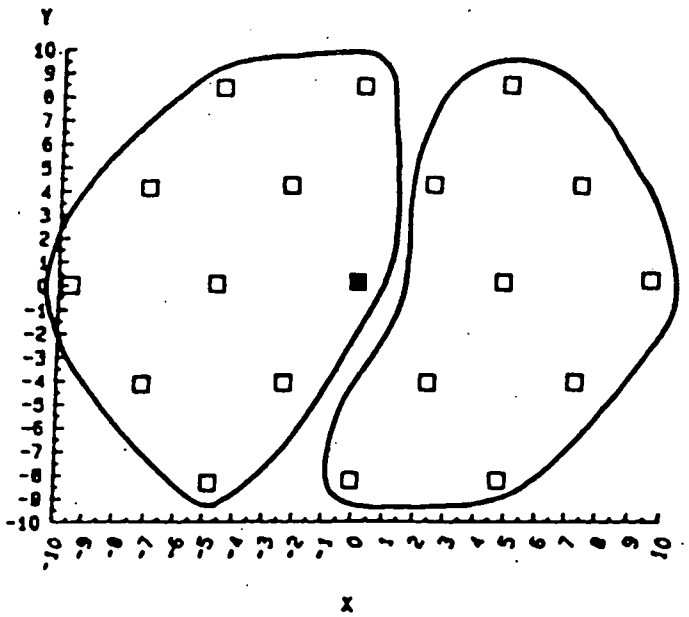


Figure 9

223

A 6 GROUP COMPOSITING PLAN FOR 19 SAMPLE POINTS

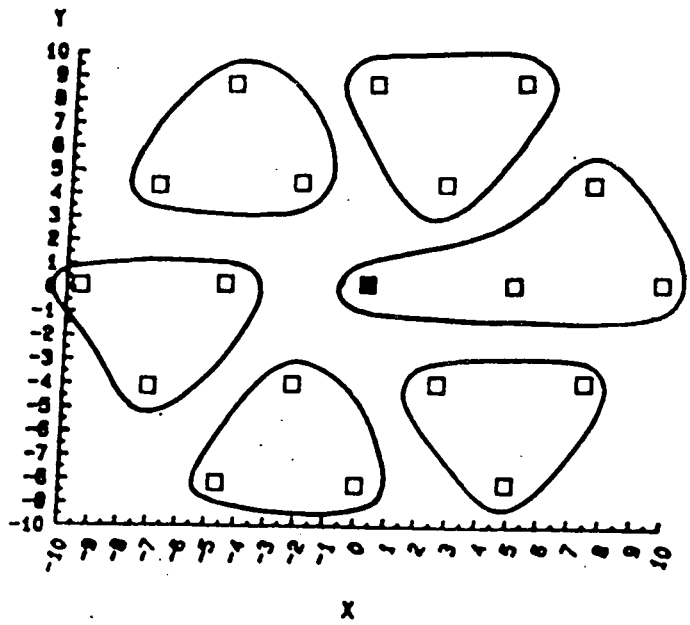


Figure 10. Location of sample points in a 19 sample point plan, with detail of a 2 group compositing design.

224

A 4 GROUP COMPOSITING PLAN FOR 37 SAMPLE POINTS

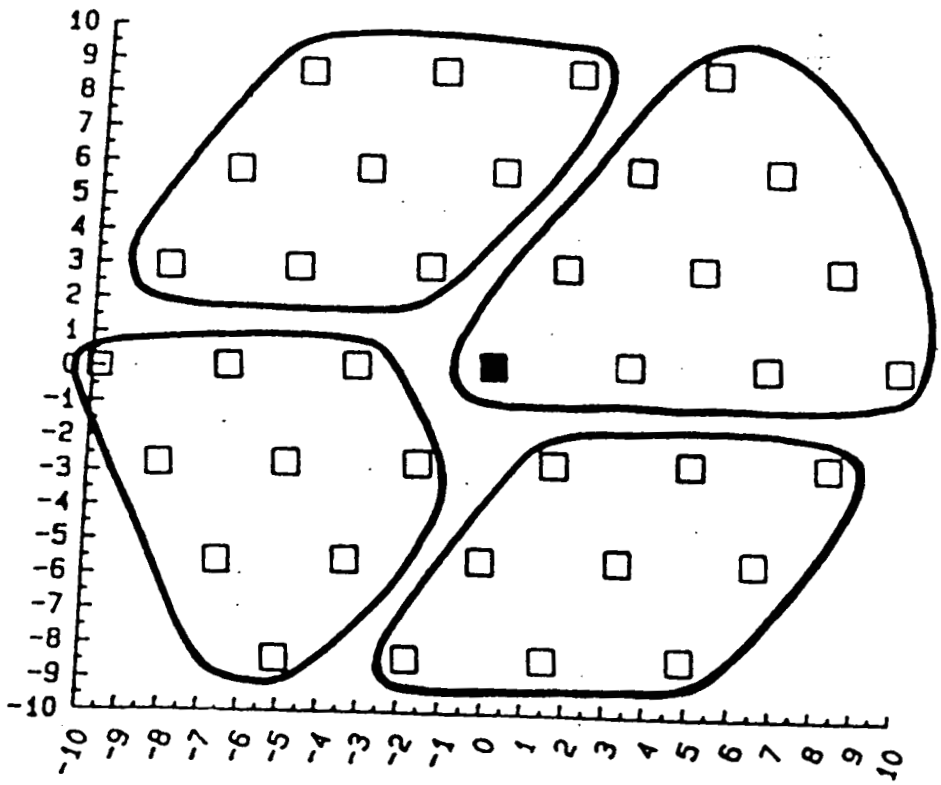


Figure 11. Location of sample points in 37 sample point plan, with detail of a 4 group compositing design.

225

Table 6. Recommended Compositing Strategies

No. of samples collected	Compositing strategy
7	One group of 7
19	One group of 10, one of 9
37	Three groups of 9, one of 10

b. If the true PCB level in a sample is C, then the measured value is a normally distributed random variable with mean 0.8C and standard deviation (0.3)(0.8C) = 0.24C. Thus, it is assumed that the analytical method is 80% accurate, with 30% relative standard deviation.

c. The maximum allowable level in a single sample is 10 ppm. However, the measured level for a single sample must exceed 14.2 ppm for a finding of noncompliance. As previously discussed, this corresponds to a single-sample false positive rate of 0.5%.

d. The residual contamination present is modeled as a randomly placed circle of variable radius and contamination level. The PCB level is assumed to be uniform within the randomly-placed circle and zero outside it.

e. Analysis of samples is terminated as soon as a positive result is obtained on a single analysis. If a composite does not give a definitive result (positive or negative), the individual specimens from which the composite was formed are analyzed in sequence before any other composite.

f. The compositing strategies used are shown in Figures 8 and 11.

226

The results of the computations are shown in Tables 7 through 20. Tables 7 through 12 show the performance of the compositing strategies recommended in Section 3. For each strategy, there is a pair of tables. The first table shows the probability of reporting a violation of a 10 ppm cleanup standard, for different levels of residual contamination and percent of cleanup area contaminated. When the contamination level is 10 ppm or less, the number in the table is the probability of a false positive, i.e., a false finding of noncompliance. These probabilities are all very low, as they should be. When the level is above 10 ppm, the number in the table is the probability that a violation will be detected by the sampling design. For levels close to 10 ppm, and for small percentages of cleanup area residually contaminated, the detection probability is low. When the level is high and the percent of area contaminated is large, however, detection probability approaches 100%. For small areas with high contamination, detection capability is modest. This is because there is only a small chance that the contaminated area will be sampled. Similarly, detection capability is also modest for large areas contaminated near the 10 ppm limit. The reason for this is that, even though a number of contaminated samples will be found in such cases, the analytical method is not likely to give positive identification of levels near the 10 ppm cutoff. This is the price paid for reducing the single-sample false positive rate to 0.5%.

The second table for each compositing strategy shows the expected (average) number of analyses needed to reach a decision. For a fixed percent of area contaminated, the smallest number of analyses is needed if the level of contamination is very high or very low. For intermediate levels, more analyses are needed. The largest number of analyses are required with a large area contaminated at close to 10 ppm. In such a situation, the levels of the composite(s) will mostly lie in the intermediate range for which no conclusion is possible based on analysis of the composite. Thus, individual analyses will almost always be required, so that the advantage of compositing is lost.

Tables 13 through 20 compare the recommended compositing strategies for the 7-point and 19-point designs to alternative compositing strategies for these designs, for 4 different contaminated percentages (1%, 9%, 25%, and 49%). The comparison is based on the expected number of analyses required. Overall detection capabilities are comparable for the different strategies. The tables show that the recommended strategies are best, except for larger areas contaminated close to the 10 ppm level.

227

Table 7. Probability of Declaring a Violation of a 10 ppm Cleanup Standard, for the 7 Point, 1 Composite Design[a]

Level of residual PCB contamination (ppm)		Percent of cleanup area with residual PCB contamination					
		1	4	9	16	25	49
Compliant	8	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	10	< 0.001	< 0.001	< 0.001	< 0.001	0.002	0.007
Noncompliant	11	< 0.001	< 0.001	< 0.001	< 0.001	0.009	0.032
	12	< 0.001	0.001	0.001	0.002	0.017	0.092
	13	0.001	0.005	0.005	0.009	0.045	0.184
	14	0.003	0.010	0.019	0.028	0.085	0.298
	15	0.006	0.016	0.039	0.065	0.134	0.396
	16	0.009	0.029	0.064	0.102	0.202	0.517
	18	0.019	0.074	0.137	0.218	0.344	0.655
	20	0.030	0.110	0.199	0.335	0.479	0.787
	25	0.048	0.186	0.342	0.554	0.736	0.905
	50	0.070	0.245	0.487	0.767	0.977	0.989
	75	0.071	0.245	0.496	0.787	0.992	0.995
	100	0.068	0.255	0.499	0.800	0.995	0.997
	150	0.070	0.246	0.481	0.796	0.998	0.999
	200	0.073	0.254	0.489	0.806	> 0.999	> 0.999
	300	0.069	0.257	0.494	0.792	> 0.999	> 0.999
	500	0.070	0.242	0.492	0.811	> 0.999	> 0.999

[a]Seven samples analyzed first as a composite, then individually if necessary to reach a decision.

228

Table 8. Expected Number of Analyses to Decide Compliance or Violation, for a 10 ppm Cleanup Standard, for the 7-Point, 1-Composite Design[a]

Level of residual PCB contamination (ppm)		Percent of cleanup area with residual PCB contamination					
		1	4	9	16	25	49
Compliant	4	1.00	1.00	1.00	1.00	1.00	1.11
	6	1.00	1.00	1.00	1.00	1.06	2.31
	8	1.00	1.00	1.00	1.00	1.44	3.96
	10	1.00	1.01	1.02	1.03	1.75	4.96
Noncompliant	11	1.01	1.04	1.05	1.11	2.01	5.31
	12	1.04	1.08	1.17	1.32	2.21	5.39
	13	1.04	1.18	1.40	1.59	2.56	5.35
	14	1.10	1.32	1.63	2.02	2.86	5.18
	15	1.13	1.45	1.85	2.35	3.22	4.90
	16	1.15	1.52	2.03	2.67	3.50	4.71
	18	1.19	1.69	2.41	3.18	3.95	4.36
	20	1.24	1.85	2.57	3.59	4.19	4.04
	25	1.26	1.98	2.85	3.84	4.47	3.61
	50	1.28	1.96	2.93	3.99	4.45	2.96
	75	1.28	1.94	2.93	3.98	4.23	2.26
	100	1.21	1.79	2.53	3.45	3.54	1.87
	150	1.09	1.28	1.52	1.86	1.89	1.30
	200	1.03	1.11	1.15	1.34	1.33	1.13
	300	1.01	1.01	1.04	1.09	1.06	1.03
	500	1.00	1.00	1.01	1.02	1.02	1.01

[a]Seven samples analyzed first as a composite, then individually if necessary to reach a decision.

229

Table 9. Probability of Declaring a Violation of a 10 ppm Cleanup Standard, for the 19 Point, 2 Composite Design[a]

Level of residual PCB contamination (ppm)		Percent of cleanup area with residual PCB contamination					
		1	4	9	16	25	49
Compliant	8	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	10	< 0.001	< 0.001	0.002	0.007	0.015	0.028
Noncompliant	11	< 0.001	< 0.001	0.007	0.034	0.058	0.017
	12	0.001	0.002	0.029	0.084	0.153	0.281
	13	0.003	0.007	0.062	0.179	0.304	0.497
	14	0.005	0.021	0.114	0.304	0.455	0.693
	15	0.012	0.052	0.178	0.407	0.606	0.832
	16	0.025	0.083	0.264	0.518	0.744	0.908
	18	0.046	0.167	0.421	0.698	0.883	0.978
	20	0.077	0.263	0.556	0.812	0.945	0.993
	25	0.125	0.461	0.784	0.923	0.990	0.999
	50	0.161	0.631	0.978	0.992	0.999	> 0.999
	75	0.171	0.651	0.993	0.997	> 0.999	> 0.999
	100	0.168	0.642	0.994	0.999	> 0.999	> 0.999
	150	0.166	0.657	0.998	0.999	> 0.999	> 0.999
	200	0.175	0.648	0.999	0.999	> 0.999	> 0.999
	300	0.168	0.654	0.999	> 0.999	> 0.999	> 0.999
	500	0.180	0.661	0.999	> 0.999	> 0.999	> 0.999

[a]Nineteen samples analyzed first as two composites, then individually if necessary to reach a decision.

230

Table 10. Expected Number of Analyses to Decide Compliance or Violation, for a 10 ppm Cleanup Standard, for the 19-Point, 2-Composite Design[a]

Level of residual PCB contamination (ppm)		Percent of cleanup area with residual PCB contamination					
		1	4	9	16	25	49
Compliant	4	2.00	2.00	2.00	2.18	3.30	7.49
	6	2.00	2.00	2.00	3.79	6.70	11.22
	8	2.00	2.00	3.01	6.15	9.20	13.18
	10	2.01	2.03	3.72	7.46	10.55	14.02
Noncompliant	11	2.03	2.14	4.07	7.90	10.74	13.81
	12	2.10	2.32	4.57	8.08	10.67	12.78
	13	2.21	2.74	4.84	7.94	9.95	11.00
	14	2.25	3.02	5.16	7.90	9.31	9.27
	15	2.37	3.40	5.50	7.65	8.42	7.80
	16	2.49	3.84	5.89	7.30	7.59	6.63
	18	2.60	4.36	6.11	6.57	6.29	5.02
	20	2.68	4.65	6.26	6.18	5.48	4.25
	25	2.82	5.02	6.20	5.45	4.57	3.36
	50	2.80	5.03	5.96	4.70	3.48	2.28
	75	2.80	5.05	5.69	3.68	2.63	1.84
	100	2.77	4.95	5.37	3.46	2.26	1.69
	150	2.53	3.94	3.99	2.59	1.80	1.46
	200	2.21	2.67	2.61	1.91	1.55	1.33
	300	1.99	1.89	1.70	1.50	1.34	1.19
	500	1.92	1.69	1.48	1.39	1.30	1.16

[a]Nineteen samples analyzed first as two composites, then individually if necessary to reach a decision.

231

Table 11. Probability of Declaring a Violation of a 10 ppm Cleanup Standard, for the 37 Point, 4 Composite Design[a]

Level of residual PCB contamination (ppm)		Percent of cleanup area with residual PCB contamination					
		1	4	9	16	25	49
Compliant	8	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	10	< 0.001	0.002	0.010	0.022	0.031	0.060
Noncompliant	11	0.001	0.008	0.041	0.084	0.124	0.225
	12	0.001	0.024	0.103	0.217	0.305	0.488
	13	0.005	0.053	0.224	0.388	0.536	0.751
	14	0.012	0.094	0.360	0.575	0.726	0.908
	15	0.023	0.159	0.501	0.740	0.859	0.950
	16	0.039	0.242	0.621	0.831	0.936	0.991
	18	0.091	0.390	0.785	0.940	0.985	> 0.999
	20	0.147	0.542	0.884	0.981	0.996	> 0.999
	25	0.249	0.771	0.958	0.995	0.999	> 0.999
	50	0.340	0.976	0.997	0.999	0.999	> 0.999
	75	0.343	0.991	0.999	0.999	> 0.999	> 0.999
	100	0.353	0.993	0.999	> 0.999	> 0.999	> 0.999
	150	0.339	0.997	> 0.999	> 0.999	> 0.999	> 0.999
	200	0.357	0.996	> 0.999	> 0.999	> 0.999	> 0.999
	300	0.344	0.997	> 0.999	> 0.999	> 0.999	> 0.999
	500	0.348	0.999	> 0.999	> 0.999	> 0.999	> 0.999

[a]Thirty-seven samples analyzed first as four composites, then individually if necessary to reach a decision.

232

Table 12. Expected Number of Analyses to Decide Compliance or Violation, for a 10 ppm Cleanup Standard, for the 37-Point, 4-Composite Design[a]

Level of residual PCB contamination (ppm)		Percent of cleanup area with residual PCB contamination					
		1	4	9	16	25	49
Compliant	4	4.00	4.01	4.41	6.72	9.85	15.69
	6	4.00	4.15	6.66	10.22	13.48	19.36
	8	4.00	4.77	9.01	12.76	15.98	22.08
	10	4.02	5.36	10.56	14.29	17.18	23.04
Noncompliant	11	4.07	5.69	10.87	14.29	16.93	21.28
	12	4.18	5.97	10.94	13.74	15.68	17.84
	13	4.35	6.28	10.56	12.74	13.44	13.54
	14	4.57	6.78	10.21	11.21	11.13	10.10
	15	4.73	7.04	9.60	9.71	9.33	7.78
	16	4.90	7.33	9.08	8.77	7.83	6.12
	18	5.09	7.59	8.02	7.05	6.16	4.71
	20	5.26	7.74	7.28	6.26	5.30	3.96
	25	5.34	7.55	6.53	5.28	4.37	3.08
	50	5.27	7.14	5.39	3.78	3.06	2.16
	75	5.23	6.84	4.31	3.04	2.55	1.90
	100	5.22	6.43	3.73	2.64	2.32	1.73
	150	4.55	4.89	3.02	2.37	2.07	1.57
	200	3.95	3.57	2.53	2.15	1.90	1.52
	300	3.59	2.67	2.28	2.04	1.81	1.44
	500	3.49	2.48	2.22	1.99	1.79	1.44

[a]Thirty-seven samples analyzed first as four composites, then individually if necessary to reach a decision.

233

Table 13. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 7-Point Design, When an Area 1% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		1 Composite	2 Composites	Individually
Compliant	4	1.00	2.00	7.00
	8	1.00	2.00	7.00
	10	1.00	2.00	7.00
Noncompliant	12	1.04	2.02	6.98
	14	1.10	2.05	6.96
	16	1.15	2.07	6.92
	20	1.24	2.10	6.88
	25	1.26	2.11	6.84
	50	1.28	2.09	6.80
	100	1.21	1.98	6.78
	200	1.03	1.96	6.80
	500	1.00	1.96	6.81

Table 14. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 7-Point Design, When an Area 9% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		1 Composite	2 Composites	Individually
Compliant	4	1.00	2.00	7.00
	8	1.00	2.00	7.00
	10	1.02	2.01	6.99
Noncompliant	12	1.17	2.09	6.91
	14	1.63	2.32	6.69
	16	2.03	2.50	6.49
	20	2.57	2.77	6.06
	25	2.85	2.79	5.65
	50	2.93	2.60	5.45
	100	2.53	1.85	5.46
	200	1.15	1.72	5.45
	500	1.01	1.17	5.45

234

Table 15. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 7-Point Design, When an Area 25% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		1 Composite	2 Composites	Individually
Compliant	4	1.00	2.00	7.00
	8	1.44	2.13	7.00
	10	1.71	2.24	6.98
Noncompliant	12	2.21	2.44	6.81
	14	2.86	2.84	6.29
	16	3.50	3.23	5.64
	20	4.19	3.54	4.68
	25	4.47	3.56	4.12
	50	4.45	2.97	3.58
	100	3.54	1.61	3.51
	200	1.33	1.38	3.50
	500	1.02	1.37	3.50

Table 16. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 7-Point Design, When an Area 49% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		1 Composite	2 Composites	Individually
Compliant	4	1.11	2.02	7.00
	8	3.96	2.99	7.00
	10	4.96	3.50	6.96
Noncompliant	12	5.39	3.81	6.61
	14	5.18	3.94	5.79
	16	4.71	3.86	4.82
	20	4.04	3.49	3.53
	25	3.61	3.03	2.87
	50	2.96	2.22	2.40
	100	1.87	1.36	2.40
	200	1.13	1.23	2.39
	500	1.01	1.20	2.39

235

Table 17. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 19-Point Design, When an Area 1% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		2 Composites	6 Composites	Individually
Compliant	4	2.00	6.00	19.00
	8	2.00	6.00	19.00
	10	2.01	6.00	19.00
Noncompliant	12	2.10	6.03	18.93
	14	2.25	6.07	18.74
	16	2.49	6.11	18.46
	20	2.68	6.07	18.06
	25	2.82	6.01	17.75
	50	2.80	5.80	17.49
	100	2.77	5.56	17.46
	200	2.21	5.53	17.46
	500	1.92	5.57	17.46

Table 18. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 19-Point Design, When an Area 9% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		2 Composites	6 Composites	Individually
Compliant	4	2.00	6.00	19.00
	8	3.01	6.19	19.00
	10	3.72	6.32	18.96
Noncompliant	12	4.57	6.54	18.40
	14	5.16	6.74	16.90
	16	5.89	6.83	14.86
	20	6.26	6.33	11.89
	25	6.20	5.74	10.22
	50	5.96	4.45	8.94
	100	5.37	3.34	8.64
	200	2.61	3.17	8.63
	500	1.48	3.17	8.62

236

Table 19. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 19-Point Design, When an Area 25% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		2 Composites	6 Composites	Individually
Compliant	4	3.30	6.07	19.00
	8	9.20	7.73	19.00
	10	10.55	8.44	18.83
Noncompliant	12	10.67	8.47	17.31
	14	9.31	7.67	13.72
	16	7.59	6.57	10.58
	20	5.48	5.09	6.25
	25	4.57	4.24	4.35
	50	3.48	3.22	3.34
	100	2.26	2.51	3.29
	200	1.55	2.41	3.26
	500	1.30	2.43	3.23

Table 20. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 19-Point Design, When an Area 49% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		2 Composites	6 Composites	Individually
Compliant	4	7.49	6.28	19.00
	8	13.18	9.85	19.00
	10	14.02	10.84	18.73
Noncompliant	12	12.78	10.10	16.15
	14	9.27	7.78	11.34
	16	6.63	5.87	7.14
	20	4.25	3.92	3.74
	25	3.36	3.23	2.61
	50	2.28	2.46	2.10
	100	1.69	1.85	2.06
	200	1.33	1.79	2.04
	500	1.16	1.78	2.02

237

The major conclusions that can be drawn from these results are as follows. First, the proposed cutoff on the measured PCB level for a finding of noncompliance for a single sample, 14.2 ppm, is successful in controlling the overall false positive rate of the sampling scheme. For example, when an area half the size of the entire site remains contaminated just at the allowable limit of 10 ppm, the false positive rate is 1% for the 7-point design, 3% for the 19-point design, and 6% for the 37-point design. Note, that the overall false-positive rate is highest for contamination just at the allowable limit. Second, the detection capabilities of the design appear satisfactory, bearing in mind the difficulty of detecting randomly-located contamination by any sampling scheme without exhaustive sampling. As an example, the proposed 19-point design can detect 50 ppm contamination present in 9% of the cleanup area with 98% probability. Similarly, the 19-point design can detect 20 ppm contamination present in 25% of the area with 95% probability. Third, the proposed compositing strategies are quite effective in reducing the number of analyses needed to reach a decision in all cases except those involving large areas contaminated near the cutoff of 10 ppm. For example, for contaminated levels of 25 ppm or greater, the expected number of analyses to reach a decision never exceeds 5 for the 7-point design, or 7 for the 19-point design, or 8 for the 37-point design. Larger number of analyses are needed in cases of contamination close to the allowable limit of 10 ppm, up to 23 for the 37-point design when 49% of the area is contaminated at 10 ppm.

B. Sampling Techniques

The types of media to be sampled will include soil, water, vegetation and solid surfaces (concrete, asphalt, wood, etc.). General sampling methods are described below. Additional sampling guidance documents are available (Mason 1982, USWAG 1984).

1. Solids Sampling

When soil, sand, or sediment samples are to be taken, a surface scrape samples should be collected. Using a 10 cm x 10 cm (100 cm^2) template to mark the area to be sampled, the surface should be scraped to a depth of 1 cm with a stainless steel trowel or similar implement. This should yield at least 100 g soil. If more sample is required, expand the area but do not sample deeper. Use a disposable template or thoroughly clean the template between samples to prevent contamination of subsequent samples. The sample should be scraped directly into a precleaned glass bottle. If it is free-flowing, the sample should be thoroughly homogenized by tumbling. If not, successive subdivision in a stainless steel bowl should be used to create a representative subsample.

In some cases, such as sod, scrape samples may not be appropriate. For these cases, core samples, not more than 5 cm deep, should be taken using a soil coring device. These core samples should be well-homogenized in a stainless steel bowl by successive subdivision. A portion of each sample should then be removed, weighed and analyzed.

Samples should be stored in the dark at 4°C in precleaned glass bottles. If samples are to be analyzed quickly, the storage requirements may be relaxed as long as sample integrity is maintained. Before collection of

238

verification samples, this equipment must be used to generate a field blank as described in Section IV.E.

2. Water Sampling

a. Surface Sampling

If PCBs dissolved in a hydrocarbon oil were spilled, they will most likely be dispersed on the surface. Therefore, a surface water collection technique should be used. Surface water samples should be collected by grab techniques. Where appropriate, the precleaned glass sample bottle may be dipped directly into the body of water at the designated sample collection point. A sample is collected from the water surface by gently lowering a precleaned sample bottle horizontally into the water until water begins to run into it. The bottle is then slowly turned upright keeping the lip just under the surface so that the entire sample is collected from the surface.

b. Subsurface Sampling

If the PCBs were in an Askarel or other heavier-than-water matrix, the PCBs will sink. In these cases water near the bottom should be collected. To collect subsurface water, the bottle should be lowered to the specified depth with the cap on. The cap is then removed, the bottle allowed to fill, and the bottle brought to the surface.

c. Other Sampling Approaches

When the above approaches are not feasible, other dippers, tubes, siphons, pumps, etc., may be used to transfer the water to the sample bottle. The sampling system should be of stainless steel, Teflon, or other inert, impervious, and noncontaminating material. Before collection of samples, this equipment must be used to generate a field blank as described in Section IV.E.

d. Sample Preservation

The bottle is then lifted out of the water, capped with a PTFE- or foil-lined lid, identified with a sample number, and stored at approximately 4°C (USEPA 1984a) until analysis to retard bacterial growth. If samples are to be analyzed quickly, the storage requirements may be relaxed as long as sample integrity is maintained.

3. Surface Sampling

a. Wipe Samples

If the surface to be sampled is smooth and impervious (e.g., rain gutters, aluminum house siding), a wipe sample should indicate whether the cleanup has sufficiently removed the PCBs. These surfaces should be sampled by first applying an appropriate solvent (e.g., hexane) to a piece of 11 cm filter paper (e.g., Whatman 40 ashless, Whatman "50" smear tabs, or equivalent) or gauze pad. This moistened filter paper or gauze pad is held with a pair of stainless steel forceps and used to thoroughly swab a 100-cm^2 area as measured by a sampling template.

239

Care must be taken to assure proper use of a sampling template. Different templates may be used for the variously shaped areas which must be sampled. A 100 cm^2 area may be a 10 cm x 10 cm square, a rectangle (e.g., 1 cm x 100 cm or 5 cm x 20 cm), or any other shape. The use of a template assists the sampler in the collection of a 100 cm^2 sample and in the selection of representative sampling sites. When a template is used it must be thoroughly cleaned between samples to prevent contamination of subsequent samples by the template.

The wipe samples should be stored in precleaned glass jars at 4°C. Before collection of verification samples, the selected filter paper or gauze pad and solvent should be used to generate a field blank as described in Section IV.E.

b. Sampling Porous Surfaces

Wipe sampling is inappropriate for surfaces which are porous and would absorb PCBs. These include wood and asphalt. Where possible, a discrete object (e.g., a paving brick) may be removed. Otherwise, chisels, drills, saws, etc., may be used to remove a sufficient sample for analysis. Samples less than 1 cm deep on the surface most likely to be contaminated with PCBs should be collected.

4. Vegetation Sampling

The sample design or visual inspection may indicate that samples of vegetation (such as leaves, bushes, and flowers) are required. In this case, samples may be taken with pruning shears, a saw, or other suitable tool and placed in a precleaned glass bottle.

C. Analytical Techniques

A number of analytical techniques have been used for analysis of PCBs in the types of samples which may be associated with PCB spills. Some of the candidate analytical methods are listed in Table 21. The analysis method(s) most appropriate for a given spill will depend upon a number of factors. These include sensitivity required, precision and accuracy required, potential interferents, ultimate use of the data, experience of the analyst, availability of laboratory equipment, and number of samples to be analyzed.

As shown in Table 21, many analytical methods are available. The general analytical techniques are discussed and then compared below.

1. Gas Chromatography (GC)

As can be seen in Table 21, analysis of PCBs by gas chromatography is frequently the method of choice. PCBs are chromatographed using either packed or capillary columns and may be detected using either specific detectors or mass spectrometry. A comprehensive method for analysis of PCBs in transformer fluid and waste oils was developed by Bellar and Lichtenberg (1982). This method describes six different cleanup techniques, recommends three GC detectors, and suggests procedures for GC calibration and for measurement of precision and accuracy. This method also discusses several calculation methods.

Table 21. Standard Procedures of Analysis for PCDs

Procedure designation	Matrix	Extraction	Cleanup[c]	Determination method	Qualitative assessment	Quantitation method	LOD	QC discussed	Reference
D3534-80	Water	Hexane/CH_2Cl_2	(Florisil) (Silica Gel)	PGC/ECD[d]	No	Total area or Webb-McCall	0.1 μg/L	No	ASTM, 1981a
608	Water	CH_2Cl_2	(Florisil) (S removal)	PGC/ECD	No	Area	0.04-0.15 μg/L	Yes	EPA, 1984a; Longbottom and Lichtenberg, 1982
625	Water	CH_2Cl_2	None	PGC/EIMS (CGC)	Yes	Area	30-36 μg/L	Yes	EPA, 1984b; Longbottom and Lichtenberg, 1982
304h	Water	Hexane/ CH_2Cl_2 (85/15)	Florisil/ silica gel (CH_3CN) (S removal)	PGC/ECD or HECD	Yes	Summed areas or Webb-McCall	NS	Yes	EPA, 1978
EPA (by-products)	Water	Several	Several	HRGC/EIMS	Yes	Ind. peaks	NS	Yes	Erickson et al., 1982, 1983d; EPA, 1984c
ANSI	Water	Hexane	(H_2SO_4) (Saponification) Alumina	PGC/ECD	No	Single peak or summed peaks	2 ppm	Yes	ANSI, 1974
Monsanto	Water	Hexane	Alumina	PGC/ECD	No	Individual or total peak heights	2 ppb	No	Moein, 1976
UK-DOE	Water	Hexane	Silica gel	PGC/ECD	No	NS	106 ng/L	No	UK-DOE, 1979; Devenish and Harling-Bowen, 1980
D3304-74	Air Water Soil, sediment	DI Hexane H_2O/CH_3CN	(H_2SO_4) (Saponification) (Alumina)	PGC/ECD	No	Total area	NS	Yes	ASTM, 1981b
EPA (homolog)	Solids and liquids	Several	Several	HRGC/EIMS	Yes	Ind. peaks	NS	Yes	Erickson et al., 1985a
EPA 625-S	Sludge	CH_2Cl_2	Florisil, Silica gel, or GPC	HRGC/EIMS or PGC/EIMS	Yes	Area	NS	Yes	Haile and Lopez-Avila, 1984

Table 21 (Continued)

Procedure designation	Matrix	Extraction	Cleanup[c]	Determination method	Qualitative assessment	Quantitation method	LOD	QC discussed	Reference
EPA (Halocarbon)	Sludge	Hexane/ CH_2Cl_2/ acetone (83/15/2)	GPC S removal	PGC/ECD	Yes	Peak area or peak height	NS	Yes	Rodriguez et al., 1980
Priority Pollutant	Sludge	CH_2Cl_2 (base/ neutral and acid fractions)	GPC	PGC/EIMS	Yes	NS	NS	Yes	EPA, 1979c
8100	Sludge	CH_2Cl_2 (3 fractions)	GPC Silica gel	HRGC/EIMS or PGC/EIMS	Yes	NS	NS	Yes	Ballinger, 1978
8080	Solid waste	CH_2Cl_2	(Florisil)	PGC/ECD	No	Area	1 μg/g	Yes	EPA, 1982e
8250	Solid waste	CH_2Cl_2	None	PGC/EIMS	No	NS	1 μg/g	Yes	EPA, 1982e
8270	Solid waste	$CHCl_2$	None	CGC/EIMS	No	NS	1 μg/g	Yes	EPA, 1982e
EPA (spills)	Unspecified	Hexane/ acetone	(CH_3CN) (Florisil) (Silica gel) (Mercury)	PGC/ECD	No	Total area or Webb-McCall	NS	No	Beard and Schaum, 1978
EPA	Soil and Sediment	Acetone/ Hexane	Florisil Silica gel (S removal)	PGC/ECD	No	Computer	NS	Yes	EPA, 1982d
Monsanto	Sediment	CH_3CN	Saponification H_2SO_4 Alumina	PGC/ECD	No	Individual or total peak heights	2 ppb	No	Moein, 1976
ANSI	Sediment, soil	CH_3CN	Saponification H_2SO_4 Alumina	PGC/ECD	No	Single peak or summed peaks	2 ppm	Yes	ANSI, 1974
EPA (by-products)	Air collected on Florisil or XAD-2	Hexane	(H_2SO_4) (Florisil)	HRGC/EIMS	Yes	Ind. peaks	NS	Yes	Erickson et al., 1982, 1983d; Erickson, 1984b
EPA (ambient air)	Air near hazardous waste sites collected on PUF	Hexane/ ether	Alumina	PGC/ECD	No	Total area or peak height	10-50 ng/m³	No	Lewis, 1982

Table 21 (Continued)

Procedure designation	Matrix	Extraction	Cleanup[c]	Determination method	Qualitative assessment	Quantitation method	LOD	QC discussed	Reference
EPA (stack)	Incinerator emissions and ambient air collected on Florisil	Hexane	(H_2SO_4)	Perchlorination PGC/ECD	No	Area	10 ng	No	Haile and Baladi, 1977; Beard and Schaum, 1978
EPA	Combustion sources collected on Florisil	Pentane or CH_2Cl_2	(Florisil/ silica gel)	PGC/MS	Yes	Area/homolog	0.1 ng/inj	No	Levins et al., 1979
EPA (incinerators)	Stack gas	Pentane/ methanol		PGC/MS	Yes	Single peak	NS	Yes	Beard and Schaum, 1978
ANSI	Air (toluene impinger)	-	(H_2SO_4) (Saponification) (Alumina)	PGC/ECD	No	Single peak	2 ppb	Yes	ANSI, 1974
NIOSH (P&CAM 244)	Air collected on Florisil	Hexane	None	PGC/ECD	No	Peak height or area from standard curve or Webb-McCall	0.01 mg/m³	No	NIOSH, 1977a
NIOSH (P&CAM 753)	Air collected on Florisil	Hexane	None	PGC/ECD Perchlorination	No	Peak height or area from standard curve	0.01 mg/m³	No	NIOSH, 1977b,c
EPA (gas)	Natural gas sampled with Florisil	Hexane	H_2SO_4	PGC/ECD		Total area, peak height or Webb-McCall (Perchlorination)	0.1-2 μg/m³	No	Harris et al., 1981
EPA [5,A,(3)]	Blood	Hexane	(Florisil)	PGC/ECD	No	NS	NS	No	Watts, 1980
EPA [5,A,(1)]	Adipose	Pet. ether/ CH_3CN	Florisil	PGC/ECD	No	NS	NS	Yes	Watts, 1980
EPA (9,D)	Adipose	Pet. ether/ CH_3CN	Saponification Florisil	TLC	No	Semiquant.	10 ppm	No	Watts, 1980
EPA (9,B)	Milk	Acetone/ hexane	CH_3CN Florisil Silica acid	PGC/ECD	Yes	Ind. peaks	50 ppb	Yes	Watts, 1980 Sherma, 1981

Table 21 (Continued)

Procedure designation	Matrix	Extraction	Cleanup[c]	Determination method	Qualitative assessment	Quantitation method	LOD	QC discussed	Reference
AOAC (29)	Food	CH_3CN/Pet. ether	Florisil MgO/ Celite Saponification	PGC/ECD	No	Total area or Ind. peaks	NS[a]	No	AOAC, 1980a
Japan	Food	Pet. ether/ CH_3CN	Silica gel Saponification (Florisil)	PGC/ECD	Yes	Summed areas perchlorination	NS	No	Tanabe, 1976
PAM	Food	Pet. ether/ CH_3CN	Silicic acid (Saponification) (Oxidation) (Florisil)	PGC/ECD (PGC/HECD) (NP-TLC) (RP-TLC)	No	Area	NS	No	FDA, 1977
AOAC (29)	Paper and paperboard	Saponification	Florisil MgO/ Celite Saponification	PGC/ECD	No	Total area or Ind. peaks	NS[a]	No	AOAC, 1980b
D3303-74	Capacitor Askarels	DI[b]	None	SCOT HRGC/FID	No	Total area	2.8×10^{-8} mol/L	No	ASTM, 1980a
D4059-83	Mineral oil	Dilute with hexane or isooctane	Florisil slurry (H_2SO_4) (Florisil column)	PGC/ECD (PGC/HECD)	Yes	Ind. peaks or Webb-McCall	50 ppm	No	ASTM, 1983
EPA (oil)	Transformer fluids or waste oils	DI	(H_2SO_4) (Florisil) (Alumina) (Silica gel) (GPC), (CH_3CN)	PGC/HECD or /ECD or /EIMS (HRGC)	No	Total area or Webb-McCall	1 mg/kg	Yes	EPA, 1981 Bellar and Lichtenberg, 1981
EPA (by-products)	Products or wastes	Several	Several	HRGC/EIMS	Yes	Ind. peaks	NS	Yes	Erickson et al., 1982, 1983d; Erickson, 1984a
DCMA	3 pigment types	A. Hexane/ H_2SO_4 B. CH_2Cl_2	None Florisil	PGC/ECD	No	10 isomers	~ 1 ppm/homolog	Yes	DCMA, 1982
DOW	Chlorinated benzenes	DI	None	PGC/EIMS	Yes	Total peak height/homolog	NS	Yes	Dow, 1981
EPA (isomer groups)	Unspecified	Not addressed	Not addressed	HRGC/EIMS	Yes	Ind. peaks	NS	Yes	EPA, 1984d

Source: M. D. Erickson, The Analytical Chemistry of PCBs, Butterworths, Boston, MA, 1985, in press.

a No specific details.
b Direct injection or dilute and inject.
c Techniques in parentheses are described as optional in the procedure.
d Or PGC with microcoulometric or electrolytic conductivity.

a. Gas Chromatograph/Electron Capture Detection

Packed column gas chromatography with electron capture detection (GC/ECD) is generally the method of choice for analysis of spill site samples, transformer oils, and other similar matrices which must be analyzed for PCB content prior to disposal (Copland and Gohmann 1982). GC/ECD is very sensitive, highly selective against hydrocarbon background, and relatively inexpensive to operate. The technique is most appropriate when the PCB residue resembles an Aroclor® (Aroclor® is a registered trademark of Monsanto Company; the trademark designation is not used throughout this report) standard and other halogenated compounds do not interfere.

While it is considered a selective detector, ECD also detects non-PCB compounds such as halogenated pesticides, polychlorinated naphthalenes, chloroaromatics, phthalate and adipate esters, and other compounds. These compounds may be differentiated from PCBs only by chromatographic retention time. Elemental sulfur can interfere with PCB analysis in sediment and other samples which have been subjected to anaerobic degradation conditions. There are also common interferences which do not give discrete peaks. An example of a nonspecific interference is mineral oil (ASTM 1983). Mineral oil, a complex mixture of hydrocarbons, can cause a general suppression of ECD response. Mineral oils from transformers often contain PCBs as a result of cross-contamination of transformer oils.

A major disadvantage of ECD is the range of response factors which different PCB congeners exhibit. Zitko et al. (1971) and Hattori et al. (1981) published response factors ranges of about 540 and 9000, respectively. Boe and Egaas (1979), Onsuka et al. (1983) and Singer et al. (1983) have also published ECD response factors. The range of response factors seriously inhibits reliable quantitation of individual PCB congeners or non-Aroclor PCBs unless the composition of the sample and standard are the same.

When PCBs are analyzed by packed column gas chromatography, the PCBs are usually quantitated by total areas or individual peaks. In the total areas method, the areas of all peaks in a retention window are summed and this total compared with the corresponding response of an Aroclor standard. With the individual peak quantitation method, response factors are calculated for each peak in the packed column chromatogram. The most prominent individual peak quantitation method was originated by Webb and McCall (1973). These results may be reported as an Aroclor concentration or as total PCB. Packed column GC techniques are generally useful for quantitation of samples which resemble pure Aroclors but are prone to errors from interfering compounds or from PCB mixtures that do not resemble pure Aroclors (Albro 1979). For this reason analysts have been using capillary gas chromatography for the analysis of PCBs. Capillary gas chromatography offers the analyst the ability to separate most of the individual PCB isomers. Bush et al. (1982) has proposed a method of obtaining "total PCB" values by integration of all PCB peaks, using response factors generated from an Aroclor mixture. Zell and Ballschmiter (1980) have developed a simplified approach where only a selected few "diagnostic peaks" are quantitated. In a similar approach Tuinstra et al. (1983) have quantitated six specific, diagnostic congeners which appear to be useful for regulatory cutoff analyses.

245

b. GC/Hall Electrolytic Conductivity Detector

Electrolytic conductivity detectors have also been used with packed column gas chromatography to selectively detect PCBs (Webb and McCall 1973, Sawyer 1978). The Hall electrolytic conductivity detector (HECD) measures the change in conductivity of a solution containing HCl or HBr which is formed by pyrolysis of halogenated organic GC effluents. The HECD exhibits 10^5-10^6 selectivity for halogenated compounds over other compounds. It also gives a linear response over at least a 10^3 range. HECD and ECD were compared for their use in detecting PCBs in waste oil, hydraulic fluid, capacitor fluid, and transformer oil (Sonchik et al. 1984). They found both detectors acceptable, but noted that the HECD gave higher results with less precision than the ECD. The method detection limits ranged from 3-12 ppm for HECD and 2-4 ppm for ECD. Greater than 100% recovery of spikes analyzed by HECD indicated a nonspecific response to non-PCB components, since extraneous peaks were not observed. Another comparison of HECD and ECD for the analysis of PCBs in oils at the 30-500 ppm levels found that the type of detector made no significant difference in the results (Levine et al. 1983). The authors noted that they had expected higher accuracy from the more specific HECD. They postulated that the cleanup procedures (Florisil, alumina, and sulfuric acid) all had effectively removed the non-PCB species which would have caused interferences in the ECD and reduced its accuracy.

c. GC/Mass Spectrometry

Highly specific identification of PCBs is performed by GC with mass spectrometric (GC/MS) detection. High resolution gas chromatography is generally used with mass spectrometry, so individual PCB isomers may be separated and identified. A GC/MS produces a chromatogram consisting of data points at about 1 second intervals, which are actually full mass spectra. The data are stored by a computer and may be retrieved in a variety of ways. The data file contains information on the amount of compound (signal intensity), molecular weight (parent ion), and chemical composition (fragmentation patterns and isotopic clusters).

GC/MS is particularly suited to detection of PCBs because of its intense molecular ion and the characteristic chlorine cluster. Chlorine has two naturally occurring isotopes, ^{35}Cl and ^{37}Cl, which occur in a ratio of 100:33. Thus, a molecule with one chlorine atom will have a parent ion, M, and an M+2 peak at 33% relative intensity. With two chlorine atoms, M+2 has an intensity of 66% and M+4, 11%.

Because of its expense, complexity of data, and lack of sensitivity, GC/MS has not been used as extensively as other GC methods (particularly GC/ECD), despite its inherently higher information content. As the above factors have been improved, GC/MS has become much more popular for analysis of PCBs, and will probably continue to increase in importance. Several factors including the introduction of routine instruments without costly accessories, decreasing data system costs, and mass-marketing, have combined to keep the costs of GC/MS down while prices of other instruments have risen steadily. With larger data systems and more versatile and "user-friendly"

software, the large amount of data is more easily handled. However, data reduction of a GC/MS chromatogram still requires substantially more time than for a GC/ECD chromatogram. In addition, the sensitivity of GC/MS has improved.

d. Field-Portable Gas Chromatography Instrumentation

Gas chromatography may be used for analysis of samples in the field. Gas chromatography is a well-established laboratory technique, and portable instruments with electron capture detectors are available (Spittler 1983, Colby et al. 1983, Picker and Colby 1984). A field-portable GC/ECD was used to obtain rapid measurements of PCBs in sediment and soil (Spittler 1983). The sample preparation consisted of a single solvent extraction. The PCBs were eluted from the GC within 9 min. In a 6-h period, 40 soils and 10 QC samples were analyzed, with concentrations ranging from 0.2 to 24,000 ppm. The use of field analysis permits real-time decisions in a cleanup operation and reduces the need for either return visits to a site.

Mobile mass spectrometers are also available. An atmospheric pressure chemical ionization mass spectrometer, marketed by SCIEX, has been mounted in a van and used for in situ analyses of soil and clay (Lovett et al. 1983). The instrument has apparently been used for field determination of PCBs in a variety of emergency response situations, including hazardous waste site cleanups. Other, more conventional mass spectrometers, should also be amenable to use in the field.

2. Thin-Layer Chromatography (TLC)

Thin-layer chromatography is a well-established analytical technique which has been used for the determination of PCBs for many years. Since the publication of a TLC method for PCBs by Mulhern (Mulhern 1968, Mulhern et al. 1971), several researchers have used TLC to measure PCBs in various matrices. Methods have been reported by Willis and Addison (1972) for the analysis of Aroclor mixtures, by Piechalak (1984) for the analysis of soils, and by Stahr (1984) for the analysis of PCB containing oils. Even with a densitometer to measure the intensity of the spots, TLC is not generally considered quantitative. Order-of-magnitude estimates of the concentration are certainly obtainable, but the precision and accuracy probably do not approach that of the gas chromatographic methods.

A spill site sample extract will probably need to be cleaned up before TLC analysis. Levine et al. (1983) have published a comparison of various cleanup procedures. Stahr (1984) has compared the Levine sulfuric acid cleanup to a SepPak® C_{18} cleanup method.

Different TLC techniques have been used to improve the sensitivity and selectivity of the method. Several researchers have reported that the use of reverse-phase TLC (C_{18}-bonded phase) achieves a better separation of PCBs from interferences (DeVos and Peet 1971, DeVos 1972, Stalling and Huckins 1973, Brinkman et al. 1976). Koch (1979) has reported an order of magnitude improvement in the PCB limit of detection through use of circular

247

TLC. The two most common methods of visualization are fluorescence (Kan et al. 1973, Ueta et al. 1974) and reaction with $AgNO_3$ followed by UV irradiation (DeVos and Peet 1971, DeVos 1972, Kawabata 1974, Stahr 1984).

No direct comparison of the performance of TLC with other techniques for analysis of samples from spill sites has been made. Two studies (Bush et al. 1975, Collins et al. 1972) compared TLC and GC/ECD. In both studies, the PCB values obtained were comparable. However, the study by Bush et al. indicated that the TLC results were generally lower than GC/ECD.

3. Total Organic Halide Analyses

Total organic halide analysis can be used to estimate PCB concentrations for guiding field work, but is not appropriate for verification or enforcement analyses. A total organic halide analysis indicates the presence of chlorine and sometimes the other halogens. Many of the techniques also detect inorganic chlorides such as sodium chloride. The reduction of organochlorine to free chloride ion with metallic sodium can be used for PCB analysis. The free chloride ions can be then detected colorimetrically (Chlor-N-Oil®) or by a chloride ion-specific electrode (McGraw-Edison). The performance of these kits has not been tested with any matrix other than mineral oil. X-ray fluorescence (XRF) has also been studied as a PCB screening technique (McQuade 1982, Schwalb and Marquez 1982).

D. Selection of Appropriate Methods

1. Criteria for Selection

The primary criterion for an enforcement method is that the data be highly reliable (i.e., they are legally defensible). This does not necessarily imply that the most exotic, state-of-the-art methods be employed; rather that the methods have a sound scientific basis and validation data to support their use. Many other criteria also enter into selection of a method, including accuracy, precision, reproducibility, comparability, consistency across matrices, availability, and cost.

For PCB spills, it is assumed that the spills will be relatively fresh and therefore that PCB mixtures will generally resemble those in commercial products (i.e., Aroclor®). It is further assumed that, for most of the matrices likely to be encountered, the levels of interferences will be relatively low.

2. Selection of Instrumental Techniques

Based upon the above criteria and assumptions, either GC/ECD or GC/MS should provide suitable data. Since GC/ECD is included in more standard methods and since the technique is more widely used, it appears to be the technique of choice. The primary methods recommended below are all based on GC/ECD instrumental analysis. Some of the secondary and confirmatory techniques are based on GC/EIMS.

3. Selection of Methods

Ideally, a standard method would be available for each matrix likely to be encountered in a PCB spill. The matrices of concern include solids (soil, sand, sediment, bricks, asphalt, wood, etc.), water, oil; surface wipes, and vegetation. The methods for these matrices are summarized in Table 22 and discussed in detail below. A primary recommended method is given and should be used in most spill instances. The secondary method may be useful for confirmatory analyses, or where the situation (e.g., high level of interferences) indicates that the primary method is not applicable. The methods used must be documented or referenced.

a. Solids (Soil, Sand, Sediment, Bricks, Asphalt, Wood, Etc.)

EPA Method 8080 from SW-846 (USEPA 1982e) is the primary recommended method. The secondary methods, Method 8250 and Method 8270, are GC/MS analogs. Method 8080 entails an acetone/hexane (1:1) extraction, a Florisil column chromatographic cleanup, and a GC/ECD instrumental determination. A total area quantitation versus Aroclor standards is specified. No qualitative criteria are supplied. A detection limit of 1 μg/g is prescribed. No validation data are available.

Bulk samples (bricks, asphalt, wood, etc.) should be readily extractable using a Soxhlet extractor according to EPA Method 8080 (USEPA 1982e). The sample must be crushed and subsampled to ensure proper solvent contact.

b. Water

EPA Method 608 (USEPA 1984e) is recommended as the primary method. This is one of the "priority pollutant" methods and involves extraction of water samples with dichloromethane. An optional Florisil column chromatographic cleanup and also an optional sulfur removal are given. Samples are analyzed by GC/ECD and quantitated against the total area of Aroclor standards. No qualitative criteria are given. This method has been extensively validated and complex recovery and precision equations are given in the method for seven Aroclor mixtures. The average recovery is about 86% and average overall precision about ± 26%. The average recovery and precision for the more common Aroclors (1242, 1254, and 1260) are about 78% and ± 26%, respectively. Detection limits are not given in the current version (USEPA 1984a), although they were listed as between 0.04 and 0.15 μg/L for the seven Aroclor mixtures listed as priority pollutants in the method validation study (Millar et al. 1984).

c. Oils

Spilled oil samples should be analyzed according to an EPA method (Bellar and Lichtenberg 1981). The method is written for transformer fluids and waste oils, but should also be applicable to other similar oils such as capacitor fluids. In this method, samples are diluted by an appropriate factor (e.g., 1:1000). Six optional cleanup techniques are given.

249

Table 22. Summary of Recommended Analytical Methods

Matrix	Primary method (GC/ECD)		Secondary method		
	Designation	Reference	Designation	GC detector	Reference
Solids	8080	USEPA 1982e	8250, 8270	MS	USEPA 1982e
Water	608	USEPA 1984a	625	MS	USEPA 1984b
Oil	"oil"	USEPA 1981a; Bellar and Lichtenberg, 1981	"oil"	MS	USEPA 1981a; Bellar and Lichtenberg, 1981
Surface wipes	Hexane extraction/608	None	Hexane extraction/625	MS	None
Vegetation	AOAC (29)	AOAC 1980a	None	None	None

The sample may be analyzed by GC/ECD as the primary method. Secondary instrumental choices, also presented in the method, are GC/HECD, GC/MS, and capillary GC/MS. PCBs are quantitated by either total areas or the Webb-McCall (1973) method. No qualitative criteria are given. QC criteria are given. A detection limit of 1 mg/kg is stated, although it is highly dependent on the amount of dilution required. An interlaboratory validation study (Sonchik and Ronan 1984) indicated 81 to 126% recoveries for different PCB mixtures, with an average of 97% for Aroclors 1242, 1254, and 1260, as measured by ECD. The overall method precision ranged from ± 11 to ± 55%, with an average of ± 12% for Aroclors 1242, 1254, and 1260. The method validation statistics were presented in more detail as regression equations.

d. Surface Wipes

No standard method is available for analysis of PCBs collected on surface wipes. However, since this matrix should be relatively clean and easily extractable, a simple hexane extraction should be sufficient. Samples should be analyzed according to EPA Method 608 (USEPA 1984a), except for Section 10.1 through 10.3. In lieu of these sections, the sample should be extracted three times with 25 to 50 mL of hexane. The sample can be extracted by shaking for at least 1 min per extraction in the wide-mouthed jar used for sample storage. Note that the rinses should be with hexane so that solvent exchange from methylene chloride to hexane (Section 10.7) is not necessary.

e. Vegetation

The AOAC (1980a) procedure for food is recommended for analysis of vegetation (leaves, vegetables, etc.). This method involves extraction of a macerated sample with acetonitrile. The acetonitrile is diluted with water and the PCBs extracted into petroleum ether. The concentrated extract is cleaned up by Florisil column chromatography by elution with a mixture of ethyl ether and petroleum ether. The sample is analyzed by GC/ECD with quantitation by total areas or individual peak heights as compared to Aroclor standards. No qualitative criteria are given. Validation studies with chicken fat and fish (Sawyer 1973) are not relevant to the types of matrices to be encountered in PCB spills.

4. Implementation of Methods

Each laboratory is responsible for generating reliable data. The first step is preparation of an in-house protocol. This detailed "cookbook" is based on methods cited above, but specifies which options must be followed and provides more detail in the conduct of the techniques. It is essential that a written protocol be prepared for auditing purposes.

251

Each laboratory is responsible for generating validation data to demonstrate the performance of the method in the laboratory. This can be done before processing of samples; however, it is often impractical. Validation of method performance (replicates, spikes, QC samples, etc.) while analyzing field samples is acceptable.

Changes in the above methods are acceptable, provided the changes are documented and also provided that they do not affect performance. Some minor changes (e.g., substitution of hexane for petroleum ether) do not generally require validation. More significant changes (e.g., substitution of a HECD for ECD) will require documentation of equivalent performance.

E. Quality Assurance

Quality assurance must be applied throughout the entire monitoring program including the sample planning and collection phase, the laboratory analysis phase, and the data processing and interpretation phase.

Each participating EPA or EPA contract laboratory must develop a quality assurance plan (QAP) according to EPA guidelines (USEPA 1980). Additional guidance is also available (USEPA 1983). The quality assurance plan must be submitted to the regional QA officer or other appropriate QA official for approval prior to analysis of samples.

1. Quality Assurance Plan

The elements of a QAP (U.S. EPA, 1980) include:

Title page
Table of contents
Project description
Project organization and responsibility
QA objectives for measurement data in terms of precision, accuracy, completeness, representativeness, and comparability
Sampling procedures
Sample tracking and traceability
Calibration procedures and frequency
Analytical procedures
Data reduction, validation and reporting
Internal quality control checks
Performance and system audits
Preventive maintenance
Specific routine procedures used to assess data precision, accuracy and completeness
Corrective action
Quality assurance reports to management

252

2. Quality Control

Each laboratory that uses this method must operate a formal quality control (QC) program. The minimum requirements of this program consist of an initial and continuing demonstration of acceptable laboratory performance by the analysis of check samples, spiked blanks, and field blanks. The laboratory must maintain performance records which define the quality of data that are generated.

The exact quality control measures will depend on the laboratory, type and number of samples, and client requirements. The QC measures should be stipulated in the QA Plan. The QC measures discussed below are given for example only. Laboratories must decide on which of the measures below, or additional measures, will be required for each situation.

a. Protocols

Virtually all of the available PCB methods contain numerous options and general instructions. Effective implementation by a laboratory requires the preparation of a detailed analysis protocol which may be followed unambiguously in the laboratory. This document should contain working instructions for all steps of the analysis. This document also forms the basis for conducting an audit.

b. Certification and Performance Checks

Prior to the analysis of samples, the laboratory must define its routine performance. At a minimum, this must include demonstration of acceptable response factor precision with at least three replicate analyses of a calibration solution; and analysis of a blind QC check sample (e.g., the response factor calibration solution at unknown concentration submitted by an independent QA officer). Acceptable criteria for the precision and the accuracy of the QC check sample analysis must be presented in the QA plan.

Ongoing performance checks should include periodic repetition of the initial demonstration or more elaborate measures. More elaborate measures may include control charts and analysis of QA check samples containing unknown PCBs, and possibly with matrix interferences.

c. Procedural QC

The various steps of the analytical procedure should have quality control measures. These include, but are not limited to, the following:

Instrumental Performance: Instrumental performance criteria and a system for routinely monitoring the performance should be set out in the QA Plan. Corrective action for when performance does not meet the criteria should also be stipulated.

253

Qualitative Identification: Any questionable results should be confirmed by a second analytical method. A least 10% of the identifications, as well as any questionable results, should be confirmed by a second analyst.

Quantitation: At least 10% of all calculations must be checked. The results should be manually checked after any changes in computer quantitation routines.

d. Sample QC

Each sample and each sample set must have QC measures applied to it to establish the data quality for each analysis result. The following should be considered when preparing the QA plan:

Field Blanks: Field blanks are analyzed to demonstrate that the sample collection equipment has not been contaminated. A field blank may be generated by using the sampling equipment to collect a blank sample (e.g., using the water sampling equipment to sample laboratory reagent grade water) or by extracting the sampling equipment (e.g., extracting a sheet of filter paper from the lot used to collect wipe samples or rinsing the soil sampling apparatus into the sample jar). A field blank must be collected and analyzed for each type of sample collected.

Laboratory Reagent Blanks: These blanks are generated in the laboratory and are analyzed to assess contamination of glassware, reagents, etc., in the laboratory. Generally, a reagent blank is processed through the entire analysis process. Although in special circumstances, additional reagent blanks may be generated which are processed through only part of the procedure to isolate sources of contamination. At least one laboratory reagent blank must be generated and analyzed for each type of sample analyzed.

Check Samples: These samples contain known concentrations of PCBs in the sample matrix. They are analyzed along with field samples to demonstrate the method performance. The PCB concentrations may be known to the analyst.

Blind Check Samples: These samples are the same as the check samples discussed above, except the PCB concentration is not known to the analyst.

Replicate Samples: One sample from each batch of 20 or fewer will be analyzed in triplicate. The sample is divided into three replicate subsamples and all these subsamples carried through the analytical procedure, blind to the analyst. The results of these analyses must be comparable within the limits required for spiked samples.

Spiked Samples: The sensitivity and reproducibility must be demonstrated for any method used to report verification data. This can be done by analyzing spiked blanks near the required detection limit. To demonstrate the ability of the method to reproducibly detect the spiked sample, one or more spiked samples should be analyzed in at least triplicate for each group of 20 or fewer samples within each sample type collected. Samples will

254

be spiked with a PCB mixture similar to that spilled (e.g., Aroclor 1260). Example concentrations are:

Matrix	Spike Level
Soil, etc.	10 μg/g (10 ppm)
Water	100 μg/L (100 ppb))
Wipes	100 μg/wipe (100 μg/100 cm^2)

Quantitative techniques must detect the spike level within ±30% for all spiked samples.

e. Sample Custody

As part of the Quality Assurance Plan, the chain-of-custody protocol must be described. A chain-of-custody provides defensible proof of the sample and data integrity. The less rigorous sample traceability documentation merely provides a record of when operations were performed and by whom. Sample traceability is not acceptable for enforcement activities.

Chain-of-custody is required for analyses which may result in legal proceedings and where the data may be subject to legal scrutiny. Chain-of-custody provides conclusive written proof that samples are taken, transferred, prepared, and analyzed in an unbroken line as a means to maintain sample integrity. A sample is in custody if:

- It is in the possession of an authorized individual;
- It is in the field of vision of an authorized individual;
- It is in a designated secure area; or
- It has been placed in a locked container by an authorized individual.

A typical chain-of-custody protocol contains the following elements:

1. Unique sample identification numbers.
2. Records of sample container preparation and integrity prior to sampling.
3. Records of the sample collection such as:
   - Specific location of sampling.

255

- Date of collection.
- Exact time of collection.
- Type of sample taken (e.g., air, water, soil).
- Initialing each entry.
- Entering pertinent information on chain-of-custody record.
- Maintaining the samples in one's possession or under lock and key.
- Transporting or shipping the samples to the analysis laboratory.
- Filling out the chain-of-custody records.
- The chain-of-custody records must accompany the samples.

4. Unbroken custody during shipping. Complete shipping records must be retained; samples must be shipped in locked or sealed (evidence tape) containers.

5. Laboratory chain-of-custody procedures consist of:

   - Receiving the samples.
   - Checking each sample for tampering.
   - Checking each sample against the chain-of-custody records.
   - Checking each sample and noting its condition.
   - Assigning a sample custodian who will be responsible for maintaining chain-of-custody.
   - Maintaining the sign-offs for every transfer of each sample on the chain-of-custody record.
   - Ensuring that all manipulations of the sample are duly recorded in a laboratory notebook along with sample number and date. These manipulations will be verified by the program manager or a designee.

F. Documentation and Records

Each laboratory is responsible for maintaining complete records of the analysis. A detailed documentation plan should be prepared as part of

256

the QAP. Laboratory notebooks should be used for handwritten records. Digital or other GC/MS data must be archived on magnetic tape, disk, or a similar device. Hard copy printouts may also be kept if desired. Hard copy analog data from strip chart recorders must be archived. QA records should also be retained.

The documentation must completely describe how the analysis was performed. Any variances from a standard protocol must be noted and fully described. Where a procedure lists options (e.g., sample cleanup), the option used and specifics (solvent volumes, digestion times, etc.) must be stated.

The remaining samples and extracts should be archived for at least 2 months or until the analysis report is approved by the client organization (whichever is longer) and then disposed unless other arrangements are made. The magnetic disks or tapes, hard copy chromatograms, hard copy spectra, quantitation reports, work sheets, etc., must be archived for at least 3 years. All calculations used to determine final concentrations must be documented. An example of each type of calculation should be submitted with each verification spot.

G. Reporting Results

Results of analysis will normally be reported as follows:

Matrix	Reporting Units
Soil, etc.	µg PCB/g of sample (ppm)
Water	mg PCB/L of sample (ppm)
Surfaces (wipes)	µg PCB/wipe (µg PCB/100 cm^2)

In some cases, the results are to be reported by homolog. In this case, 11 values are reported per sample: one each for the 10 homologs and one for the total. Some TSCA analyses require reporting the results in terms of resolvable gas chromatographic peak (U.S. EPA, 1982c, 1984e). In these cases, the number of results reported equals the number of peaks observed on the chromatogram. These analyses are generally associated with a regulatory cutoff (e.g., 2 µg/g per resolvable chromatographic peak (U.S. EPA, 1982c, 1984). In these cases it may be sufficient, depending on the client organization's request, to report only those peaks which are above the regulatory cutoff.

Even if an Aroclor is used as the quantitation standard, the results are never to be reported as "µg Aroclor®/g sample." TSCA regulates all PCBs, not merely a specific commercial mixture.

251

V. REFERENCES

Albro PW. 1979. Problems in analytic methodology: sample handling, extraction, and cleanup. Ann NY Acad Sci 320:19-27.

American National Standards Institute, Inc. 1974. American national standard guidelines for handling and disposal of capicator- and transformer-grade askarels containing polychlorinated biphenyls. ANSI C107.1-1974. New York, NY.

American Society for Testing and Materials. 1980. Standard method for rapid gas chromatographic estimation of high boiling homologues of chlorinated biphenyls for capacitor askarels. ANSI/ASTM D 3303-74 (Reapproved 1979). In: Annual book of ASTM standards, Part 40. Philadelphia, Pennsylvania, pp. 870-876.

American Society for Testing and Materials. 1981a. Standard method for polychlorinated biphenyls (PCBs) in water. ANSI/ASTM D 3534-80. In: Annual book of ASTM standards, Part 31. Philadelphia, Pennsylvania, pp. 816-833.

American Society for Testing and Materials. 1981b. Standard method for analysis of environmental materials for polychlorinated biphenyls. ANSI/ASTM D 3304-77. In: Annual book of ASTM standards, Part 31. Philadelphia, Pennsylvania, pp. 877-885.

American Society for Testing and Materials. 1983. Standard method for analysis of polychlorinated biphenyls in mineral insulating oils by gas chromatography. ANSI/ASTM D 4059-83. In: Annual book of ASTM standards, Part 40. Philadelphia, Pennsylvania, pp. 542-550.

Association of Official Analytical Chemists. 1980a. General method for organochlorine and organophosphorus pesticides, Method 29.001. Official Methods of Analysis of the Association of Official Analytical Chemists, W. Horwitz, Ed. (13th ed., Washington, DC), pp. 466-474.

Association of Official Analytical Chemists. 1980b. PCB in paper and paperboard, Method 29.029. Official Methods of Analysis of the Association of Official Analytical Chemists, W. Horwitz, Ed. (13th ed., Washington, DC), p. 475-476.

Ballinger DG. 1978 (December 11). Test procedures for priority organics in municipal wastewater and sludges. U.S. Environmental Protection Agency, Cincinnati, Ohio.

Beard JH III, Schaum J. 1978 (February 10). Sampling methods and analytical procedures manual for PCB disposal: Interim Report, Revision 0. Office of Solid Waste, U.S. Environmental Protection Agency, Washington, DC.

Bellar TA, Lichtenberg JJ. 1982. The determination of polychlorinated biphenyls in transformer fluid and waste oils. Prepared for U.S. Environmental Protection Agency, EPA-600/ 4-81-045.

258

Boe B, Egaas E. 1979. Qualitative and quantitative analyses of polychlorinated biphenyls by gas-liquid chromatography. J Chromatogr 180:127-132.

Brinkman UATh, De Kok A, De Vries G, Reymer HGM. 1976. High-speed liquid and thin-layer chromatography of polychlorinated biphenyls. J Chromatogr 128:101-110.

Bush B, Baker F, Dell'Acqua R, Houck CL, Lo F-C. 1975. Analytical response of polychlorinated biphenyl homologues and isomers in thin-layer and gas chromatography. J Chromatogr 109:287-295.

Bush B, Connor S, Snow J. 1982. Glass capillary gas chromatography for sensitive, accurate polychlorinated biphenyl analysis. J Assoc Off Anal Chem 65(3):555-566.

Colby BN, Burns EA, Lagus PL. 1983. The S-Cubed PCBA 101, an automated field analyzer for PCBs. Abstract No. 731, 1983 Pittsburgh Conference and Exposition on Analytical Chemistry and Applied Spectroscopy.

Collins GB, Holmes DC, Jackson FJ. 1972. The estimation of polychlorobiphenyls. J Chromatogr 71:443-449.

Copland GB, Gohmann CS. 1982. Improved method for polychlorinated biphenyl determination in complex matrices. Environ Sci Technol 16:121-124.

De Vos RH. 1972. Analytical techniques in relation to the contamination of the fauna. TNO-nieuws 27:615-622.

De Vos RH, Peet EW. 1971. Thin-layer chromatography of polychlorinated biphenyls. Bull Environ Contam Toxicol 6(2):164-170.

Devenish I, Harling-Bowen L. 1980. The examination and estimation of the performance characteristics of a standard method for organo-chlorine insecticides and PCB. In: Hydrocarbons and Halogenated Hydrocarbons in the Aquatic Environment, B. K. Afghan and D. Mackay, Eds. (New York: Plenum Press), pp. 231-253.

Dow Chemical Company. 1981 (July 1). Determination of chlorinated biphenyls in the presence of chlorinated benzenes. Midland MI.

Dry Color Manufacturers Association. 1981. An analytical procedure for the determination of polychlorinated biphenyls in dry phthalocyanine blue, phthalocyanine green, and diarylide yellow pigments. Arlington, VA.

Erickson MD, Stanley JS, Turman K, Radolovich G, Bauer K, Onstot J, Rose D, Wickham M. 1982. Analytical methods for by-product PCBs--preliminary validation and interim methods. Interim Report No. 4. Office of Toxic Substances, U.S. Environmental Protection Agency, Washington, D. C., EPA-560/5-82-006, NTIS No. PB83 127 696, 243 pp.

269

Erickson MD, Stanley JS, Radolovich G, Blair RB. 1983 (August 15). Analytical method: the analysis of by-product chlorinated biphenyls in commerical products and product wastes. Revision 1, Prepared by Midwest Research Institute for Office of Toxic Substances, U.S. Environmental Protection Agency, Washington, DC, under Subcontract No. A-3044(8149)-271, Work Assignment No. 17 to Battelle, Washington, DC.

Erickson MD 1984a. Analytical method: The analysis of by-product chlorinated biphenyls in commercial products and product wastes, revision 2. U.S. Environmental Protection Agency, Office of Toxic Substances, Washington, DC, EPA 560/5-85-010.

Erickson MD. 1984b. Analytical method: The analysis of by-product chlorinated biphenyls in water, revision 2. U.S. Environmental Protection Agency, Office of Toxic Substances, Washington, DC, EPA 560/5-85-012.

Erickson MD. 1985. The analytical chemistry of PCBs. Butterworths, Boston, MA.

Erickson MD, Stanley JS, Turman JK, and Radolovich G. 1985a. Analytical method: The analysis of chlorinated biphenyls in liquids and solids. U.S. Environmental Protection Agency, Office of Toxic Substances, Washington, DC, EPA-560/5-85-023.

Fisher DJ, Rouse TO, Lynn TR. 1984. Field determination of PCB in transformer oil "CLOR-N-OIL Kit." In: Proceedings: 1983 PCB Seminar, Addis G, and Komai RY, Eds. Report No. EPRI-EL-3581, Palo Alto, CA: Electric Power Research Institute.

Food and Drug Administration. Pesticide Analytical Manual. Vol. I, August 1, 1977.

Haile CL, Baladi E. 1977. Methods for determining the total polychlorinated biphenyl emissions from incineration and capacitor and transformer filling plants. U. S. Environmental Protection Agency, EPA-600/4-77-048, NTIS No. PB-276 745/7G1.

Haile CL, Lopez-Avila V. 1984. Development of analytical test procedures for the measurement of organic priority pollutants--project summary. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, EPA-600/S4-84-001; (Full Report available as NTIS No. PB 84-129 048).

Harris RW, Grainger CF, Mitchell WJ. 1981. Validation of a method for measuring polychlorinated biphenyls in natural gas pipelines. EPA 600/4-81-048; NTIS No. PB82-207556.

Hattori Y, Kuge Y, Nakamoto M. 1981. The correlation between the electron-capture detector response and the chemical structure for polychlorinated biphenyls. Bull Chem Soc Jpn 54(9):2807-2810; Chem Abstr 96:34427s (1981).

260

Kan T, Kamata K, Ueta T, Yamazoe R, Totani T. 1973. Fluorescence reactions of organohalogen compounds. I. Fluorometry of polychlorinated biphenyls (PCB) with diphenylamine on thin-layer chromatograms. Tokyo Toritsu Eisei Kenkyusho Kenky Nempo 24:137-145; Chem Abst 80:115771w (1974).

Kawabata J. 1974. Simple method for the determination of PCBs [polychlorinated biphenyls] by a combination of thin-layer chromatography and UV absorption. Kogai To Taisaku 10(10):1112-1116; Chem Abst 83:201652b (1975).

Koch R. 1979. Circular thin-layer chromatography as a rapid method for a qualitative detection of organochlorine compounds. Acta Hydrochim Hydrobiol 7(3):355-356; Chem Abst 91:101574z (1979).

Levine SP, Homsher MT, Sullivan JA. 1983. Comparison of methods of analysis of polychlorinated biphenyls in oils. J Chromatogr 257:255-266.

Levins PL, Rechsteiner CE, Stauffer JL. 1979. Measurement of PCB emissions from combustion sources. U.S. Environmental Protection Agency, Report No. EPA-600/7-79-047.

Lewis RG. 1982 (March). Procedures for sampling and analysis of polychlorinated biphenyls in the vicinities of hazardous waste disposal sites. U.S. Environmental Protection Agency, Research Triangle Park, NC, 14 pp.

Lingle JW. Wisconsin Electric Power Company, P.O. Box 2046, Milwaukee, WI 53201. May 24, 1985. Personal communication.

Longbottom JE, Lichtenberg JJ, Eds. 1982 (July). Methods for organic chemical analysis of municipal and industrial wastewater. U.S. Environmental Protection Agency, Report No. EPA-600/4-82-057.

Lovett AM, Nacson S, Hijazi NH, Chan R. 1983. Real time ambient air measurements for toxic chemical. In: Proceedings: a specialty conference on: measurement and monitoring of non-criteria (toxic) contaminants in air, Frederick ER, Ed., The Air Pollution Control Association, Pittsburgh, PA, 113-125 pp.

Mason BJ. 1982 (October). Preparation of soil sampling protocol: techniques and strategies. ETHURA, McLean, VA, under subcontract to Environmental Research Center, University of Nevada, for U.S. Environmental Protection Agency, Las Vegas.

Matern B. 1960. Spacial variation. Medd. fr. Stateus Skogsforsknings Institut. 49:1-144.

McQuade JM. 1982. PCB analysis by X-ray fluorescence. In: Proceedings: 1981 PCB Seminar, Addis G, Marks J, Eds., Report No. EPRI-EL-2572, Palo Alto, CA: Electric Power Research Institute, pp. 2-9.

Millar JD, Thomas RE, Schattenberg HJ. 1984 (June). EPA Method Study 18, Method 608--organochlorine pesticides and PCB's. Quality Assurance Branch, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. Report No. EPA-600/4-84-061, NTIS No. PB84 211358, 197 pages.

261

Moein GJ. 1976. Study of the distribution and fate of polychlorinated biphenyls and benzenes after spill of transformer fluid. Report No. EPA 904/9-76-014, NTIS No. PB288484.

Mulhern BM. 1968. An improved method for the separation and removal of organochlorine insecticides from thin-layer plates. J Chromatogr 34:556-558.

Mulhern BM, Cromartie E, Reichel WL, Belisle A. 1971. Semiquantitative determination of polychlorinated biphenyls in tissue samples by thin layer chromatography. J Assoc Offic Anal Chem 54(3):548-550.

National Institute for Occupational Safety and Health. 1977a (April). NIOSH Manual of Analytical Methods, Second Edition, Part I, NIOSH Monitoring Methods, Vol. 1, "Polychlorinated Biphenyls (PCB) in Air, Analytical Method P&CAM 244," U.S. Department of Health, Education, and Welfare, Cincinnati, Ohio.

National Institute for Occupational Safety and Health. 1977b (April). NIOSH Manual of Analytical Methods, Second Edition, Part I, NIOSH Monitoring Methods, Vol. 1, "Polychlorinated Biphenyls (PCB) in Air, Analytical Method P&CAM 253," U.S. Department of Health, Education, and Welfare, Cincinnati, Ohio.

NIOSH. 1977c (September). National Institute for Occupational Safety and Health. Criteria for a recommended standard....occupational exposure to polychlorinated biphenyls (PCBs). U.S. Department of Health, Education, and Welfare (Public Health Service, Center for Disease Control, and National Institute for Occupational Safety and Health), DHEW (NIOSH) Publication No. 7-225, 224 pp.

NIOSH. 1980 (September). National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services. Health Hazard Evaluation Report No. 80-85-745. Oakland, CA: Pacific Gas and Electric Company.

Onsuka FI, Kominar RJ, Terry KA. 1983. Identification and determination of polychlorinated biphenyls by high-resolution gas chromatography. J Chromatogr 279:111-118.

Picker JE, Colby BN. 1984. Field determination of Aroclors using an automated electron capture detector gas chromatograph. In: Proceedings: 1983 PCB Seminar, Addis G, Komai RY, Eds., Report No. EPRI-EL-3581. Palo Alto, CA: Electric Power Research Institute.

Piechalak B. 1984. The semiquantitative detection of polychlorinated biphenyls (PCBs) in contaminated soils by thin-layer chromatography. In: Proceedings: 1983 PCB Seminar, Addis G, Komai RY, Eds., Report No. EPRI-EL-3581. Palo Alto, CA: Electric Power Research Institute.

Rodriguez CF, McMahon WA, Thomas RE. 1980 (March). Method development for determination of polychlorinated hydrocarbons in municipal sludge. Final Report, Contract No. 68-03-2606, Environmental Protection Agency, EPA-600/2-80-029; NTIS No. PB 82-234 071.

262

Sawyer LD. 1973. Collaborative study of the recovery and gas chromatographic quantitation of polychlorinated biphenyls in chicken fat and polychlorinated biphenyl-DDT combinations in fish. J Assoc Offic Anal Chem 56(4):1015-1023.

Sawyer LD. 1978. Quantitation of polychlorinated biphenyl residues by electron capture gas-liquid chromatography: reference material characterization and preliminary study. J Assoc Offic Anal Chem 61(2):272-281.

Schwalb AL, Marquez A. 1982. Salt River Project's experience with the Horiba Sulfur/Chlorine-in-Oil Analyzer. In: Proceedings: 1981 PCB Seminar, Addis G, Marks J, Eds., Report No. EPRI-EL-2572. Palo Alto, CA: Electric Power Research Institute, pp. 2-23.

Sherma, J. Manual of Analytical Quality Control for Pesticides and Related Compounds in Human and Environmental Samples, EPA-600/2-81-059; NTIS No. PB81-222721 (April 1981).

Singer E, Jarv T, Sage M. 1983. Survey of polychlorinated biphenyls in ambient air across the province of Ontario. Chapter 19 in Physical Behavior of PCBs in the Great Lakes, Mackay D, Paterson S, Eisenreich SJ, Simmons MS, Eds. Ann Arbor, MI: Ann Arbor Science Publishers, Inc., pp 367-383.

Sonchik S, Madeleine D, Macek P, Longbottom J. 1984. Evaluation of sample preparation techniques for the analysis of PCBs in oil. J Chromatogr Sci 22:265-271.

Spittler TM. 1983. Field measurement of PCB's in soil and sediment using a portable gas chromatograph. Natl Conf Manage Uncontrolled Hazard Waste Sites 105-107; Chem Abst 100:220890p (1984).

Stalling DL, Huckins JN. 1973. Reverse phase thin layer chromatography of some Aroclors, halowaxes, and pesticides. J Assoc Offic Anal Chem 56(2): 367-372.

Stahr HM. 1984. Analysis of PCBs by thin layer chromatography. J Liq Chrom 7(7):1393-1402.

Tahiliani VH. 1984. CLOR-N-OIL field test program. In: Proceedings: 1983 PCB Seminar, Addis G, Komai RY, Eds., Report No. EPRI-EL-3581. Palo Alto, CA: Electric Power Research Institute.

Tanabe H. 1976. PCB microanalysis. In PCB Poisoning and Pollution, K. Higuchi, Ed. (Tokyo: Kodansha, Ltd; New York: Academic Press), pp. 127-145.

Tuinstra LGMTh, Driessen JJM, Keukens HJ, Van Munsteren TJ, Roos AH, Traag WA. 1983. Quantitative determination of specified chlorobiphenyls in fish with capillary gas chromatography and its use for monitoring and tolerance purposes. Intern J Environ Anal Chem 14:147-157.

263

Ueta T, Kamata K, Kan T, Kazama M, Totani T. 1974. Fluorescence reactions for organic halogen compounds. II. In situ fluorometry of polychlorinated biphenyls and their isomers on thin-layer chromatograms using diphenylamine. Tokyo Toritsu Eisei Kenkyusho Kenkyu Nempo 25:111-118; Chem Abst 83:21991c (1975).

United Kingdom Department of the Environment. 1979. Organochlorine Insecticides and Polychlorinated Biphenyls in Waters 1978; Tentative Method. Methods for the Examination of Waters and Associated Materials. Organochlorine Insectic. Polychlorinated Biphenyls Waters 28 pp.

USEPA. 1978 (September). U.S. Environmental Protection Agency. Methods for benzidine, chlorinated organic compounds, pentachlorophenol and pesticides in water and wastewater. Interim Report, Environmental Monitoring and Support Laboratory, Cincinnati, OH.

USEPA. 1979a (December 3). U.S. Environmental Protection Agency. Organochlorine pesticides and PCBs--Method 608. 44 FR 69501-69509.

USEPA. 1979b (December 3). U.S. Environmental Protection Agency. Base/neutrals, acids, and pesticides--Method 625. 44 FR 69540-69552.

USEPA. 1979c (September). U.S. Environmental Protection Agency. Analytical protocol for screening publicly owned treatment works (POTW) sludges for organic priority pollutants. Environmental Monitoring and Support Laboratory, Cincinnati, OH.

USEPA. 1980. U.S. Environmental Protection Agency. Guidelines and specifications for preparing quality assurance project plans. Office of Monitoring Systems and Quality Assurance, QAMS-005/80.

USEPA. 1981a (February). U.S. Environmental Protection Agency. The analysis of polychlorinated biphenyls in transformer fluid and waste oils. Office of Research and Development, Environmental Monitoring and Support Laboratory, Cincinnati, OH.

USEPA. 1981b. U.S. Environmental Protection Agency. PCB disposal by thermal destruction. Solid Waste Branch, Air and Hazardous Materials Division, Region 6, Dallas, TX, EPA-200/9-81-001; NTIS No. PB82 241 860, 606 pp.

USEPA. 1981c (March). U.S. Environmental Protection Agency. TSCA Inspection Manual.

USEPA. 1982a (November 4). U.S. Environmental Protection Agency. Analysis of pesticides, phthalates, and polychlorinated biphenyls in soils and bottom sediments. HWI Sample Management Office, Alexandria, VA, unpublished method, 12 pp.

USEPA. 1982b (July). U.S. Environmental Protection Agency. Test methods for evaluating solid waste, physical/chemical methods, SW-846, 2nd ed. Office of Solid Waste and Emergency Response, Washington, DC.

USEPA. 1982c (October 21). 40 CFR Part 761, Polychlorinated Biphenyls (PCBs); Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions; Use in Closed and Controlled Waste Manufacturing Processes. Fed. Reg. 47:46980-46986.

USEPA. 1982d (November 4). Analysis of Pesticides, Phthalates, and Polychlorinated Biphenyls in Soils and Bottom Sediments. HWI Sample Management Office, Alexandria, VA, unpublished method, 12 pp.

USEPA. 1982e (July). Test Methods for Evaluating Solid Waste-Physical/Chemical Methods, SW-846, 2nd Edition. Office of Solid Waste and Emergency Response, Washington, DC.

USEPA. 1983. U.S. Environmental Protection Agency. Quality assurance program plan for the Office of Toxic Substances, Office of Pesticides and Toxic Substances, Washington, D.C.

USEPA. 1984a (October 20). Organochlorine Pesticides and PCBs--Method 608. Fed. Reg. 49(209):89-104.

USEPA. 1984b (October 26). Base/Neutrals, Acids, and Pesticides--Method 625. Fed. Reg. 49(209):153-174.

USEPA. 1984c (October 11). 40 CFR Part 761, Polychlorinated Biphenyls (PCBs); Manufacture, Processing, Distribution in Commerce and Use Prohibitions; Use in Electrical Transformers. Fed. Reg. 49:39966-39989.

USEPA. 1984d (October). Mass Spectrometric Identification and Measurement of Polychlorinated Biphenyls as Isomer Groups. Draft Report by Physical and Chemical Methods Branch, Office of Research and Development, Cincinnati, OH.

USEPA. 1984e (July 10). 40 CFR Part 761, Polychlorinated Biphenyls (PCBs); Manufacturing, Processing, Distribution in Commerce and Use Prohibitions; Response to Individual and Class Petitions for Exemptions, Exclusions, and Use Authorization, Final Rule. Fed. Reg. 49:28154-28209.

USWAG. 1984 (October 15). The Utility Solid Waste Activities Group. Proposed spill cleanup policy and supporting studies. U.S. Environmental Protection Agency.

Watts RR (Ed.). 1980 (June). Analysis of Pesticide Residues in Human and Environmental Samples, A Compilation of Methods Selected for Use in Pesticide Monitoring Programs, U.S. Environmental Protection Agency, Research Triangle Park, NC, EPA-600/8-80-038.

Webb RG, McCall AC. 1973. Quantitative PCB standards for electron capture gas chromatography. J Chromatogr Sci 11:366-373.

Willis DE, Addison RF. 1972. Identification and estimation of the major components of a commercial polychlorinated biphenyl mixture, Aroclor 1221. J Fish Res Board Can 29(5):592-595.

265

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. 560/5-85-026	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Verification of PCB Spill Cleanup by Sampling and Analysis		5. REPORT DATE August 1985
		6. PERFORMING ORGANIZATION CODE 8501-A(37)
7. AUTHOR(S) Bruce A. Boomer, Mitchell D. Erickson, Stephen E. Swanson, Gary L. Kelso, David C. Cox,* Bradley D. Schultz*		8. PERFORMING ORGANIZATION REPORT NO. Interim Report No. 2
9. PERFORMING ORGANIZATION NAME AND ADDRESS Midwest Research Institute, 425 Volker Boulevard, Kansas City, Missouri 64110; * Washington Consulting Group, 1625 I Street, N.W., Washington, DC 20006		10. PROGRAM ELEMENT NO. Work Assignment No. 37
		11. CONTRACT/GRANT NO. EPA Contract No. 68-02-3938 & EPA Contract No. 68-01-6721
12. SPONSORING AGENCY NAME AND ADDRESS Exposure Evaluation Division, TS 798, Office of Toxic Substances, U.S. EPA, 401 M Street, SW, Washington, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED
		14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

The EPA work assignment managers are Daniel T. Heggem and Richard A. Levy
The EPA project officers are Joseph J. Breen and Joseph S. Carra

16. ABSTRACT

This report, intended primarily for EPA enforcement personnel, outlines specific sampling and analysis methods to determine compliance with EPA policy on the cleanup of PCB spills. The sampling and analysis methods can be used to determine the residual levels of PCBs at a spill site following the completion of cleanup activities. Although the methodologies outlined in this document are applicable to PCB spills in general, specific incidents may require special efforts beyond the scope of this report.

A sampling design is proposed for use by EPA enforcement staff in detecting residual PCB contamination above a designated limit after a spill site has been cleaned. The proposed design involves sampling on a hexagonal grid which is centered on the cleanup area and extends just beyond its boundaries. Guidance is provided for centering the design on the spill site, for staking out the sampling locations, and for taking possible obstacles into account. Compositing strategies, in which several samples are pooled and analyzed together, are recommended for each of the three proposed designs. Sampling and analysis techniques are described for PCB-contaminated solids (soil, sediment, etc.), water, oils, surface wipes, and vegetation. Quality assurance (QA) must be applied throughout the entire monitoring program. Quality control (QC) measures, including protocols, certification and performance checks, procedural QC, sample QC, and sample custody as appropriate, should be stipulated in a QA plan.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
PCBs, polychlorinated biphenyl spills, spill cleanup, sampling, analysis		

18. DISTRIBUTION STATEMENT Unlimited	19. SECURITY CLASS (This Report) Unclassified	21. NO. OF PAGES 74
	20. SECURITY CLASS (This page) Unclassified	22. PRICE

266

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

Zell M, Ballschmiter K. 1980. Baseline study of the global pollution. III. Trace analysis of polychlorinated biphenyls (PCB) by ECD glass capillary gas chromatography in environmental samples of different trophic levels. Fresenius' Z Anal Chem 304:337-349.

Zitko V, Hutzinger O, Safe S. 1971. Retention times and electron-capture detector responses of some individual chlorobiphenyls. Bull Environ Contam Toxicol 6(2):160-163.

267/267