6537 U-004-307 .3

REMOVAL SITE EVALUATION - FERNALD ENVIRONMENTAL MANAGEMENT PROJECT FIRING RANGE -(USED AS A REFERENCE IN OU2 RI REPORT)

09/00/92

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REMOVAL SITE EVALUATION

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT FIRING RANGE

FERNALD OFFICE

U. S. DEPARTMENT OF ENERGY

SEPTEMBER 1992

INTRODUCTION

In August of 1991, DOE-FN concurred (Letter, DOE-2049-91, August 27, 1991) with a WEMCO recommendation to conduct soil sampling at the FEMP Firing Range. Justification for the sampling was provided in a document entitled "Preliminary Assessment in Support of Removal Site Evaluation - FMPC Firing Range" (WMCO:EMT:91-421, July 26, 1991). This document revealed that the soil embankment area located east of the FEMP running track and firing range target area may be contaminated with lead from spent ammunition. Soil sampling of this area was initiated on January 29, 1992 and completed on February 22, 1992.

Inorganic, Full-HSL, and radiological analytical data for the soil samples taken were received by WEMCO on April 21, 1992. The data indicate that soils at the Firing Range contain leachable concentrations exceeding TCLP thresholds as defined in 40 CFR 261. At five sample locations throughout the soil embankment, leachate exceeded the U. S. EPA TCLP limit of 5 mg/l for lead. In one case, lead leached from a soil sample was 101 mg/l. Currently, United States Environmental Protection Agency policy exempts from solid waste regulation materials (i.e., ammunition) discarded as part of intended use.

Additionally, Ohio EPA clean-up standards consider lead concentrations in soils to be excessive if total lead exceeds 150 ppm or local background, whichever is lower. As many as twelve sample locations exhibited concentrations of lead in excess of 150 ppm. Of these twelve, four locations were greater than 2000 ppm.

Radiological and chemical contamination were not detected in the study area. Other than as a catchment area for ammunition, historical records and process knowledge do not reveal any other known use of the Firing Range embankment area.

Figure 1 provides a summary of all analytical data obtained and an approximation of spent ammunition recovery by sample interval. It should be noted that groundwater samples were intended to be collected from the soil boreholes. None were collected however as the boreholes were dry during sampling and after a period of 24 hours.

This Removal Site Evaluation (RSE) has been completed for review by the DOE under authorities delegated by Executive Order 12580 under Section 104 of CERCLA. The RSE development is consistent with Section 300.410 of the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) to determine if conditions at the FEMP Firing Range warrant the implementation of a CERCLA Removal Action.

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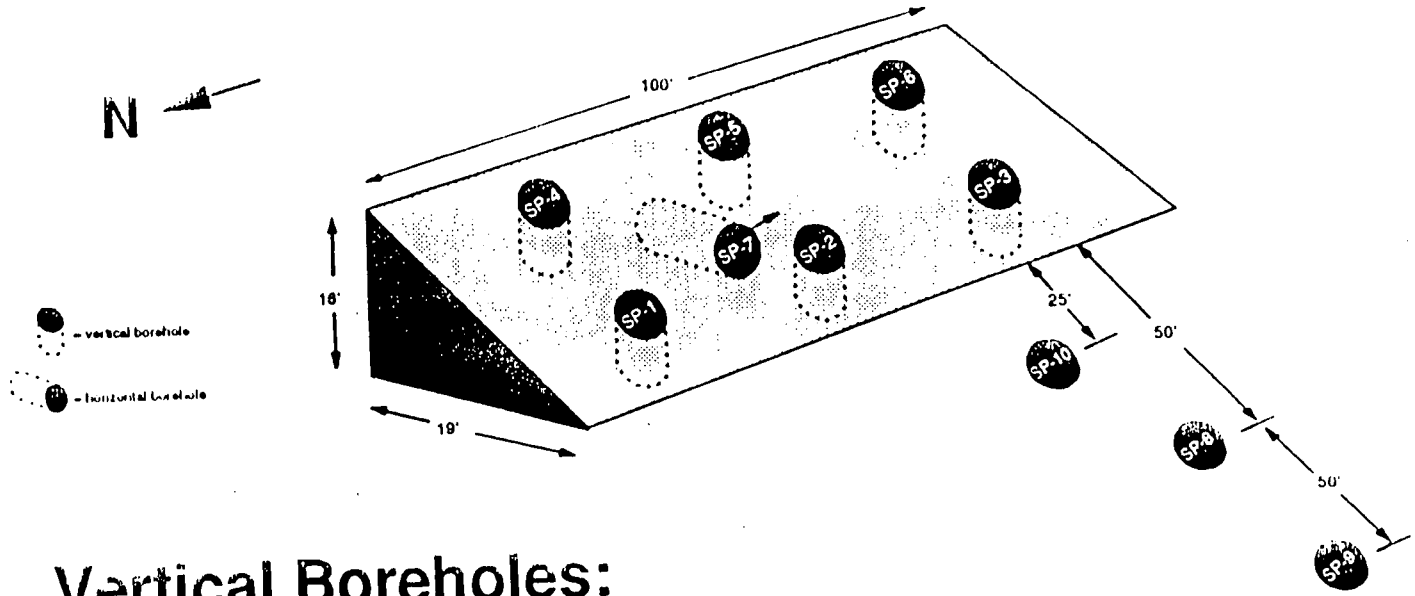
Firing Range Target Area

FIGURE 1



Vertical Boreholes:

SP - 1

Sample Depth	Total - pb	TCLP - pb
0 - 6"	655 ppm	6.9 mg/l
0 - 1'	154 ppm	1.8 mg/l
1' - 2'	6.1 ppm	--
2' - 3'	6.6 ppm	--
3' - 4'	4.9 ppm	--
4' - 5'	5.6 ppm	--

SP - 2

Total - pb	TCLP - pb
1250 ppm	2.0 mg/l
2200 ppm	4.8 mg/l
2460, 1380 ppm (D)	8.8, 9.3 mg/l
345 ppm	1.4 mg/l
57.4 ppm	--
29.6 ppm	--

SP - 3

Total - pb	TCLP - pb
123 ppm	.435 mg/l
5.6 ppm	--
4.8 ppm	--
5.1, 17.5 ppm (D)	--
4.0 ppm	--
1.6 ppm	--

SP - 4

Sample Depth	Total - pb	TCLP - pb
0 - 6"	63.2 ppm	--
0 - 1'	7.7 ppm	--
1' - 2'	11.2, 7.0 ppm (D)	--
2' - 3'	12.8 ppm	--
3' - 4'	7.9 ppm	--
4' - 5'	7.5 ppm	--

SP - 5

Total - pb	TCLP - pb
2820 ppm	101 mg/l
2270 ppm	21.2 mg/l
503 ppm	1.3 mg/l
204 ppm	2.9 mg/l
2.1 ppm	--
11.6 ppm	--

SP - 6

Total - pb	TCLP - pb
64.4 ppm	.04 mg/l
31.3 ppm	.
35.7 ppm	--
17.6 ppm	--
.	.
.	.

	Total - pb	TCLP - pb
SP - 8 (Surface)	63.3 ppm	--
SP - 9 (Surface)	34.9 ppm	--
SP - 10 (Ponding	348 ppm	.348 mg/l

D = Duplicate
* = Impenetrable Surface

Note: TCLP Conducted Where Total - pb ≥ 100 ppm, except for SP - 6 (0 to 6")
Soils Characteristically Hazardous if TCLP ≥ 5.0 mg/l

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Horizontal Borehole

SP - 7

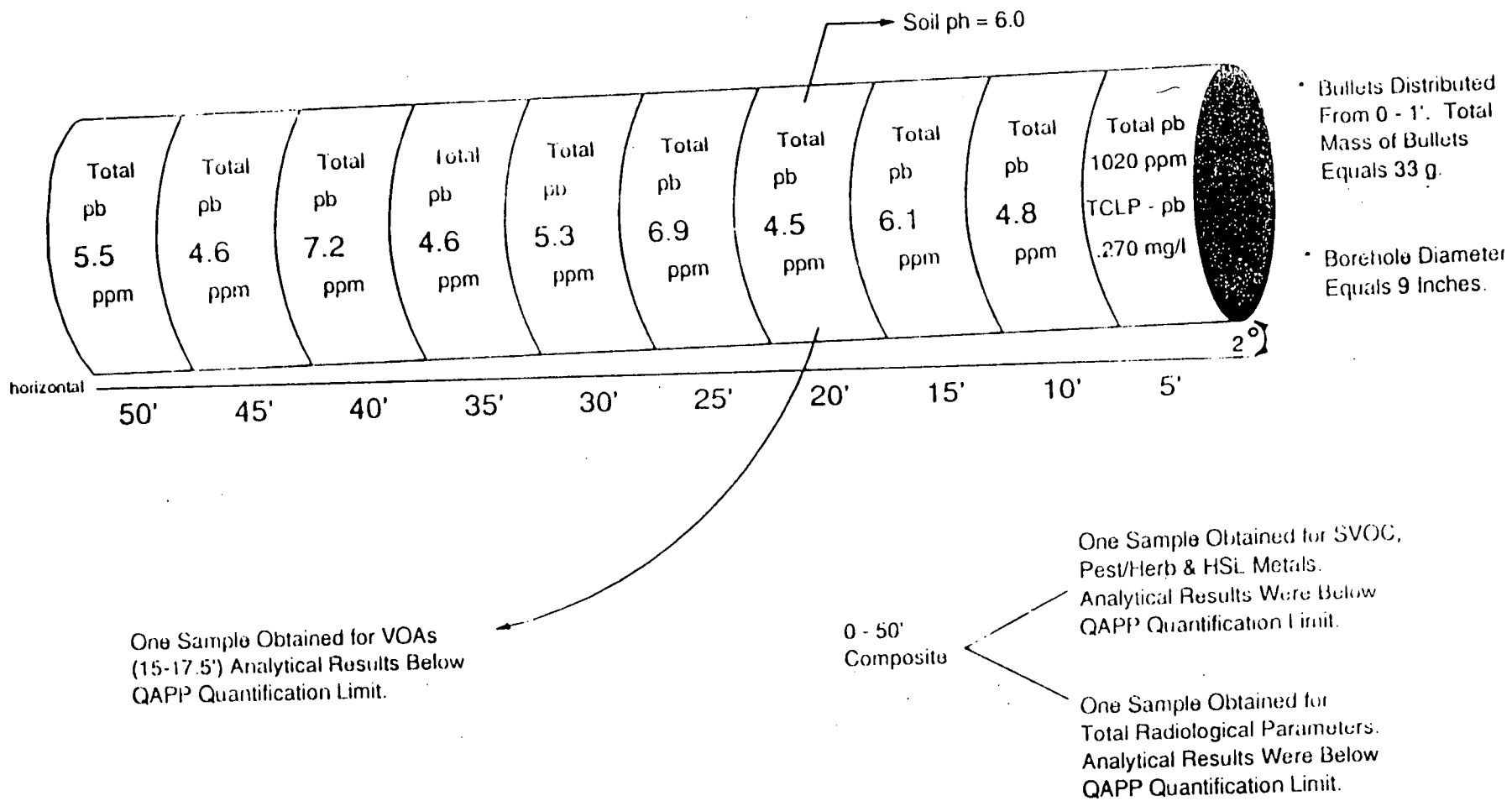
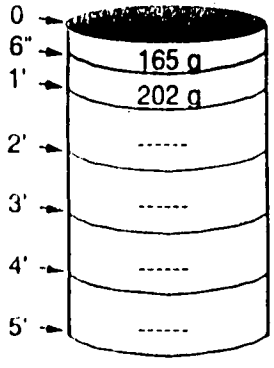


FIGURE 1 continued

Bullet Distribution Within Vertical Boreholes

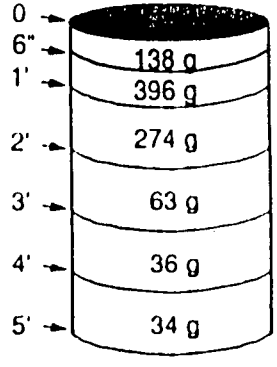
Approximate Mass of Bullets Per Interval

SP - 1



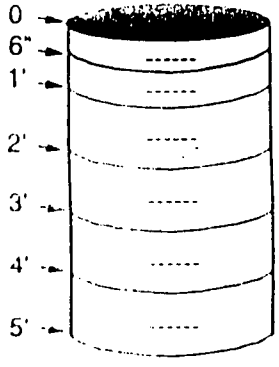
Total: 367 g

SP - 2



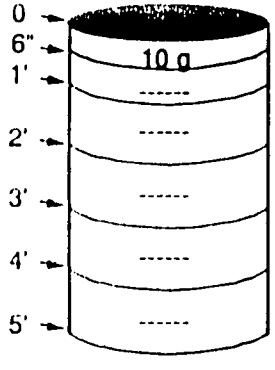
Total: 941 g

SP - 3



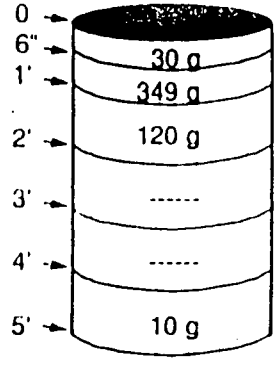
Total: --

SP - 4



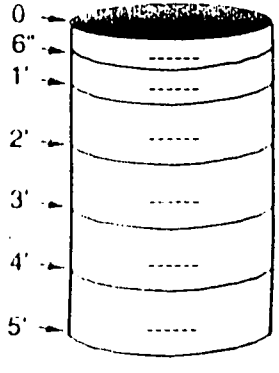
Total: 10 g

SP - 5



Total: 509 g

SP - 6



Total: --

- Borehole Diameter Equals 9 Inches
- Bullet Masses As Depicted Represent Materials Collected By a Number 10 Sieve (2mm) Screening of the Soil Prior to Sample Preparation

FIGURE 1 continued

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SOURCE TERM

Figures 2 through 4 identify the location of the Firing Range within the FEMP boundary and provide physical dimensions for the soil embankment. Field log data obtained during sampling characterize the embankment soils as primarily sand fill overlain by graded silty/clay soil. Due to the steep slope (45%) of the embankment, there has been little vegetative growth on the embankment face. Physical topography adjacent to the embankment (west) is flat. Groundwater level measurements (Well No. 2016), in an area northwest of the embankment, indicate that the potentiometric surface of the upper Great Miami Aquifer is at 520.85 MSL. Grade elevation at Well 2016 is at 540.6 MSL. Consequently, precipitation that infiltrates the ground surface and percolates downward through the unsaturated zone must travel a distance of less than 20 feet before reaching the upper Aquifer. Potential lead contamination, added to the infiltrate by processes of leaching, dissolution, and desorption might ultimately reach the Aquifer.

Records referenced in the Preliminary Assessment were used to estimate a possible accumulation of up to 158,000 pounds of spent lead ammunition in the embankment soils. During the recent sampling, embankment soils were screened (No. 10 Sieve - 2 mm) to remove lead fragments from the sample. Materials retained on the screen were identified by the field geologist as a mixture of predominately spent lead ammunition and gravel native to the embankment soils. As Figure 1 indicates, most of this material was distributed within a depth of three feet of vertical boreholes Sp-2 and Sp-5 (Figure 1). Based on this information, the estimated quantity of spent lead present in the embankment may be calculated as follows:

- Sp-2 and Sp-5 locations are contained within the center-sectional area of the sample grid.
- Sectional area of the sample grid is 33 1/3 ft. x 25 ft.
- Vertical borehole diameter equals 3 1/4 in. area equals 0.058 $ft.^2$
- Vertical borehole volume is 0.058 $ft.^2$ x 5 ft. equals 0.29 $ft.^3$ or, 0.58 $ft.^3$ for Sp-2 and Sp-5, collectively. Mass of spent ammunition collected per Sp-2 and Sp-5 volume equals 1450 g or 3.2 lbs.
- Apparent density of spent ammunition with respect to Sp-2 and Sp-5 sample data equals 3.2 lbs. / 0.58 $ft.^3$ = 5.5 $lbs./ft.^3$

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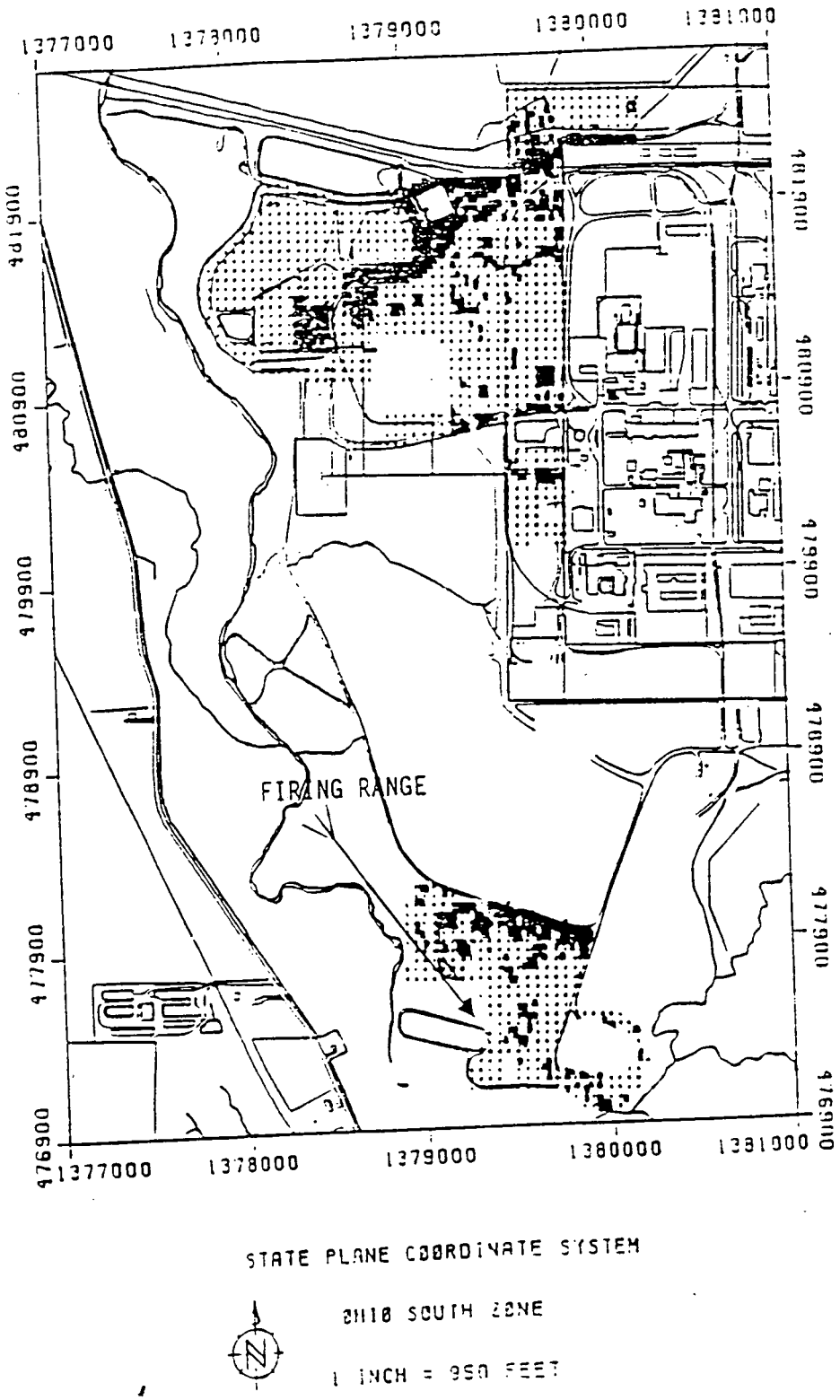


FIGURE 2 -- Firing Range Location

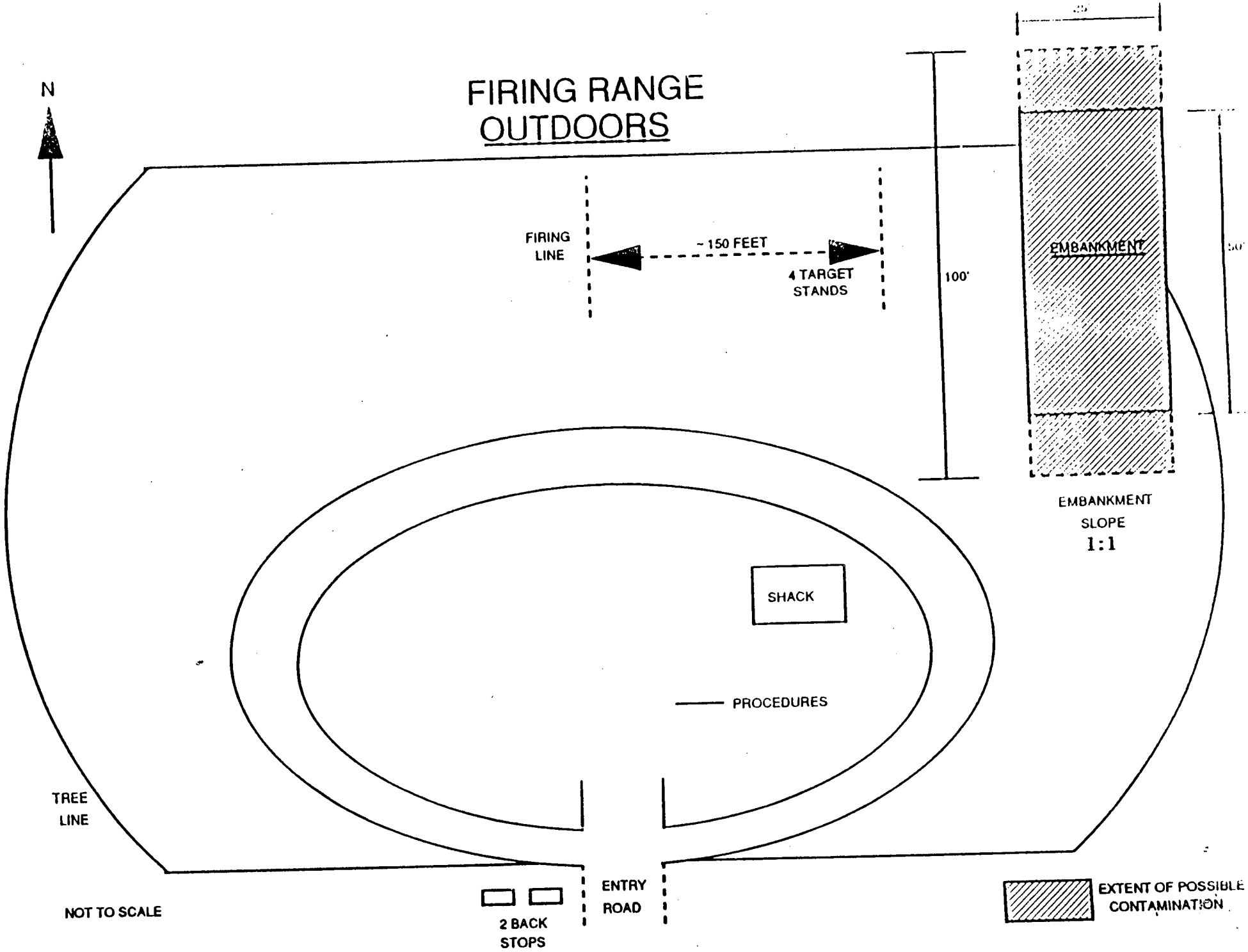
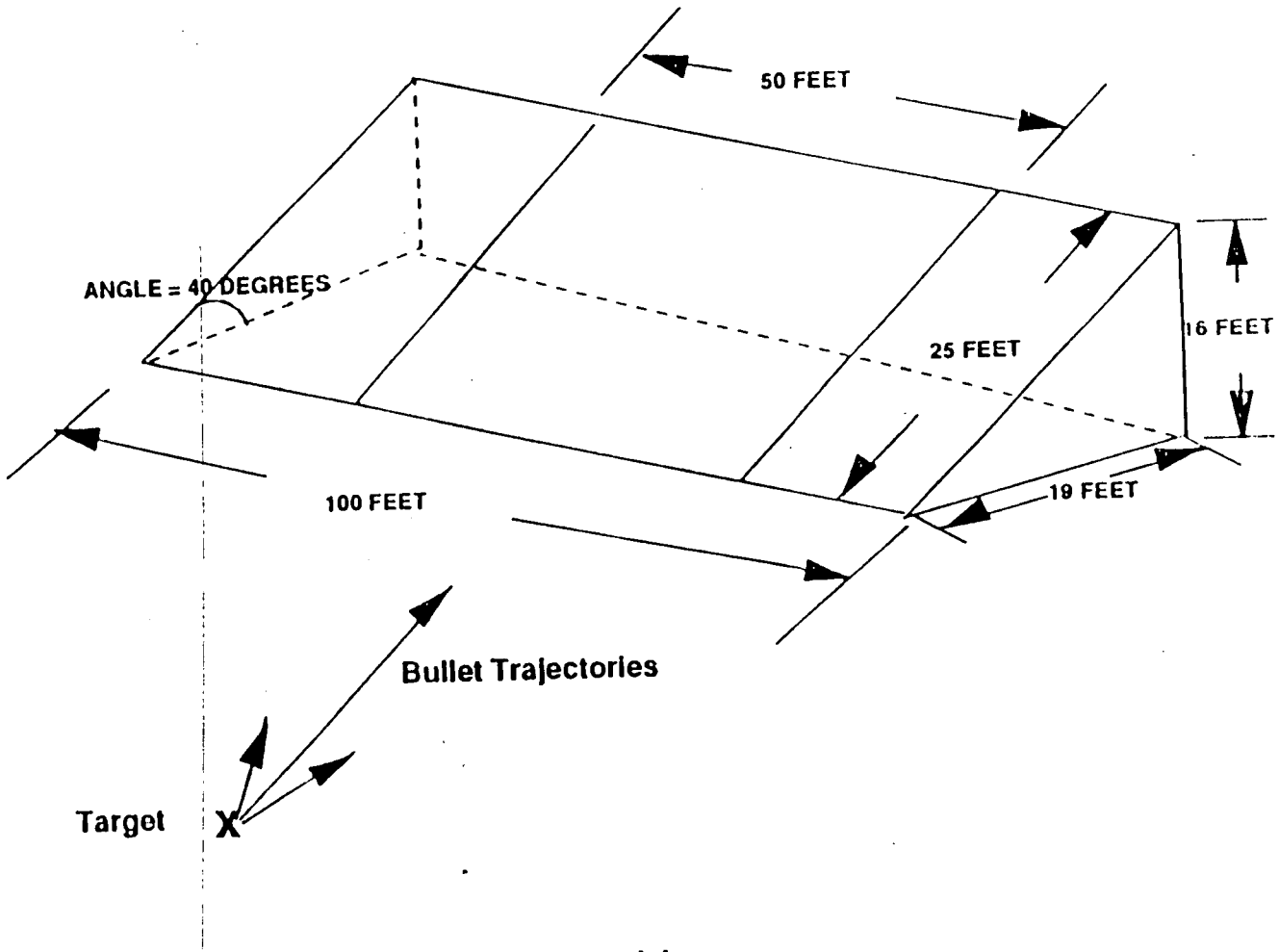

FIRING RANGE
OUTDOORS
N
FIRING LINE
~150 FEET
4 TARGET STANDS
100'
EMBANKMENT
EMBANKMENT SLOPE 1:1
SHACK
PROCEDURES
TREE LINE
ENTRY ROAD
2 BACK STOPS
NOT TO SCALE
EXTENT OF POSSIBLE CONTAMINATION

FIGURE 3

FIGURE 4

FIRING RANGE EMBANKMENT



Note 1. Embankment composed of natural and fill materials.

Note 2. Most of the lead is assumed to be contained within a 100' x 25' x 5' plane.

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SOURCE TERM *Cont'd.*

- Volume of center-sectional sample grid equals 33 1/3 ft. x 25 ft. x 5 ft. (conservative depth) equals 4167 $ft.^3$

- Refined estimate of spent ammunition based on lead obtained in sample volume and extrapolated to volume of study area equals 4167 $ft.^3$ x 5.5 $lbs./ft.^3$ = 22,920 lbs.

EVALUATION OF THE MAGNITUDE OF THE POTENTIAL THREAT

As described in the Preliminary Assessment, the primary routes of exposure to human or non-human populations associated with lead contamination include:

1 ▸ Ingestion of lead contaminated soils or waters,
2 ▸ Inhalation of dust contaminated with lead, and
3 ▸ Absorption of lead by direct skin contact.

Exposure to lead may cause temporary or permanent injury, teratogenic or life-threatening effects, as it accumulates in the blood stream and organs of humans. Symptoms associated with exposures may include anemia, stomach ailments and noticeable learning disability, particularly in children.

Data presented in Figure 1 and additional samples taken by the RI/FS subcontractor (Appendix A) indicate that both surficial and subsurface lead contamination is present in significant quantity in the soil matrix to produce hazardous leachate. Therefore an evaluation of the potential of lead contamination to migrate from the embankment soils to human or environmental receptors was warranted.

Groundwater in the vicinity of the embankment flows in a southeasterly direction. Down-gradient well monitoring data collected by WEMCO Environmental Monitoring indicate lead at concentrations well below regulatory concern. Consequently, vertical migration of lead from the embankment soils into the upper aquifer does not appear to have occurred as a result of solute transport through the embankment soil. This result is expected, since typically, "lead from firearms, when exposed to the environment, tends to oxidize and form a coating on the lead surface, which prevents it from being soluble by interaction with infiltrating surface water".[1]

[1] Mark Johnson, DYNAMAC HAZARDOUS MATERIALS TECHNICAL CENTER, Rockville, Maryland (Letter, July 13, 1988)

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EVALUATION OF THE MAGNITUDE OF THE POTENTIAL THREAT Cont'd.

Further evidence of the apparent insolubility of spent ammunition can be predicted using mathematical models that estimate unsaturated soil-contaminant transport potential. For example, using site-specific meteorological, soil, and aquifer parameters, and a worst-case soil concentration estimate of 2820 ppm total-lead (See Sp-5 results), lead contamination to the aquifer by vertical migration does not appear to occur, even after a period of 1000 years (See Appendix B - DECHEM Transport Modeling). Results indicate that at this time, and for future land use-scenarios, lead would tend to stay bound to the soil medium and contamination of the aquifer by solute transport would not pose a threat. This conclusion does not preclude the possibility that animal burrow holes or cracks in the soil may create pathways from the contamination zone to the aquifer.

The air pathway also represents an exposure route. Embankment surface soils are loose and dry, and devoid of vegetation during the winter months. With sufficiently strong wind conditions, soil particles may become re-suspended in the air. These soil particles may be contaminated with lead and can remain suspended for long distances. The U. S. Soil Conservation Service estimates these distances at ranges of up to 200 miles.[2] As a result, human exposure by inhalation or contamination of vegetation surfaces by re-suspended soils may be problematic, particularly where greater than 2000 ppm total-lead concentrations and leachable lead have been found at surface levels.

According to Joel Schwartz, public health officials are considering adopting 10 ug/dl as the blood-lead level above which action should be taken to prevent lead poisoning from occurring. Mr. Schwartz, a Senior Scientist for the U. S. EPA, has conducted studies that show that a child can become severely poisoned by eating just one milligram of lead-contaminated paint dust each day during childhood. Lead inhalation or ingestion in this quantity can cause blood-lead levels that far exceed the recommended 10 ug/dl action level. Although adults can probably tolerate larger doses, the scientific community agrees that even low-level doses cause damage.[3]

Worker or future resident exposures at the Firing Range, either by inhalation of lead entrained in suspended soil particles, or accidental ingestion of soil or dust from the embankment area, is a possibility. Furthermore, the effects of these exposures would be additive with respect to doses, for example, exposure to lead-contaminated paint or drinking-water systems received at home. Children living near the FEMP site boundary could also experience an additive exposure, if their environment already includes lead-contaminated sources.

[2] Agriculture Information Bulletin No. 555, Soil Erosion By Wind, United States Department of Agriculture, Soil Conservation Service

[3] Statement is information obtained in telephone conversation from J. M. Herskowitz (WEMCO) to J. Schwartz (U. S. EPA), May 21, 1992

To investigate potential lead inhalation exposures, a high volume air sampling probe was set at a height of 4 feet directly adjacent to the firing range embankment. On June 29, 1992 air sampling was conducted continuously for approximately 8 hours to determine if fugitive dust emissions from the embankment could result in a harmful inhalation exposure to an on-site worker in the immediate vicinity of the firing range. Analytical sample results (see Appendix C) obtained showed that lead concentrations in the breathing zone did not exceed 0.00002 mg/m^3 (Time Weighted Average). This result is significantly smaller then the National Institute for Occupational Safety and Health standard of 0.05 mg/m^3 (TWA). Therefore, workers exposed to lead concentrations in air of less then 0.05 mg/cubic meter during a 8 hour per day, 40 hour work week, are considered protected against impairment of health or functional capacity.

Based on the above, the threat of inhalation exposure to resuspended lead contaminated dust, for on and off-site human receptors, appears to be negligible. Further evidence to support this conclusion has been provided by WEMCO Environmental Compliance. After applying Ohio and U.S. EPA recommended methods for estimating fugitive particulate emissions, it was determined that resuspension of lead contaminated dust from the firing range embankment is highly unlikely (see Appendix D).

ASSESSMENT OF THE NEED FOR REMOVAL ACTION

Consistent with Section 40 CFR 300.410 of the NCP, the Department of Energy shall determine the appropriateness of a removal action. Outlined in Section 40 CFR 300.415 are eight factors considered appropriate in evaluating the need for a removal action. Those factors most relevant to the lead contamination at the Firing Range are as follows:

- Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants, or contaminants;
- Actual or potential contamination of drinking water supplies or sensitive ecosystems;
- Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or to be released;
- High levels of hazardous substances or pollutants or contaminants in soils, largely at or near the surface, that may migrate.

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These factors are considered appropriate as a result of the potential exposure to, or potential re-suspension of, lead contaminated soils from the FEMP Firing Range.

APPROPRIATENESS OF A RESPONSE

If it is determined that a response action is appropriate due to potential exposure to or threat of release of contaminants or hazardous substances, a removal action may be required to address the existing situation.

If a planning period of less than six months exists prior to initiation of a response action, DOE will issue an action memorandum. The action memorandum will describe the selected response and provide supporting documentation for the decision.

If it is determined that there is a planning period greater than six months before a response is initiated, DOE will issue an Engineering Evaluation/Cost Analysis (EE/CA) approval memorandum. This memorandum is to be used to document the threat to public health and the environment and to evaluate viable alternative response actions. It will also serve as a decision document to be included in the administration record.

Based on the evaluation of all of the above factors, it has been determined that the potential for lead to migrate vertically to the Great Miami Aquifer or become resuspended in air does not pose an immediate threat to either environmental or human receptors. This conclusion is based primarily on the results of vadose zone transport modeling, air sampling data that is considered to be representative of the study area, and application of fugitive dust emission models. Furthermore, as the area is subject to institutional controls (i.e., security patrols and fencing), accidental ingestion of lead contaminated soils is not expected to occur.

APPENDIX A

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
APR 15 1992 Remedial Investigation/Feasibility Study

Mr. Dennis Carr, CTM
Westinghouse Environmental Management
Company of Ohio
P.O. Box 398704
Cincinnati, OH 45239

Dear Mr. Carr:

Subject: Transmittal of Lead TCLP Extract of Soil

The following information on Lead TCLP extracts of soil is transmitted for your information. This data should be shared with Don Fleming of WEMCO's IRS&T Department.

On January 23, 1992, Russell Randle and Sandra Jones, from ASI/IT's Health and Safety Department, took soil samples to determine lead content at the Westinghouse Security Police firing and skeet range. Three samples were taken at each location. Purpose of the sampling was to determine soil lead concentrations for health and safety planning for proposed work. The samples were sent to Reed Environmental Services. An analysis was conducted in accordance with 40 CFR/Protection of Environment, Part 261, Appendix II for lead.

The following is a compiled list of the sample TCLP findings:

Health & Safety Sample Number	Location	Results mg/L
FR1	Firing range, at target	6.30*
FR2	Firing range, on hill directly behind target	23.7*
FR3	Firing range, firing point, approximately 25 ft in front of target	0.66
SR1	Skeet range, approximately two ft from the end of the concrete platform	1.03
SR2	Skeet range, approximately three ft from end of platform, inner circle of platform	0.28
SR3	Skeet range, approximately 75 ft from end of platform	0.21

* A solid waste exhibiting the characteristics of toxicity as defined in 40 CFR, 261.24/Toxicity Characteristics. The regulatory level for lead is 5.0 mg/L, 40 CFR, 261.24, Table 1.

If you have any questions or concerns, please contact Mr. Stephen Duce or Mr. Lee Vittitow at 738-3100.

Sincerely,

John D. Wood
Project Director

SJ7897.ppl

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ADVANCED SCIENCES, INC/IT CORPORATION
11003 HAMILTON CLEVES ROAD • P.O. BOX 475 • ROSS, OHIO 45061 (513) 738-3100

cc:

WEMCO
D. A. Nixon
P. J. Brown
J. L. Davis
S. D. Guess
D. L. Howe
G. K. Johnson
P. J. Juros
AR File
Central Files
CTM Files

DOE
J. R. Craig

ASI/IT
S. W. Duce
S. Jones
D. M. Harmel
N. E. Hopson
R. Randle
J. E. Razor
A. K. Reid
L. Vittitow
Project Files

REED ENVIRONMENTAL SERVICES

300 Doctors Building, 33 E. 7th Street
Covington, Kentucky 41011
(606) 431-6224
FAX 431-6228

February 27, 1992

Mr. Lee Vittetow
Advanced Sciences, Inc.
11003 Hamilton-Cleeves
Hamilton, OH 45061

Dear Mr. Vittetow:

Your samples were received in these laboratories on February 21, 1992 and were analyzed as received. Following are the results.

Sample	Result
FR1 - Firing Range	
Total Lead	521 mg/Kg
TCLP Extract - Lead	6.30 mg/L
FR2 - On hill behind targets	
Total Lead	262 mg/Kg
TCLP Extract - Lead	23.7 mg/L
FR3 - 25 ft. from targets	
Total Lead	25.1 mg/Kg
TCLP Extract - Lead	0.66 mg/L
SR1 - Skeet Range	
Total Lead	306 mg/Kg
TCLP Extract - Lead	1.03 mg/L
SR2 - Skeet Range	
Total Lead	182 mg/Kg
TCLP Extract - Lead	0.28 mg/L
SR3 - Skeet Range	
Total Lead	27.3 mg/Kg
TCLP Extract - Lead	0.21 mg/L

Also on February 21, 1992 we received in these laboratories samples from the EWMF Fernald Site, and these samples were analyzed for fiber using NIOSH 7400 methodology. The following results were obtained.

SOMETHING MISSING

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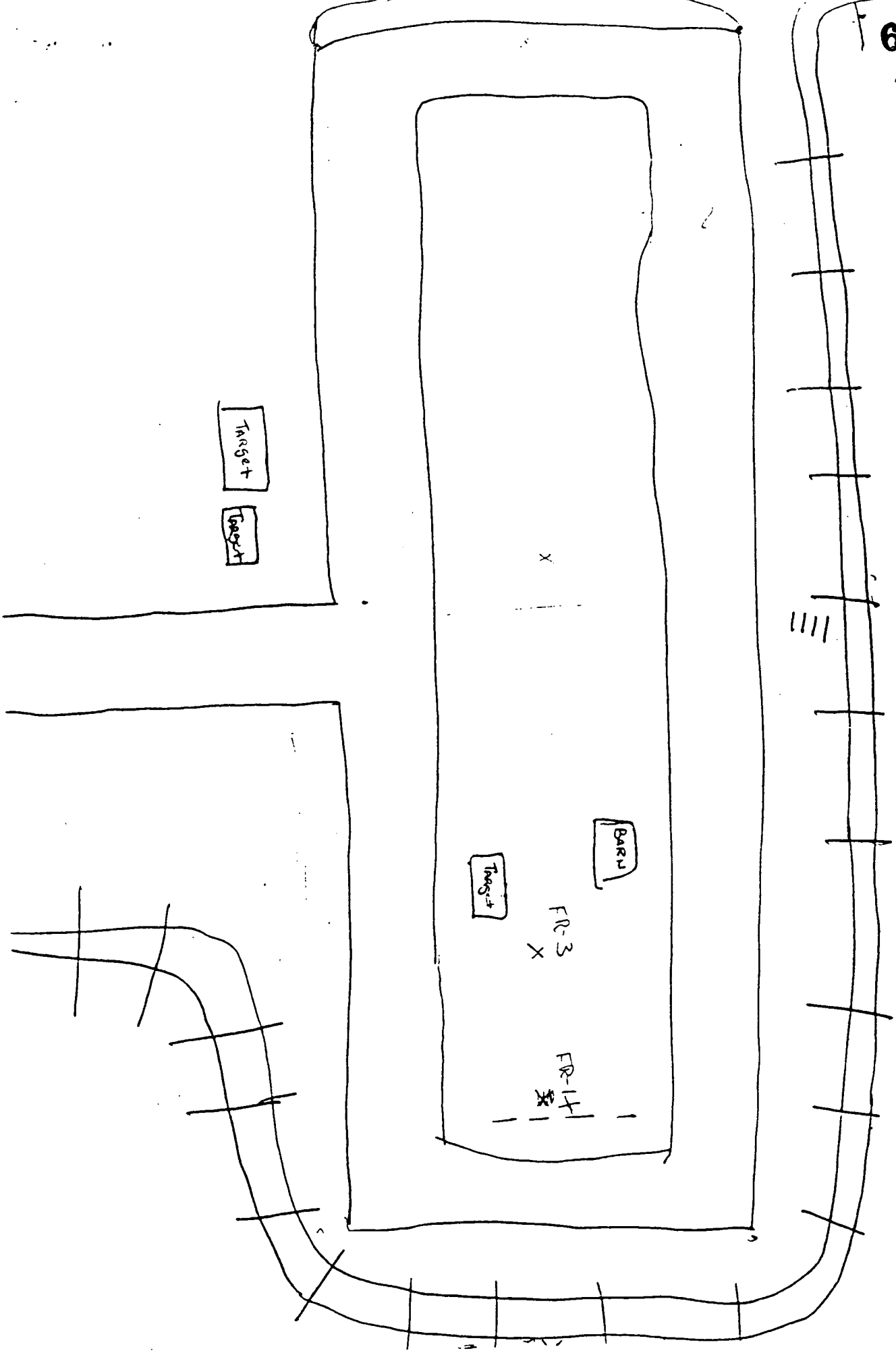
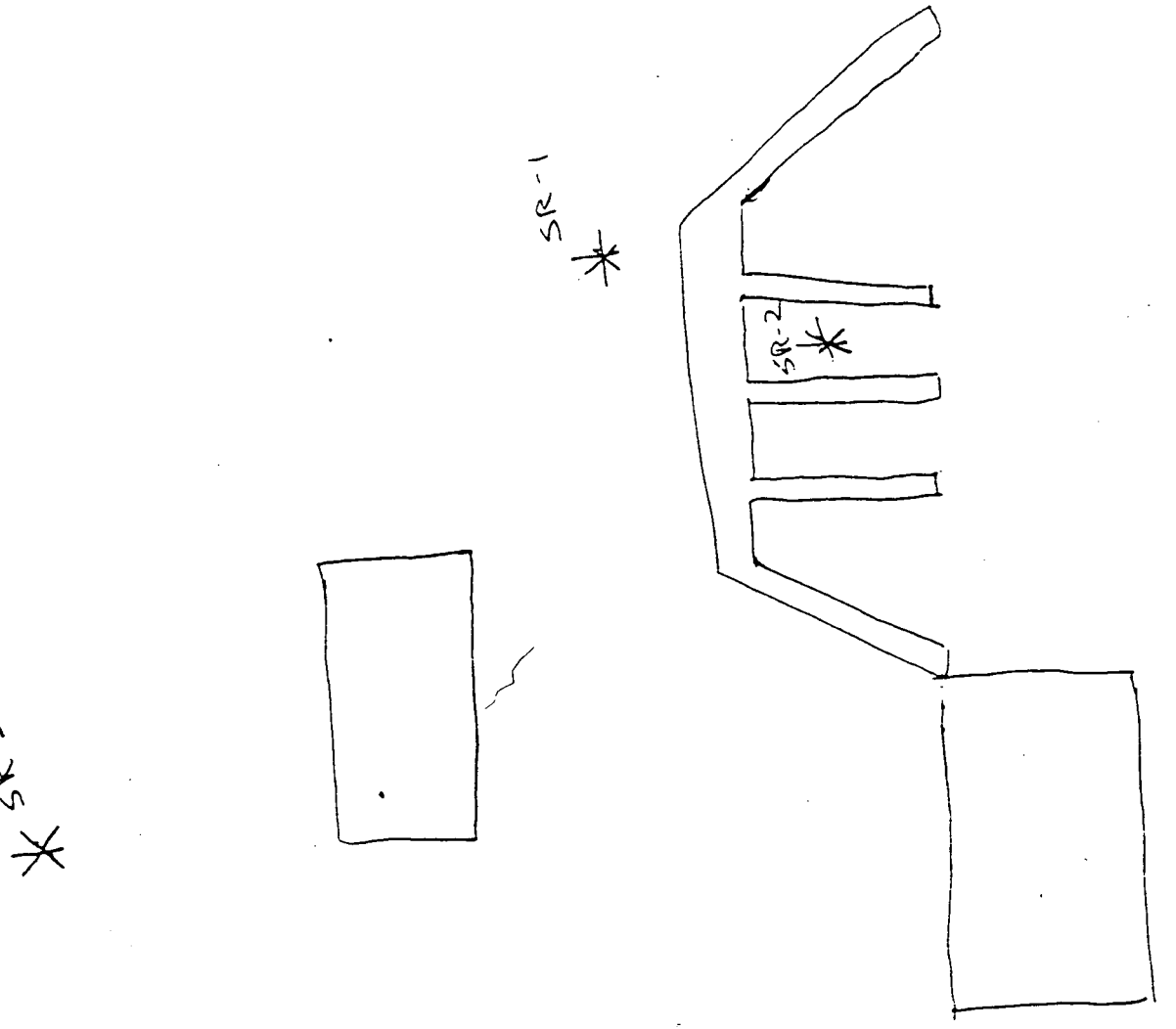

Target
Target
Target
BARU
FR-3
FR-4



SKEET Shoot RANGE

APPENDIX B

DECHEM (TM) -- RADIOLOGICAL ASSESSMENTS CORPORATION
Neeses, SC 29107
Risk-based assessment of exposure of people to sites of chemical contamination in soil after remedial measures.

Site: FEMP FIRING RANGE
Date and time of analysis: Wed May 06 11:42:46 1992
Data file: FIRE
Print file: FPRINT

SECTION I: PROBLEM DATA

Exposure pathways	In effect?
Food ingestion	Yes
Drinking water	Yes
Inhalation	Yes

Modifying (use) factors for exposure calculations	Percent
Percent of time that an individual spends on the decommissioned site:	100
Percentages of food types consumed by an individual that were produced on site:	
Produce	100
Leafy vegetables	100
Milk	100
Meat	100
Percent of an individual's drinking water that contains chemicals from the decommissioned site:	100

Food types	Included?
Produce	Yes
Leafy vegetables	Yes
Milk	Yes
Meat	Yes

Miscellaneous parameters that are not chemical-specific	
Atmospheric soil loading by resuspension (g/m^3):	7E-005
Produce consumption by exposed individual (kg/year):	176
Leafy vegetable consumption by exposed individual (kg/year):	18
Milk consumption by exposed individual (L/year):	112
Meat consumption by exposed individual (kg/year):	94
Drinking water consumption by exposed individual (L/year):	511
Annual breathing rate of exposed individual (m^3/year):	8030
Soil consumption by a cow (g/day):	500

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Site parameters applicable to all chemicals

Site length (m):	10
Site width (m):	8
Net water input rate (cm/year) (= rainfall + irrigation - evapotransp. - surf. runoff):	104

Layer depths (m) From -> To:	Soil bulk density (g/cm^3)	Effective soil porosity (fraction)	Soil moisture content (fraction)
0 -> 0.15	1.6	0.39	0.39
0.15 -> 0.3048	1.6	0.39	0.39
0.3048 -> 0.61	1.6	0.39	0.39
0.61 -> 0.91	1.6	0.39	0.39
0.91 -> 1.22	1.6	0.39	0.39
1.22 -> 1.52	1.6	0.39	0.39
1.52 -> 6.1	1.6	0.39	0.39

Parameters for the groundwater aquifer (drinking water pathway)

Distance of water source from decommissioned area (m):	0
Effective porosity of aquifer (cm^3/cm^3):	0.39
Longitudinal dispersivity in aquifer (m):	1
Transverse dispersivity in aquifer (m):	1
Seepage velocity in aquifer (m/s):	0.001
Thickness of aquifer (m):	30.5
Density of soil in aquifer (g/cm^3):	1.6
Pre-cleanup buildup of residual groundwater contamination (years):	35

Chemical-specific profiles for AS

Soil layers (m)	Initial post-cleanup concentration (ppm)	Soil/water K_d coefficient (mL/g)	Solubility in water (g/mL)
0 -> 0.15	2820	3000	0.443
0.15 -> 0.3048	2270	3000	0.443
0.3048 -> 0.61	503	3000	0.443
0.61 -> 0.91	204	3000	0.443
0.91 -> 1.22	2.1	3000	0.443
1.22 -> 1.52	11.6	3000	0.443
1.52 -> 6.1	0	3000	0.443
Aquifer	0 mg/L	3000	

Chemical-specific parameters

	AS
Intake limits for reference values (mg/year):	
Inhalation:	18.3

Ingestion:	73
n-octanol/water coefficient (organic chemicals only):	-----
Soil and groundwater loss-rate coefficient for physical, chemical and biological processes (1/year):	0
Bioconcentration factors referenced to dry soil:	
Pasture grass: (a)	0.04
Crops: (b)	0.003
Milk (kg/L):	3.74E-005
Meat:	0.00125

(a) Dry weight. (b) Edible parts, wet weight.
(c) BCF calculated from n-octanol/water coefficient (K_ow).

SECTION II: PROBLEM RESULTS

Annual reference value for all chemicals over time

Time (years after cleanup)	Total: all chemicals	AS
1	30.7	30.7
5	30.6	30.6
10	30.3	30.3
20	29.9	29.9
50	28.6	28.6
100	26.6	26.6
500	14.9	14.9
1000	7.26	7.26

Annual reference value by pathway: All Chemicals

Time (years after cleanup)	Total: All Pathways	Vegetables	Milk	Meat	Drinking Water	Inhalation
1	30.7	22.2	0.291	8.15	1.76E-011	0.0867
5	30.6	22.1	0.29	8.1	8.54E-011	0.0862
10	30.3	21.9	0.288	8.05	1.66E-010	0.0856
20	29.9	21.6	0.283	7.93	3.27E-010	0.0844

50	28.6	20.7	0.271	7.59	8.05E-010	0.0808
100	26.6	19.2	0.253	7.07	1.6E-009	0.0752
500	14.9	10.8	0.142	3.96	9.89E-009	0.0422
1000	7.26	5.24	0.0688	1.93	3.62E-008	0.0205

Annual reference value by pathway: AS

Time (years after cleanup)	Total: All Pathways	Vegetables	Milk	Meat	Drinking Water	Inhalation
1	30.7	22.2	0.291	8.15	1.76E-011	0.0867
5	30.6	22.1	0.29	8.1	8.54E-011	0.0862
10	30.3	21.9	0.288	8.05	1.66E-010	0.0856
20	29.9	21.6	0.283	7.93	3.27E-010	0.0844
50	28.6	20.7	0.271	7.59	8.05E-010	0.0808
100	26.6	19.2	0.253	7.07	1.6E-009	0.0752
500	14.9	10.8	0.142	3.96	9.89E-009	0.0422
1000	7.26	5.24	0.0688	1.93	3.62E-008	0.0205

Chemical concentrations in and transfer rates among exposure media

Chemical: AS
Time: 1 years since cleanup

Soil layer From -> To (m):	Concentrations in Soil And Soil Water: Soil (ppm)	Water (mg/L)
0 -> 0.15	2820	0.939
0.15 -> 0.3048	2270	0.757
0.3048 -> 0.61	504	0.168
0.61 -> 0.91	204	0.0681
0.91 -> 1.22	2.24	0.000747
1.22 -> 1.52	11.6	0.00386
1.52 -> 6.1	0.000548	1.83E-007

Rates of Transfer from Soil To Other Media (mg/(cm^2 y))

Soil to Air:	
Diffusion	0
Evapotransp.	0
Soil to Groundwater:	
Leaching	0

Concentrations in Other Exposure Media

Air Concentrations (mg/cm^3):	
Resusp. Part.	0.000197
Vapors	0
Milk (mg/L)	0.19
Meat (mg/kg)	6.33
Vegs. (mg/kg)	8.45
Pasture (mg/kg)	113

Concentration in Groundwater at Well (Receptor) (mg/L): 2.52E-012

Chemical concentrations in and transfer rates among exposure media

Chemical: AS
Time: 5 years since cleanup

Soil layer From -> To (m):	Concentrations in Soil And Soil Water: Soil (ppm)	Water (mg/L)

Rates of Transfer from Soil To Other Media (mg/(cm^2 y))

Soil to Air:	
Diffusion	0
Evapotransp.	0
Soil to Groundwater:	

0 -> 0.15	2800	0.933
0.15 -> 0.3048	2270	0.758
0.3048 -> 0.61	509	0.17
0.61 -> 0.91	205	0.0684
0.91 -> 1.22	2.81	0.000935
1.22 -> 1.52	11.6	0.00386
1.52 -> 6.1	0.00274	9.13E-007

Leaching 7.6E-008

Concentrations in Other Exposure Media

Air Concentrations (mg/cm^3):
Resusp. Part. 0.000196
Vapors 0
Milk (mg/L) 0.189
Meat (mg/kg) 6.29
Vegs. (mg/kg) 8.4
Pasture (mg/kg) 112

Concentration in Groundwater at Well (Receptor) (mg/L): 1.22E-011

Chemical concentrations in and transfer rates among exposure media

Chemical: AS
Time: 10 years since cleanup

Soil layer From -> To (m):	Concentrations in Soil And Soil Water: Soil (ppm)	Water (mg/L)
0 -> 0.15	2780	0.926
0.15 -> 0.3048	2280	0.759
0.3048 -> 0.61	515	0.172
0.61 -> 0.91	206	0.0687
0.91 -> 1.22	3.51	0.00117
1.22 -> 1.52	11.5	0.00385
1.52 -> 6.1	0.00547	1.82E-006

Rates of Transfer from Soil To Other Media (mg/(cm^2 y))

Soil to Air:
Diffusion 0
Evapotransp. 0
Soil to Groundwater:
Leaching 1.71E-007

Concentrations in Other Exposure Media

Air Concentrations (mg/cm^3):
Resusp. Part. 0.000195
Vapors 0
Milk (mg/L) 0.187
Meat (mg/kg) 6.25
Vegs. (mg/kg) 8.34
Pasture (mg/kg) 111

Concentration in Groundwater at Well (Receptor) (mg/L): 2.37E-011

Chemical concentrations in and transfer rates among exposure media

Chemical: AS
Time: 20 years since cleanup

Soil layer From -> To (m):	Concentrations in Soil And Soil Water: Soil (ppm)	Water (mg/L)
0 -> 0.15	2740	0.913
0.15 -> 0.3048	2280	0.761
0.3048 -> 0.61	528	0.176
0.61 -> 0.91	208	0.0695
0.91 -> 1.22	4.93	0.00164

Rates of Transfer from Soil To Other Media (mg/(cm^2 y))

Soil to Air:
Diffusion 0
Evapotransp. 0
Soil to Groundwater:
Leaching 1.9E-007

Concentrations in Other Exposure Media

Air Concentrations (mg/cm^3):

25

1.22 -> 1.52	11.5	0.00383
1.52 -> 6.1	0.0109	3.64E-006

Resusp. Part.	0.000192
Vapors	0
Milk (mg/L)	0.185
Meat (mg/kg)	6.16
Vegs. (mg/kg)	8.22
Pasture (mg/kg)	110

Concentration in Groundwater at Well (Receptor) (mg/L): 4.67E-011

Chemical concentrations in and transfer rates among exposure media

Chemical: AS
Time: 50 years since cleanup

Soil layer From -> To (m):	Concentrations in Soil And Soil Water: Soil (ppm)	Water (mg/L)
0 -> 0.15	2620	0.874
0.15 -> 0.3048	2300	0.767
0.3048 -> 0.61	565	0.188
0.61 -> 0.91	216	0.0719
0.91 -> 1.22	9.23	0.00308
1.22 -> 1.52	11.4	0.0038
1.52 -> 6.1	0.0271	9.03E-006

Rates of Transfer from Soil To Other Media (mg/(cm^2 y))

Soil to Air:	
Diffusion	0
Evapotransp.	0
Soil to Groundwater:	
Leaching	7.53E-007

Concentrations in Other Exposure Media

Air Concentrations (mg/cm^3):	
Resusp. Part.	0.000184
Vapors	0
Milk (mg/L)	0.177
Meat (mg/kg)	5.9
Vegs. (mg/kg)	7.87
Pasture (mg/kg)	105

Concentration in Groundwater at Well (Receptor) (mg/L): 1.15E-010

Chemical concentrations in and transfer rates among exposure media

Chemical: AS
Time: 100 years since cleanup

Soil layer From -> To (m):	Concentrations in Soil And Soil Water: Soil (ppm)	Water (mg/L)
0 -> 0.15	2440	0.814
0.15 -> 0.3048	2320	0.772
0.3048 -> 0.61	626	0.209
0.61 -> 0.91	229	0.0764
0.91 -> 1.22	16.5	0.00552
1.22 -> 1.52	11.4	0.00381
1.52 -> 6.1	0.054	1.8E-005

Rates of Transfer from Soil To Other Media (mg/(cm^2 y))

Soil to Air:	
Diffusion	0
Evapotransp.	0
Soil to Groundwater:	
Leaching	1.68E-006

Concentrations in Other Exposure Media

Air Concentrations (mg/cm^3):	
Resusp. Part.	0.000171
Vapors	0
Milk (mg/L)	0.165
Meat (mg/kg)	5.49
Vegs. (mg/kg)	7.32
Pasture (mg/kg)	97.6

Concentration in Groundwater at
Well (Receptor) (mg/L): 2.28E-010

Chemical concentrations in and transfer rates among exposure media

Chemical: AS
Time: 500 years since cleanup

Soil layer From -> To (m):	Concentrations in Soil And Soil Water: Soil (ppm)	Water (mg/L)
0 -> 0.15	1370	0.457
0.15 -> 0.3048	2100	0.699
0.3048 -> 0.61	1020	0.342
0.61 -> 0.91	385	0.128
0.91 -> 1.22	86.9	0.029
1.22 -> 1.52	21.5	0.00715
1.52 -> 6.1	0.334	0.000111

Rates of Transfer from Soil To Other Media (mg/(cm^2 y))

Soil to Air:	
Diffusion	0
Evapotransp.	0
Soil to Groundwater:	
Leaching	8.48E-006

Concentrations in Other Exposure Media

Air Concentrations (mg/cm^3):	
Resusp. Part.	9.59E-005
Vapors	0
Milk (mg/L)	0.0924
Meat (mg/kg)	3.08
Vegs. (mg/kg)	4.11
Pasture (mg/kg)	54.8

Concentration in Groundwater at
Well (Receptor) (mg/L): 1.41E-009

Chemical concentrations in and transfer rates among exposure media

Chemical: AS
Time: 1000 years since cleanup

Soil layer From -> To (m):	Concentrations in Soil And Soil Water: Soil (ppm)	Water (mg/L)
0 -> 0.15	665	0.222
0.15 -> 0.3048	1510	0.504
0.3048 -> 0.61	1250	0.418
0.61 -> 0.91	623	0.208
0.91 -> 1.22	212	0.0707
1.22 -> 1.52	60.4	0.0201
1.52 -> 6.1	1.22	0.000408

Rates of Transfer from Soil To Other Media (mg/(cm^2 y))

Soil to Air:	
Diffusion	0
Evapotransp.	0
Soil to Groundwater:	
Leaching	3.36E-005

Concentrations in Other Exposure Media

Air Concentrations (mg/cm^3):	
Resusp. Part.	4.66E-005
Vapors	0
Milk (mg/L)	0.0449
Meat (mg/kg)	1.5
Vegs. (mg/kg)	2
Pasture (mg/kg)	26.6

Concentration in Groundwater at
Well (Receptor) (mg/L): 5.17E-009

TABLE 6-2
REPRESENTATIVE FLOW PARAMETERS FOR THE FEMP[a]

Parameter	Vadose	Aquifer[b]
Porosity (%)	31 - 39	39
Specific Yield (%)	6 - 25	25
Bulk Density (g/cm^3)	1.6 - 1.8	1.6
Field Capacity (%)	14 - 28	14
Dispersion coefficient (ft^2/d)	0.00071 - 0.00187	109
Hydraulic Conductivity		
- Vertical (ft/day)	0.000355 - 45	45
- Horizontal (ft/day)	0.0071 - 450	450
Seepage Velocity (ft/day)	0.001 - 0.014	1.09

a RI/FS Database
b Mean values obtained from SWIFT III calibration

APPENDIX C

ENVIRONMENTAL HEALTH RESEARCH AND TESTING, INC.

RESULT SHEET

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TESTING ENVIRONMENT

CUSTOMER NAME: WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO

ANALYSIS PERFORMED: Total Lead Analysis (NIOSH 7300)

DATE ANALYZED: 08-01-92 LAB NOTEBOOK NO.: 254, Pg. 28 & 29

SAMPLE NUMBERS EHRT NO.	CUSTOMER NO.	MATRIX	m^3	RESULTS (ug/filter)
~~15352-001~~	~~26563~~	~~Filter~~		~~0.12~~
~~15352-002~~	~~26592~~	~~Filter~~		~~0.048~~
15352-003	26623 C-36	Filter	25.8	0.24
15352-004	26624 HALL 189	Filter	30.5	0.27
7/10 15352-005	26625 Rm 190 (ANTE Rm)	Filter	25.5	0.094
7/13 15352-006	26640 Rm 150	Filter	26.3	0.088
15352-007	26641 WEST HALL SMOKING AREA.	Filter		0.50
15352-008	26642 OUTSIDE Rm 189.	Filter	9.03	0.64
15352-009	26643 C-36	Filter	7.88	0.13
15352-010	26654 BLANK	Filter		0.045
15352-011	26687 Rm 212	Filter		4.4

QUALITY CONTROL

Method Blank	N/A	Blank	BDL

Detection Limit - < 0.010 ug/filter

.05 g/m³ TLV

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Chemical name, structure/formula, CAS and RTECS Nos., and DOT ID and Guide Nos.	Synonyms, trade names, and conversion factors	Exposure limits (TWA unless noted otherwise)	Code	Description	Proper MW, BP, SOL Fl.P, IP, So.Gr, flammability	VP FRZ JEL, LEL	and reactivities	method (See Table 1)
Lead (as Pb) Pb 7439-92-1 (Metal) OF7525000 (Metal) (Pb: 53 soluble cmpds)	Metal: Lead metal, Plumbum (Note: OSHA considers "Lead" to mean metallic Pb, all inorganic Pb cmpds (Pb oxides and Pb salts), and a class of organic Pb cmpds called soaps. All other organic Pb cmpds are excluded from this definition.)	NIOSH 0.100 mg/m3 (Air concentration to be maintained so that worker blood lead remains <0.060 mg/100 g of whole blood.) OSHA (1910.1025) 0.050 mg/m3	100 mg/m3	Metal: A heavy, ductile, soft gray solid.	MW: 207.2 BP: 3164°F Sol: Insoluble Fl.P: NA IP: NA So.Gr: 11.34 (Metal) Metal: Noncombustible Solid in bulk form.	VP: 0 mm (approx) MLT: 621°F JEL: NA LEL: NA	Strong oxidizers, hydrogen peroxide, acids	Filter: HNO_3/H_2O_2, AA: III [#7082]
Lindane $C_6H_6Cl_6$ 58-89-9 GV4900000 (Z761: 55)	BHC Gamma-Hexachlorocyclohexane. HCH 1,2,3,4,5,6-Hexachlorocyclohexane	NIOSH/OSHA 0.5 mg/m3 (skin)	500 [illegible]	White to yellow crystalline powder with a slight musty odor. Pesticide.	MW: 290.8 BP: 614°F Sol: 0.001% Fl.P: NA IP: ? So.Gr: 1.85 Noncombustible Solid, but may be dissolved in flammable liquids.	VP: 0.00001 mm MLT: 235°F JEL: NA LEL: NA	Corrosive to metals	Filter/Bub: isooctane; GC/EConD: III [#55021]
Lithium hydride LiH 7580-67-8 OJ6300000 (Z414: 40 Z805: 40 (Used solid))	Lithium monohydride	NIOSH/OSHA 0.025 mg/m3	55 mg/m3	Odorless, off white to gray translucent, crystalline mass or white powder.	MW: 7.95 BP: Decomposes Sol: Reacts Fl.P: ? IP: NA So.Gr: 0.78 Combustible Solid, but can form airborne dust clouds which may explode on contact with flame, heat, or oxidizers.	VP: 0 mm (approx) MLT: 1256°F JEL: ? LEL: ?	Strong oxidizers, halogenated hydrocarbons, acids, water (Note: May ignite SPONTANEOUSLY in air and may reignite after fire is extinguished. Reacts with water to form hydrogen & lithium hydroxide.)	None available
LPG C_3H_8, C_4H_{10}, C_4H_8, C_4H_6 68476-85-7 OE7545000 (Z875: 00)	Bottled gas. Compressed petroleum gas. Liquefied hydrocarbon gas. Liquefied petroleum gas. LPG	NIOSH/OSHA 1000 ppm (1800 mg/m3)	19,000 ppm (LEL)	Colorless, noncorrosive, odorless gas when pure. (Note: A foul-smelling odorant is usually added. A fuel mixture of propane, propylene, butanes & butylenes. Shipped as a liquefied compressed gas.)	MW: 42 to 58 BP: >-44°F Sol: ? Fl.P: NA (Gas) IP: 10.95 eV Flammable Gas	VP: >1 atm FRZ: ? UEL: 9.5%) (Propane) 8.4% (Butane) LEL: 2.1% (Propane) 1.6% (Butane)	Strong oxidizers, chlorine dioxide	Combustible gas meter: none; none; II(2) [#S93]

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WEMCO

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CONTAMINANTS (contd.)

Code	Description	1990/91 ACGIH *1 TWA Limit	Units
0178	Hydrocarbons	none.	mg/m3
0180	Hydrogen chloride (Ceiling limit *2)	5.	ppm
0190	Hydrogen fluoride (Ceiling & TWA limit *2)	3.	ppm
0200	Hydrogen sulfide	10.	ppm
0210	Iron oxide fume	5.	mg/m3
0215	Isopropanol (2-propanol)	400.	ppm
0220	Lead, inorganic *4	0.05	mg/m3
0221	Lead-212 (Thorium-B) *5	4400.	α d/m/m3
0230	Lithium carbonate	none.	mg/m3
0240	Magnesium oxide fume	10.	mg/m3
0250	Manganese fume	1.	mg/m3
0260	Mercury, vapor	0.05	mg/m3
0265	Methyl alcohol SKIN*7	200.	ppm
0270	Methylene chloride (Suspect Human Carcinogen)	50.	ppm
0271	Methyl ethyl ketone (2-Butanone) (Ceiling Limit *2)	200.	ppm
0272	Methyl isobutyl ketone (4-methyl-2-pentanone)	50.	ppm
0275	Methyl mercaptan	0.5	ppm
0280	Nickel metal	1.	mg/m3
0290	Nitric acid	2.	ppm
0300	Nitric oxide (NO)	25.	ppm
0310	Nitrogen dioxide (NO2) (STEL) *4	1.	ppm
0311	Nitrous gases (NOx)	none	ppm
0320	Nuisance dust, total (< 1% free silica)	10.	mg/m3
0330	Nuisance dust, respirable *4	5.	mg/m3
0340	Odor (breathing air - CGA Grade D)	absent.	pres./absent
0350	Oil mist, mineral	5.	mg/m3
0351	Oil mist, vegetable	none.	mg/m3
0360	Oxygen (breathing air - CGA Grade D)	19.5-22	%v/v
0370	Ozone	0.1	ppm
0375	PCB's, Mixture of 42 & 54% clorinated SKIN *7	0.5	mg/m3
0377	Pentane, n-	600.	ppm
[illegible]	Perchloric acid	none	ppm

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APPENDIX D

WEMCO
OUT

From: K. O. Klee

JUL 8 8 22 AM '92

WEMCO:EC&QA:(SC):92-178

Date: July 2, 1992

Subject: POSSIBLE LEAD-CONTAINING FUGITIVE DUST EMISSIONS FROM THE OUTDOOR FIRING RANGE

To: Jay Herskowitz

I looked at the firing range and the location at which the samples were taken for lead analysis. The firing range is located in an area of less than two acres and is almost completely covered with vegetation. It is a low-lying area; open, fairly flat and surrounded by trees.

Samples 1 through 7 were taken from the hill located at the Northeast corner of the firing range area. This hill is surrounded by trees on the North, South and East and is open to the West. Samples 8, 9 and 10 were taken from the grassy area to the West of the hill.

The equation I have for estimating fugitive dust emissions assumes that the area in question is barren. Trees and other vegetation covering the firing range protect the soil from both wind and water erosion. Resuspension of lead-contaminated dust from the firing range area is highly unlikely because of the extent of the vegetative growth.

Air emissions of fugitive dust or lead-contaminated dust are not likely to occur from this area and this area would not be considered a source of air emissions as long as it is not disturbed.

If you have any additional questions or comments, please call me at x8640.

Kay Klee

K. O. Klee
Sitewide Regulatory Integration

c: S. M. Beckman
P. B. Spotts
SC Files
Central Files

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1) Reasonably Available Control Measures (RACM) for Fugitive Dust Sources. Ohio EPA. September 1980.

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2) Method for Estimating Fugitive Particulate Emissions from Hazardous Waste Sites. U. S. Environmental Protection Agency, Cincinnati, Ohio. August 1987. EPA/600/2-87/066. PB87-232203.