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CONTRACT NO. DE-AC05-86OR21548

CLOSEOUT REPORT FOR THE FROG POND DRAINAGE

WELDON SPRING SITE REMEDIAL ACTION PROJECT
WELDON SPRING, MISSOURI

OCTOBER 2000 **REV. 0**

U.S. Department of Energy
Oak Ridge Operations Office
Weldon Spring Site Remedial Action Project

Prepared by MK-Ferguson Company and Jacobs Engineering Group

MORRISON KNUDSEN CORPORATION MK-FERGUSON GROUP Weldon Spring Site Remedial Action Project Contract No. DE-AC05-86OR21548	
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PLAN TITLE: Close Out Report for the Frog Pond Drainage	

APPROVALS

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DOE/OR/21548-840

Weldon Spring Site Remedial Action Project

Close Out Report for the Frog Pond Drainage

Revision 0

October 2000

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U.S. DEPARTMENT OF ENERGY
Oak Ridge Operations Office
Under Contract DE-AC05-86OR21548

ABSTRACT

The closeout report for the Frog Pond Drainage summarizes the numerous activities involved in the characterization and remediation of the property. The Frog Pond Drainage Outlet is located on Missouri Department of Conservation property and was contaminated as a result of past U.S. Atomic Energy Commission activities. Pre-remediation chemical and radiological characterizations, remedial construction, and cleanup verification activities are detailed within this report.

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1. INTRODUCTION

1.1 Purpose

This closeout report has been prepared to document remedial actions within the Missouri Department of Conservation (MDC) Frog Pond drainage area. The Frog Pond drainage is on Missouri Department of Conservation property and is located north of the Weldon Spring Chemical Plant.

1.2 Scope

A close-out report for each vicinity property or grouping of vicinity properties will be prepared following remedial activities. These close-out reports will be included in the remedial action report for the Weldon Spring Chemical Plant Operable Unit, which will be prepared in accordance with *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA) requirements. A final site close-out report will also be prepared to complete deletion of the Weldon Spring Site from the National Priorities Listing.

1.3 Background

The Weldon Spring site is located in St. Charles County, Missouri, approximately 48 km (30 mi) west of St. Louis. The site consists of two geographically distinct areas; the 88-ha (217 acre) chemical plant area and a 3.6 ha (9 acre) limestone quarry. The chemical plant area is approximately 3.2 km (2 mi) southwest of the junction of Missouri State Route 94 and U.S. Route 40/61. The quarry is located about 6.4 km (4 mi) south-southwest of the chemical plant area. The chemical plant area and the quarry are accessible from State Route 94 and both are currently fenced and closed to the public.

The chemical plant area was initially used by the U.S. Department of the Army (the Army) to produce the explosives trinitrotoluene (TNT) and dinitrotoluene (DNT) from 1941 to 1946. By 1949, all but 810 ha (2,000 acre) of the ordnance works property had been transferred to the State of Missouri and the University of Missouri. Most of the remaining property became the chemical plant area of the Weldon Spring site and the adjacent U.S. Army Reserve and National Guard training area.

In May 1955, the U.S. Atomic Energy Commission (AEC), a predecessor of the U.S. Department of Energy (DOE), acquired 83 ha (205 acre) to construct a uranium feed materials plant. After extensive demolition, decontamination, and re-grading, the chemical plant was built by the AEC to process uranium and thorium ore concentrates from 1957 to 1966. Radioactively and chemically contaminated waste was disposed of within the chemical plant area during this period. Radioactive contaminants are primarily radionuclides of the natural uranium and Thorium-232 decay series. Chemical contaminants of concern include heavy metals and inorganic anions in excess of naturally occurring background levels, as well as organics

including polychlorinated biphenyls (PCBs) and polynuclear (or polycyclic) aromatic hydrocarbons (PAHs).

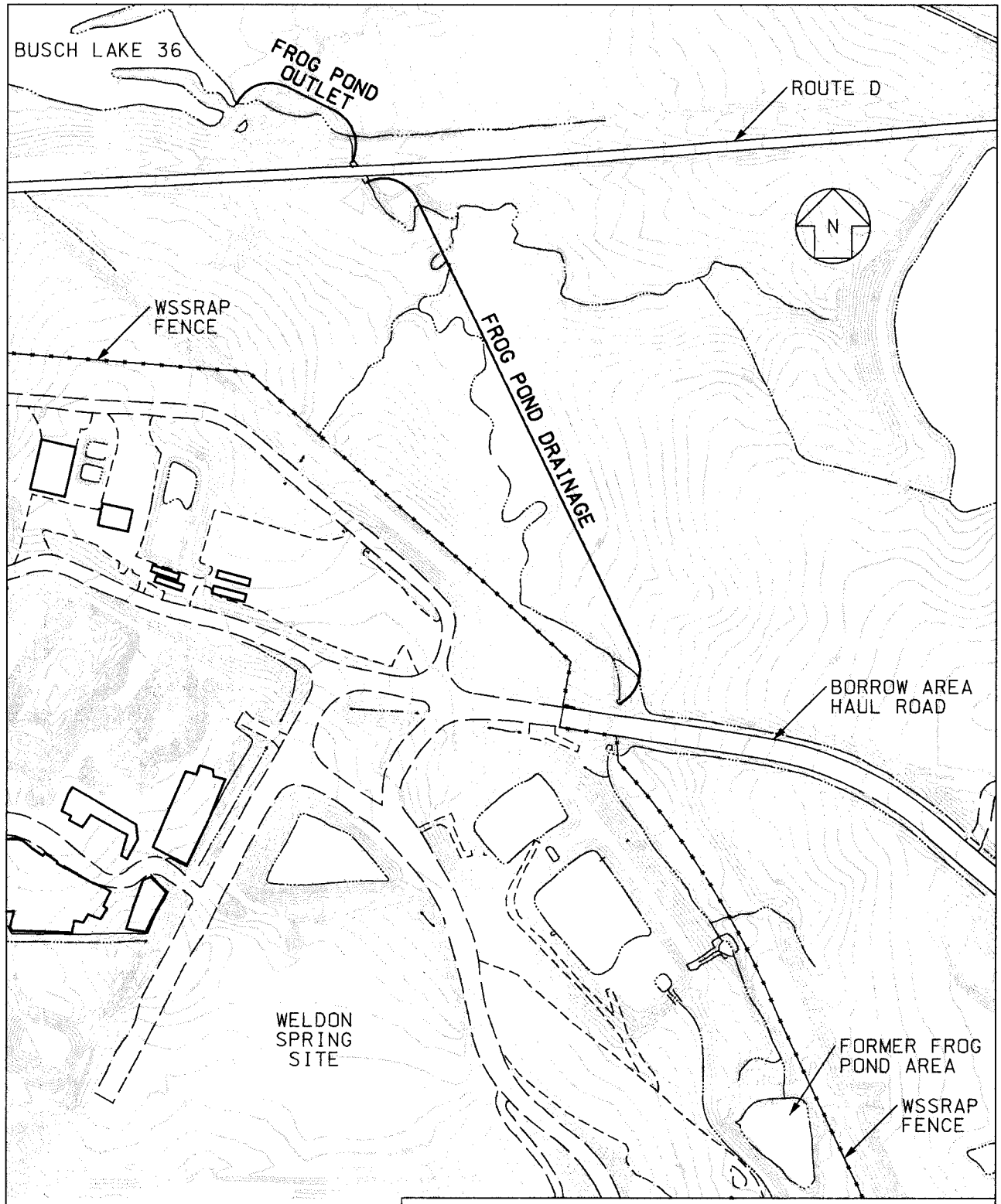
In 1958, the AEC acquired title to the Weldon Spring Quarry from the Army. The Army had used the quarry since 1942 for burning wastes from the manufacture of TNT and DNT and disposal of TNT-contaminated rubble during the operation of the ordnance works. Prior to 1942, the quarry was mined for limestone aggregate used in the construction of the ordnance works. The AEC used the quarry from 1963 to 1969 as a disposal area for uranium residues and a small amount of thorium residue. Material disposed of in the quarry during this time also consisted of building rubble and soils from the demolition of a uranium ore processing facility in St. Louis. These materials were contaminated with uranium and radium. Other radioactive materials in the quarry included drummed wastes, uncontained wastes, and contaminated process equipment.

The Army reacquired the chemical plant property in 1967 and began decontamination and dismantlement operations in order to prepare the facility for herbicide production. However, this project was cancelled in 1969 before production was initiated, and the Army returned responsibility for the property to the DOE.

The Weldon Spring site was placed in caretaker status from 1981 to 1985, when custody was transferred from the Army to the DOE. In 1985, the DOE proposed designating control and decontamination of the chemical plant, raffinate pits, and quarry as a major project. A Project Management Contractor (PMC) for the Weldon Spring Site Remedial Action Project was selected in February 1986. The quarry was placed on the Environmental Protection Agency National Priorities List (NPL) in July 1987. The DOE re-designated the site as a Major Acquisition System in May 1988. The chemical plant and raffinate pits were added to the NPL in March 1989.

The Frog Pond drainage area begins in the Frog Pond area within the Weldon Spring Site and ends at the Missouri Department of Conservation (MDC) Busch Lake 36. Frog Pond was a man-made pond excavated out of an existing drainage at some time during the operation of the feed materials plant. The pond received precipitation runoff from the northeast corner of the chemical plant and from the plant storm sewer system. Even though characterization of Frog Pond has shown radiological contamination, there is no known record of contaminated material being stored or buried in this area.

The Frog Pond drainage area can be broken down into three separate sections. The first section consists of the area from Frog Pond on the chemical plant site to the perimeter fence (Figure 1-1). The second section runs from the chemical plant perimeter fence to the south side of Missouri County Highway D. This section of drainage is on MDC property and henceforth is referred to as the Frog Pond drainage. The last section consists of the drainage north of Highway D running into Lake 36. This section of drainage is also part of the MDC property and is referred to as the Frog Pond outlet.



0 300 600

SCALE FEET

FROG POND DRAINAGE AREA

FIGURE 1-1

REPORT NO.: DOE/OR/21548-840		EXHIBIT NO.: A/VP/006/0100	
ORIGINATOR: EMR	DRAWN BY: GLN	DATE: 1/28/00	

1.4 Vicinity Property Description

In 1985, Oak Ridge Associated Universities (ORAU) conducted a comprehensive radiological survey of all areas outside the chemical plant boundary and within the boundary of the previous ordnance works area (Ref. 1 and Ref. 2). The purpose of the study was to assess the extent and levels of off-site radiological contamination resulting from operation of the uranium feed materials plant. The study examined surface and subsurface soils, water, and sediment on the properties adjacent to the site. Because of the nature of the wildlife areas, it was the DOE's and ORAU's intention to avoid any unnecessary disturbance or damage to surface features. Consequently, there were no general site clearing and gridding preparations. Instead, measurement and sampling locations were referenced to existing surface features. Results of these initial surveys were used to determine if more detailed characterization was required.

Background levels and baseline concentrations were taken of each matrix within the vicinity of the area. These levels/concentrations were used to determine the extent of radiological contamination within a surveyed area. ORAU used the following concentrations to determine radioactively contaminated soil:

Ra-226 and Th-232	5 pCi/g averaged over the first 6 inches of soil depth 15 pCi/g if greater than 6 inches deep
U-238	60 pCi/g averaged over the suspect area.

The results of the study revealed soils at several small locations in the Army Ordnance Works area and the Missouri Department of Conservation areas contained generally low levels of radioactivity as a result of previous site activities. In total, ORAU identified 17 vicinity properties, seven of which were located on the Weldon Spring Training Area and ten of which were located on the Missouri Department of Conservation (MDC) wildlife areas. Elevated levels of U-238 were identified within the Frog Pond drainage; however, the levels did not exceed DOE residual contamination criteria for classification as a contaminated MDC vicinity property.

1.5 CERCLA Summary

The *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (ROD) is a remedial action decision document written in accordance with CERCLA (Ref. 3). It was established for the chemical plant area operable unit and addresses selected remedial actions for various sources of contamination at the chemical plant and off-site vicinity properties. Remedial actions established by the ROD for vicinity properties involve soil removal and on-site disposal within a facility designed and constructed specifically for the Weldon Spring site wastes. The ROD was signed by the DOE on September 13, 1993, and by the Environmental Protection Agency (EPA) on September 28, 1993. On July 24, 1998, a non-significant change to the ROD was written including the Frog Pond outlet as a vicinity property

(Appendix A). The area was to be remediated following the guidelines in the ROD for WSSRAP vicinity properties.

Cleanup criteria for soils within the ROD were developed from the results of the site-specific risk assessment for a residential scenario. Additionally, ALARA (as low as reasonably achievable) criteria were developed to represent lower levels which the remedial actions would aim to achieve during field excavation activities. Cleanup criteria and ALARA values are applicable to surface soils (0 in. to 6 in.) and subsurface soils (greater than 6 in.). Radiological and chemical contaminants of concern for the chemical plant area are defined in the ROD and listed in Table 1-1. Soils excavated from the vicinity properties were transported to the chemical plant area for temporary storage and final on-site disposal in the engineered disposal facility being constructed in accordance with the ROD.

Table 1-1 Radionuclide and Chemical Contaminant Soil Cleanup Criteria

	SURFACE		SUBSURFACE	
Radionuclide (pCi/g)	**ALARA**	**Criteria**	**ALARA**	**Criteria**
Radium-226	5.0	6.2	5.0	16.2
Radium-228	5.0	6.2	5.0	16.2
Thorium-230	5.0	6.2	5.0	16.2
Thorium-232	5.0	6.2	5.0	16.2
Uranium-238	30.0	120	30	120
Chemical (mg/kg)				
Arsenic	45	75	75	750
Chromium (total)	90	110	110	1,110
Chromium (VI)	90	100	100	1,000
Lead	240	450	450	4,500
Thallium	16	20	20	200
PAHs	0.44	5.6	5.6	56
PCBs	0.65	8	8	80
2,4,6-TNT	14	140	140	1,400

2. PRE-REMEDIATION ACTIVITIES

2.1 ORAU Survey

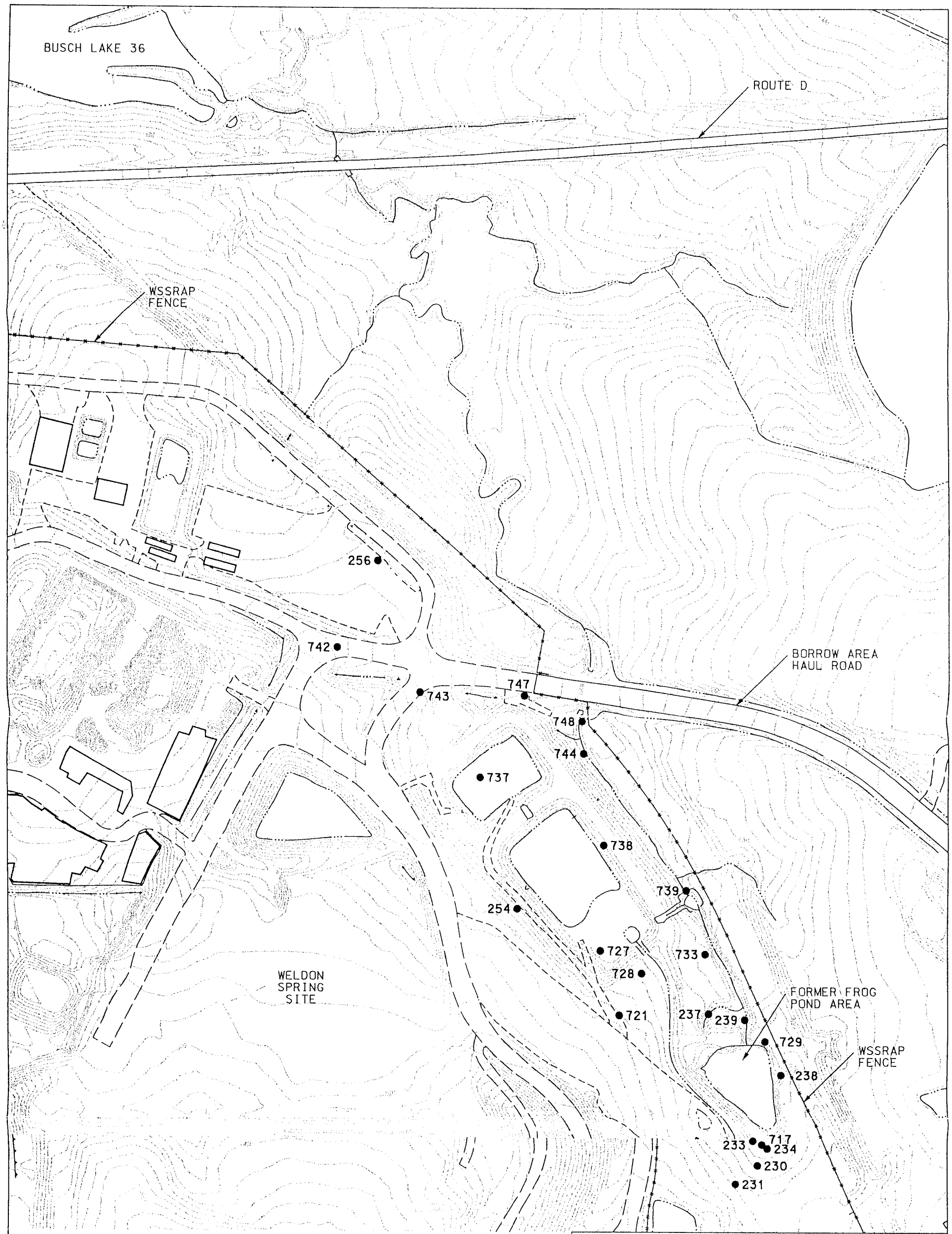
Initial soil characterization for the Frog Pond drainage area was conducted by Oak Ridge Associated University (ORAU) during July 1984 through September of 1985. During the survey, surface beta measurements, surface gamma measurements, surface and subsurface soil samples, water samples, and sediment samples were collected. ORAU collected numerous sediment and soil samples in the drainage and found that several locations exceeded background levels for U-238. As stated previously, however, the levels did not exceed the DOE residual contamination criteria to be classified as a contaminated MDC vicinity property. A summary of the ORAU data for the Frog Pond drainage soil (both surface and subsurface) is detailed in Table 2-1.

Table 2-1 ORAU Summary for Surface and Subsurface Soil

ORAU Area Sampled	Ra-226 Concentration Range (pCi/g)	Th-232 Concentration Range (pCi/g)	U-238 Concentration Range (pCi/g)	Primary Contaminant
Frog Pond Drainage Area	0.33 – 2.13	0.51 – 3.02	1.87 – 79.8	U-238

2.2 UNC Geotech Characterization

In 1988, additional soil characterization activities were conducted by UNC Geotech. The area was characterized at nine boreholes from which a total of 56 borehole soil samples were taken, 14 near-surface sample sites from which a total of 21 soil samples were taken, and 59 surface exposure rate measurements, one spectrometer measurement, and 56 FIDLER measurements. All borehole samples were analyzed for U-238 only. Near-surface soil samples were analyzed for Ra-226 and Ra-228 in addition to U-238. Sample locations for both borehole and near-surface samples are detailed in Figure 2-1. Data generated from the sampling activity are summarized in Table 2-2. Specific details of the sampling activity may be found in the *Radiologic Characterization of the Weldon Spring, Missouri, Remedial Action Site* (Ref. 4) and the *Remedial Investigation for the Chemical Plant Area of the Weldon Spring Site* (Ref. 5).



PMC REMEDIAL INVESTIGATION
SAMPLE LOCATIONS

FIGURE 2-1

REPORT NO.: DOE/OR/21548-840		EXHIBIT NO.: B/VP/007/0100	
ORIGINATOR: EMR	DRAWN BY: GLN	DATE: 1/28/00	

Table 2-2 UNC Geotech Soil Sample Results

Sample Location	Borehole Depth (ft.)	Number of Samples Taken	Ra-226 Range (pCi/g)	Ra-228 Range (pCi/g)	U-238 Range (pCi/g)
230	0 – 5.5	6	Not Analyzed	Not Analyzed	5.0 – 280.4
231	0 – 10.0	11	Not Analyzed	Not Analyzed	< 0.3 – 1.7
233	0 – 10.0	11	Not Analyzed	Not Analyzed	< 0.3 – 3.3
234	0 – 5.0	5	Not Analyzed	Not Analyzed	3.6 – 130.4
237	0 – 1.5	2	Not Analyzed	Not Analyzed	0.3 – 1.7
238	0 – 5.0	5	Not Analyzed	Not Analyzed	0.7 – 24.2
239	0 – 1.5	2	Not Analyzed	Not Analyzed	1.0 – 3.3
254	0 – 6.0	7	Not Analyzed	Not Analyzed	< 0.3 – 4.3
256	0 – 6.0	7	Not Analyzed	Not Analyzed	< 0.3 – 3.3
717	0 – 0.5	1	0.9	0.9	25.2
721	0 – 0.5	1	1.9	1.2	24.2
727	0 – 1.0	2	1.0 - 1.2	1.1 – 1.5	2.0 – 7.9
728	0 – 0.5	1	1.5	1.7	6.6
729	0 – 0.5	1	1.0	1.1	4.6
733	0 – 0.5	2	0.9 – 1.4	1.2 – 1.5	5.3 – 6.0
737	0 – 0.5	1	1.2	1.3	8.3
738	0 – 0.5	1	1.4	1.8	6.6
739	0 – 0.5	2	1.4 – 1.5	0.9 – 1.2	8.3 – 9.6
742	0 – 1.0	2	1.3 – 1.5	1.4 – 1.6	1.0 – 2.6
743	0 – 0.5	1	1.2	1.9	6.3
744	0 – 0.5	1	1.1	1.2	12.6
747	0 – 1.0	2	0.6 – 0.9	0.6 – 0.7	23.5 – 24.2
748	0 – 1.5	3	Not Analyzed	Not Analyzed	4.3 – 13.9

2.3 Engineering Characterization of the From Pond Drainage Area

Engineering characterization was performed on all three sections of the Frog Pond drainage area (the Frog Pond area, the Frog Pond drainage, and the Frog Pond outlet). The Frog Pond area was characterized from October 1997 to January 1998 under the *Frog Pond Characterization Sampling Plan* (Ref. 6). The pond was drained prior to sampling. Samples were collected from 15 locations within the Frog Pond area and 18 locations surrounding the

pond (Figure 2-2). Samples were collected at 1 ft intervals to a depth of 12 ft for inner Frog Pond samples and to a depth of 16 ft at locations outside the pond. Analysis revealed that five locations exhibited elevated concentrations for a single ROD chemical constituent. These boreholes consisted of sample locations: 2, 8, 12, 13, and 28. Eighteen other sample locations exhibited elevated concentrations for multiple ROD chemical constituents, radioactive constituents, or both. These boreholes consisted of sample locations: 4, 6, 7, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, and 31. Data generated from this sampling activity is summarized in Table 2-3. Additional information may be found in the *Analytical Data Results for the Frog Pond Characterization Sampling Plan* (Ref. 7).

Table 2-3 Frog Pond Characterization Sample Results

ROD Parameter	# Samples greater than ALARA Levels	# Samples greater than Cleanup Criteria Levels
Arsenic	1	0
Chromium	0	0
Lead	0	0
Thallium	6	1
2, 4, 6-TNT	0	0
PAHs	22	8
PCBs	13	0
Radium (total)	5	11
Ra-226	0	0
Ra-228	2	6
Th-230	8	7
Th-232	2	6
U-238	17	12

The Frog Pond drainage was sampled from October 30, 1998, to November 4, 1998, in accordance with the *Engineering Soils Sampling Plan for Army and MDC Vicinity Properties: Addendum 4; Soil Sampling at Frog Pond Drainage Outlet and MDC-6* (Ref. 8). A total of 63 samples from 32 sample locations were generated during the Frog Pond drainage characterization (Figure 2-3). Biased sample locations were determined in the field based upon both walkover survey results greater than two times background levels and relevant geomorphic principles of sediment deposition such as point bar deposits. Walkover survey results revealed,

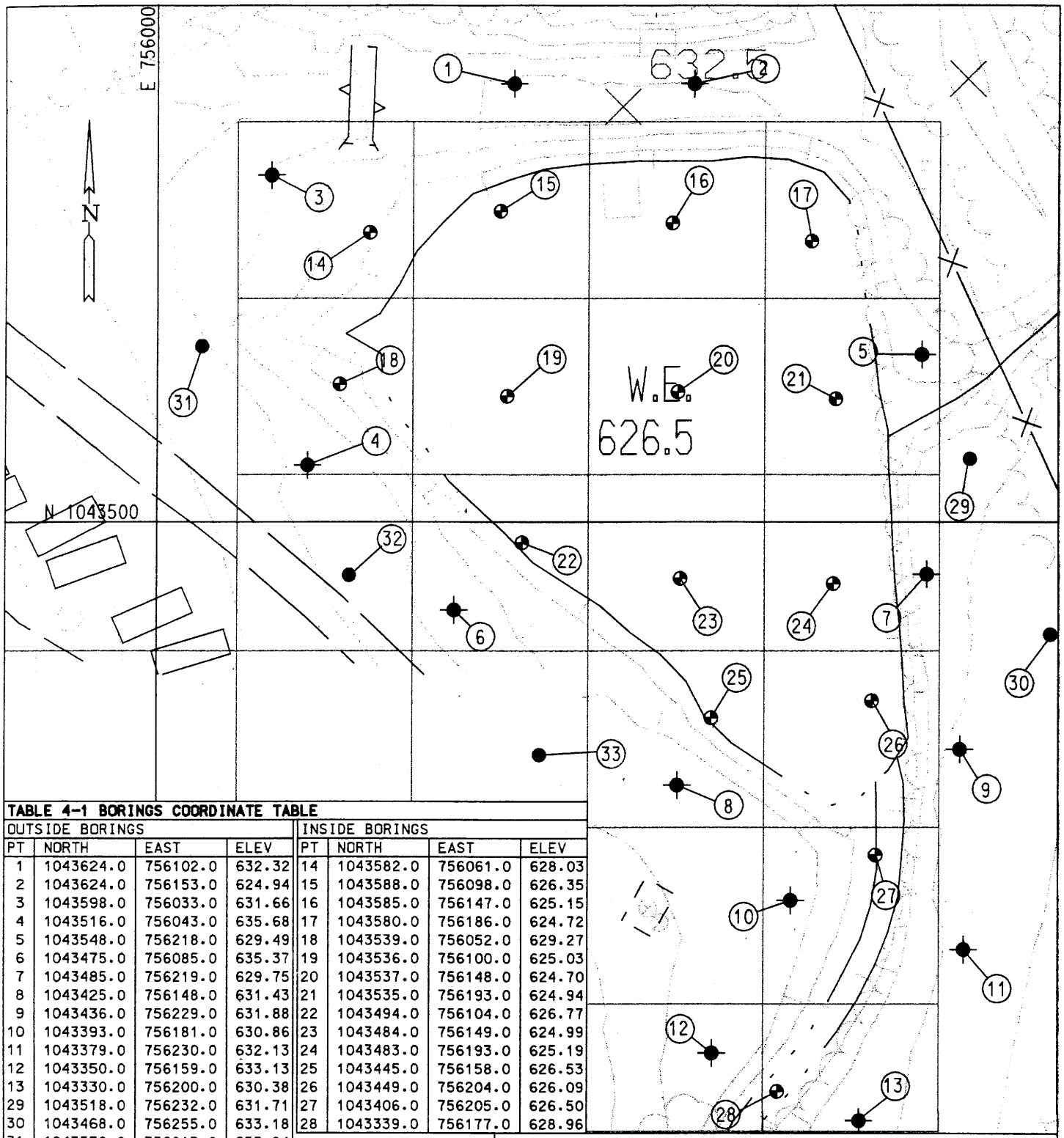


TABLE 4-1 BORINGS COORDINATE TABLE

OUTSIDE BORINGS				INSIDE BORINGS			
PT	NORTH	EAST	ELEV	PT	NORTH	EAST	ELEV
1	1043624.0	756102.0	632.32	14	1043582.0	756061.0	628.03
2	1043624.0	756153.0	624.94	15	1043588.0	756098.0	626.35
3	1043598.0	756033.0	631.66	16	1043585.0	756147.0	625.15
4	1043516.0	756043.0	635.68	17	1043580.0	756186.0	624.72
5	1043548.0	756218.0	629.49	18	1043539.0	756052.0	629.27
6	1043475.0	756085.0	635.37	19	1043536.0	756100.0	625.03
7	1043485.0	756219.0	629.75	20	1043537.0	756148.0	624.70
8	1043425.0	756148.0	631.43	21	1043535.0	756193.0	624.94
9	1043436.0	756229.0	631.88	22	1043494.0	756104.0	626.77
10	1043393.0	756181.0	630.86	23	1043484.0	756149.0	624.99
11	1043379.0	756230.0	632.13	24	1043483.0	756193.0	625.19
12	1043350.0	756159.0	633.13	25	1043445.0	756158.0	626.53
13	1043330.0	756200.0	630.38	26	1043449.0	756204.0	626.09
29	1043518.0	756232.0	631.71	27	1043406.0	756205.0	626.50
30	1043468.0	756255.0	633.18	28	1043339.0	756177.0	628.96
31	1043550.0	756013.0	635.84				
32	1043485.0	756055.0	633.84				
33	1043434.0	756109.0	634.21				

LEGEND

12 FT. INSIDE

16 FT. OUTSIDE

0 40 80

SCALE FEET

FROG POND CHARACTERIZATION SAMPLE LOCATIONS

FIGURE 2-2

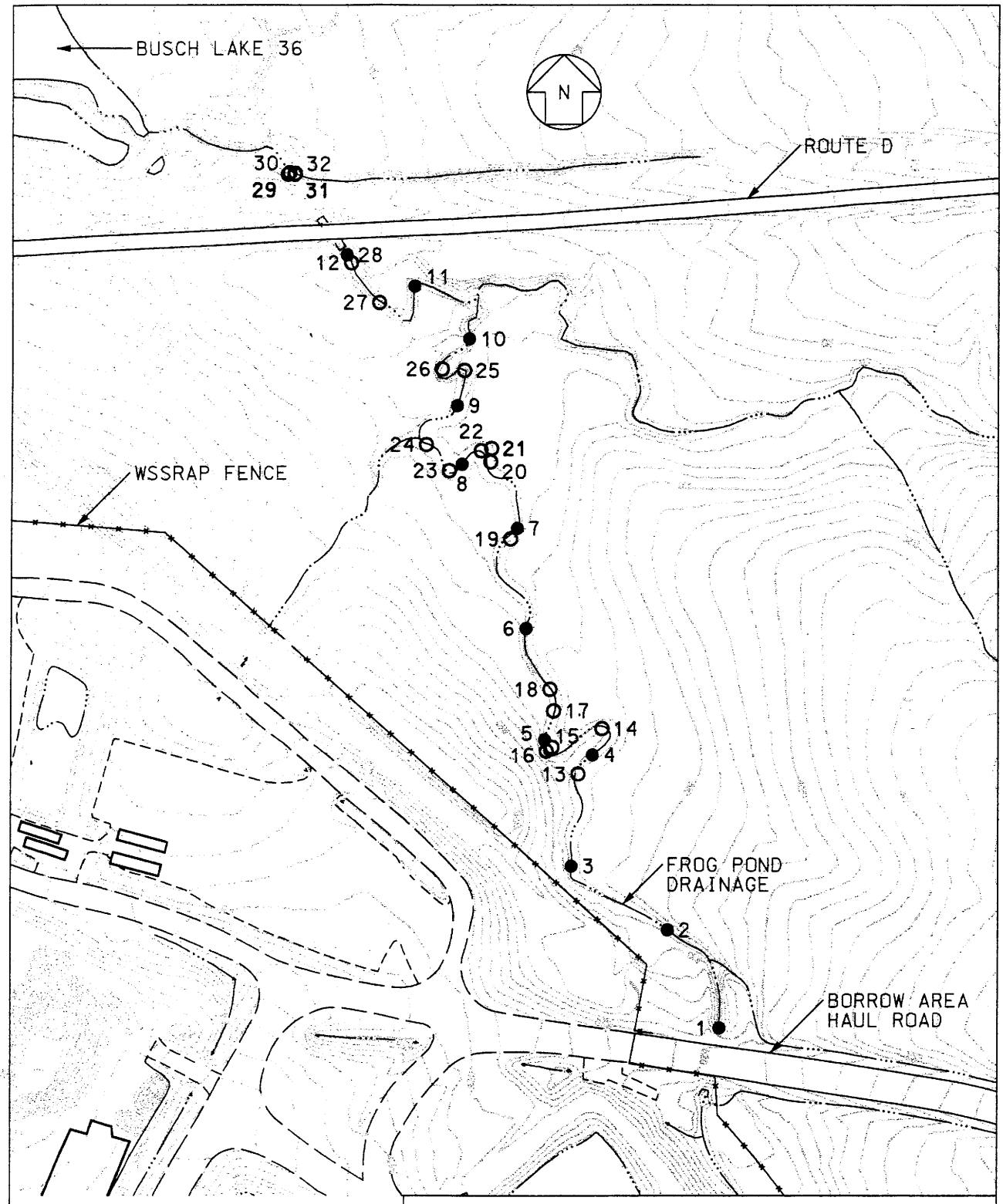
REPORT NO.: DOE/OR/21548-840	EXHIBIT NO.: A/CP/235/0997	
ORIGINATOR: EMP	DRAWN BY: GLN	DATE: 9/29/00

however, that no location was greater than two times background. Hence, biased sample locations consisted solely of sediment deposition areas along the drainage. A total of 16 biased sample locations, 12 unbiased sample locations, and four areas within the twin culverts on both the north and south sides of Highway D were taken.

Analysis revealed that no sample location along the Frog Pond drainage exceeded ROD cleanup criteria levels for any radiological parameter. Elevated concentrations of U-238 exceeded ALARA levels (30 pCi/g) at 10 out of the 32 sample locations. Ra-226, Ra-228, Th-230, Th-232. arsenic, chromium, lead, thallium, 2,4,6-TNT, and PCB concentrations were all below ALARA levels. Additional details of the results of this sampling activity may be found in the *Closure Report for Soil Sampling at Frog Pond Drainage Outlet and MDC-6; Addendum 4 of the Engineering Soil Sampling Plan for Army and MDC Vicinity Properties* (Ref. 9).

Frog Pond outlet was originally sampled for radiological characterization in accordance with the *Engineering Soils Sampling Plan for Army and MDC Vicinity Properties: Addendum 4; Soil Sampling at Frog Pond Drainage Outlet and MDC-6* (Ref. 8). Discreet soil samples were collected at 1 ft intervals from the drainage surface to the original stream base (approximately 2.5 ft to 4 ft below ground surface). Twelve of the 15 boreholes were laid across four evenly spaced transects with three borings per transect (Figure 2-4). The three remaining boreholes were reserved for biased placement in areas where walkover surveys with a Geiger-Mueller detector (44-9) indicated readings two to three times above background levels. Analysis of samples from the 15 locations revealed numerous locations exceeded the ROD U-238 cleanup criteria level of 120 pCi/g.

The Frog Pond outlet sample locations were re-sampled from September 29, 1998 through October 2, 1998, to obtain additional information on contaminant depth and potential chemical contaminants. Samples were collected using a power auger and a split spoon sampler at 1 ft intervals. Depths that had previously been characterized were excluded. Sample depths were determined by either auger refusal or breaching of the groundwater level. Depths typically varied from 4 ft to 7 ft. Analysis revealed that samples from nine of the 15 sample locations exceeded mandated cleanup criteria levels for U-238 at either one or multiple depth intervals (Table 2-3). Every sample location also exceeded the U-238 ALARA level (30 pCi/g) at either one or multiple depth intervals. Chemical characterization for ROD contaminants of concern was performed at four of the 15 sample locations. Chemical characterization revealed all four sample locations were below both ROD cleanup criteria and ALARA levels. Specific details of this sampling activity can be found in the *Closure Report for Soil Sampling at Frog Pond Drainage Outlet and MDC-6: Addendum 4 of the Engineering Soil Sampling Plan for Army and MDC Vicinity Properties* (Ref. 9).



● - UNBIASED SAMPLE LOCATIONS

O - BIASED SAMPLE LOCATIONS

0 200 400

SCALE FEET

FROG POND DRAINAGE
SAMPLE LOCATIONS

FIGURE 2-3

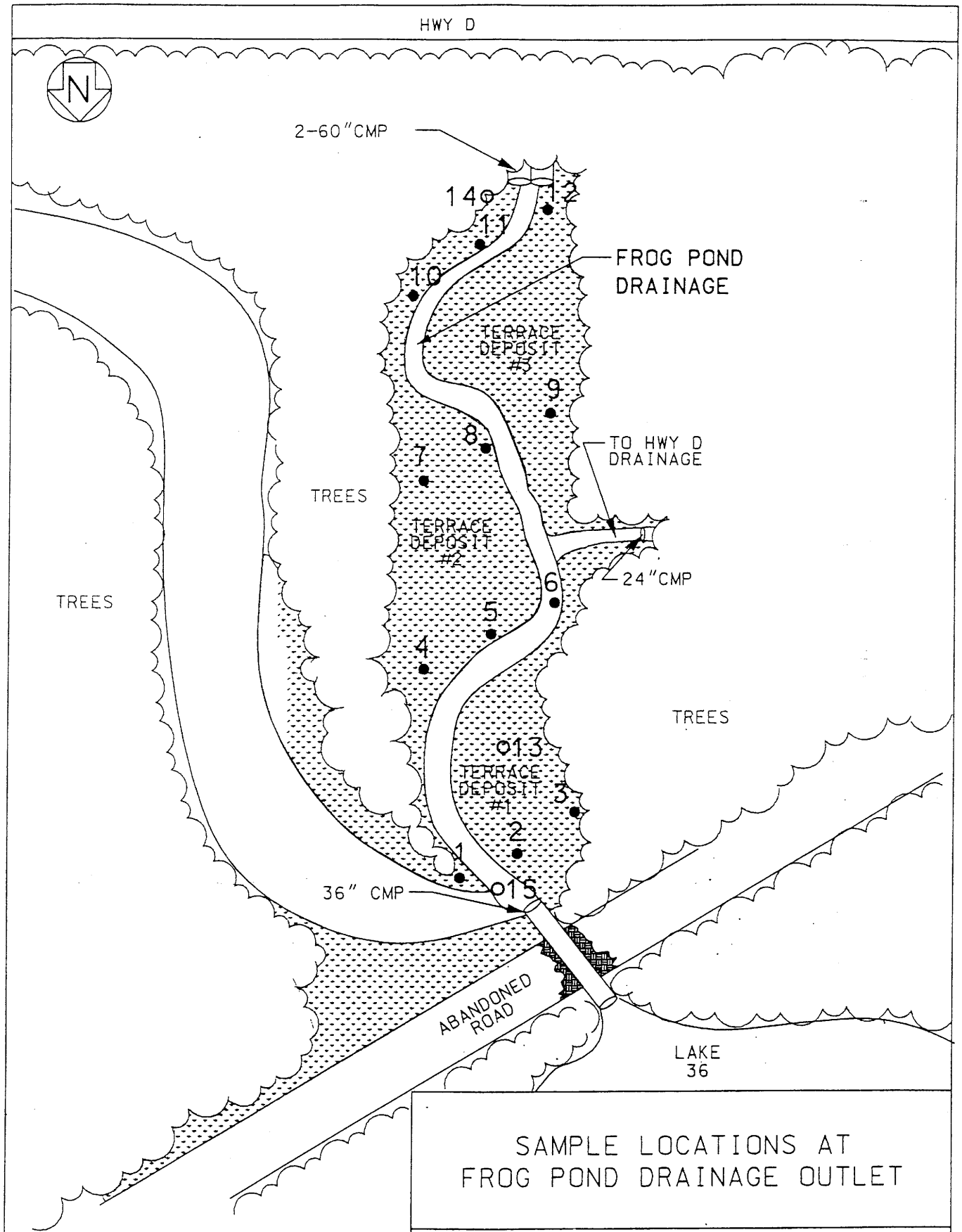
REPORT NO.: DOE/OR/21548-840		EXHIBIT NO.: A/VP/027/1098	
ORIGINATOR: EMR	DRAWN BY: GLN	DATE: 2/4/00	

Table 2-4 Frog Pond Outlet Engineering Characterization Exceeding ROD Cleanup Criteria Levels

Sample Location Number	Frog Pond Outlet Sample Number	Sample Depth Interval	Northing	Easting	U-238 Concentration (pCi/g)
2	SO-V97302-02-FPO	1' – 2'	1045594.56	755078.76	123.0
2	SO-V97302-03-FPO	2' – 3'	1045594.56	755078.76	219.0
2	SO-V97302-04-FPO	3' – 4'	1045594.56	755078.76	203.0
4	SO-V97304-06-FPO	5' – 6'	1045585.13	755122.46	181.0
6	SO-V97306-05-FPO	4' – 5'	1045587.61	755097.92	134.0
8	SO-V97308-04-FPO	3' – 4'	1045563.59	755173.13	154.0
8	SO-V97308-05-FPO	4' – 5'	1045563.59	755173.13	114.0
9	SO-V97309-04-FPO	3' – 4'	1045566.92	755189.79	138.0
9	SO-V97309-05-FPO	4' – 5'	1045566.92	755189.79	322.0
9	SO-V97309-06-FPO	5' - 6'	1045566.92	755189.79	255.0
10	SO-V97310-04-FPO	3' – 4'	1045580.19	755218.85	150.0
10	SO-V97310-05-FPO	4' – 5'	1045580.19	755218.85	309.0
10	SO-V97310-05-FPO-FR	4' – 5'	1045580.19	755218.85	194.0
12	SO-V97312-05-FPO	4' – 5'	1045550.15	755220.77	245.0
13	SO-V97313-03-FPO	2' – 3'	1045591.40	755083.37	163.0
15	SO-V97315-02-FPO	1' – 2'	1045608.17	755080.97	137.0

Based on the data from the three separate engineering characterization activities, remediation was required in the Frog Pond area and the Frog Pond outlet. Remediation was not required in the Frog Pond drainage because no samples taken exceeded ROD cleanup criteria levels. One possible explanation for this is that contaminated runoff from the Frog Pond area did not have time to settle out while traversing the Frog Pond drainage. At the Frog Pond outlet, however, the outlet acted as a settling basin allowing contaminated sediments to fall out prior to entering Busch Lake 36. The following volumes were estimated from the engineering characterization activities. It should be noted that the volume estimate for Frog Pond represents not only the Frog Pond area but also additional property south and northwest of the pond.

Frog Pond drainage area	Estimated Volume
Frog Pond	10,500 cu yd
Frog Pond drainage	No remediation necessary
Frog Pond outlet	1,634 cu yd
Total Quantity:	12,134 cu yd



● - UNBIASED SAMPLE LOCATIONS

O - BIASED SAMPLE LOCATIONS

NOT TO SCALE

SAMPLE LOCATIONS AT
FROG POND DRAINAGE OUTLET

FIGURE 2-4

REPORT NO.: DOE/OR/21548-840		EXHIBIT NO.: A/VP/003/0198	
ORIGINATOR: EMR	DRAWN BY: CRM	DATE: 2/4/00	

3. REMEDIAL ACTIVITIES

3.1 Frog Pond Construction Activities

Remediation of the Frog Pond area began on July 29, 1998, and was completed on September 12, 1998. Remediation was performed under Work Package 437 (WP-437) by the Direct Hire Organization (DHO). Contaminated sediment and soil were excavated and transported directly to the disposal cell. Any area exceeding 1.5 times background activity was excavated until the background activity fell below this criteria. The volume of contaminated material removed from Frog Pond increased from the original engineering estimate of 10,500 cu yd to 16,292 cu yd. The increase in volume was a result of both NaI 2x2 walkovers and high levels of polycyclic aromatic hydrocarbons (PAHs) which required additional excavation of the area. Upon successful completion of the confirmation sampling and unrestricted release of the area, the excavation was backfilled. Approximately 16,140 cu yd of clean common fill was returned to the excavated area and sloped so that the pond was eliminated.

3.2 Frog Pond Drainage Construction Activities

As mentioned previously, all sample results from the Frog Pond drainage were below ROD cleanup criteria levels for all radiological parameters. It was determined that remediation was not required for this area.

3.3 Frog Pond Outlet Construction Activities

Remediation of the Frog Pond outlet began on July 7, 1999, and was completed on October 7, 1999. Remediation of the area was performed under Work Package 505 Task F (WP-505F). Contaminated soil and root balls were excavated and transported directly to the disposal cell. A temporary access road running along Missouri County Highway D to an area across from Gate D of the chemical plant site was constructed and maintained during the remediation activities. The road was removed and the area seeded after completion of backfill activities.

Once remedial activities commenced, the volume of contaminated material removed increased from an estimate of 1,634 cu yd to 2,864 cu yd. Radiological surveys obtained during the walkover of the excavation revealed that contaminated material extended beyond the designed excavation limits in two separate locations. The first location was under the two 60 in. culverts running from the Frog Pond drainage, under Highway D, and into the eastern end of the outlet. The second location was underneath the 42 in. culvert leading from the western end of the outlet into Lake 36. In both situations, the subcontractor was directed by the PMC to excavate or "chase" the contamination.

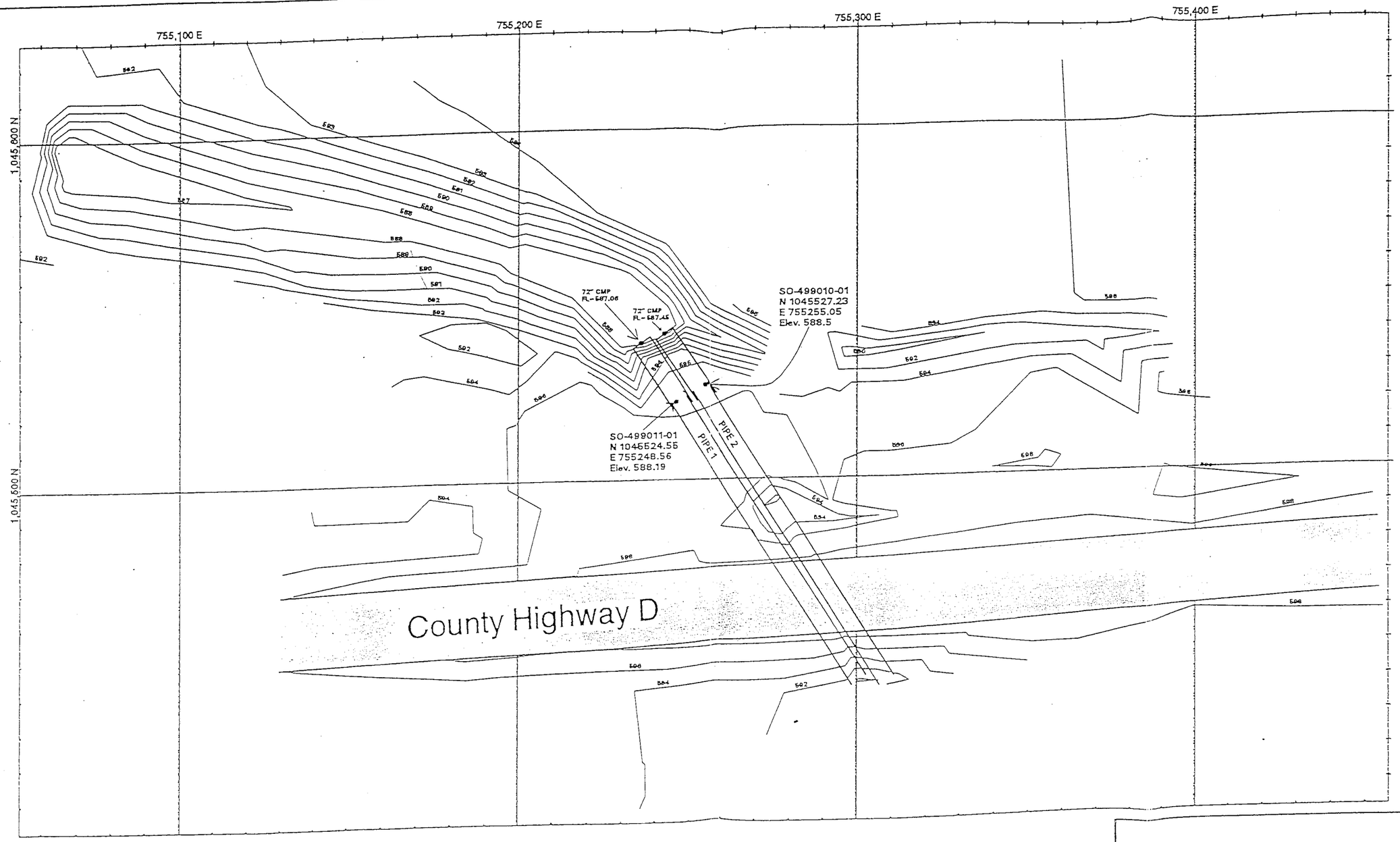
Approximately 20 ft of both 60 in. culverts and 293 cu yd of soil were removed from the eastern end of the outlet. Radiological measurements revealed that remaining soils under the culverts continued to exhibit elevated radiological levels (500 to 800 counts per minute). The additional excavated area was within 10 ft of both underground and overhead utilities. The excavation was also within close proximity of the Missouri Department of Transportation (MDOT) right-of-way. As a result of discussions with the Department of Energy on August 26, 1999, excavation ceased at the eastern end of the Frog Pond outlet. Samples were taken of the soil under both culverts, and the edge of the excavation was surveyed for future reference. Soil sampling activities were conducted under Addendum 6 of the *Engineering Soils Sampling Plan for Army and MDC Vicinity Properties* (Ref. 10). After the samples had been taken, 70 in. diameter extensions were fit over the 60 in. culverts and entombed with concrete at the culvert joints. The area was then backfilled to the original topography.

Analytical results from the sampling activity revealed the soil underneath the easternmost culvert was above ROD cleanup criteria for U-238 with a concentration of 310 pCi/g. The soil was below the Th-230 cleanup criteria level of 16.2 pCi/g; however, it did exceed the Th-230 ALARA level of 5.0 pCi/g. Soil beneath the westernmost culvert was below U-238 cleanup criteria levels but did exceed ALARA levels (30 pCi/g). A summary of the sample results is in Table 3-1 and the sample locations with respect to the current restored topography of the outlet are displayed in Figure 3-1. Further sampling details may be found in the *Closure Report for Soil Sampling at the Frog Pond Outlet, Addendum 6 of the Engineering Soil Sampling Plan for Army and MDC Vicinity Properties* (Ref. 11). The ALARA committee met on March 23, 2000 to discuss the sample results under the two culverts. Details of this meeting are provided in Section 4.4 (Frog Pond Outlet ALARA Committee Meeting).

Table 3-1 Radionuclide Concentrations in Soil Samples

WSSRAP Sample Number	Ra-226 (pCi/g)	Ra-228 (pCi/g)	Th-230 (pCi/g)	U-238 (pCi/g)	Subsurface Th-230 Cleanup Criteria (pCi/g)	Subsurface U-238 Cleanup Criteria (pCi/g)
SO-499010-01	1.18	< 1.14	6.44	**310.0**	16.2	120.0
SO-499011-01	0.82	1.02	3.30	48.4	16.2	120.0

Contaminated soil under the 42 in. culvert ranged from 2 to 5 ft in depth. The culvert was removed and a small berm of soil between the lake and the outlet was maintained so that water from the lake would not run into the excavation area. The excavation extended approximately 8 ft into the lakebed area. It was 12 ft wide and 2 ft below the bottom of the lake. This was beyond the contract established excavation boundary and a decision was made by the PMC to stop excavating along the lake. It was decided a detailed characterization of the area would be performed at a later date. The excavated area was backfilled with clay material to act



30 15 0 METERS

Scale: 1 inch = 30 feet

100 50 0 FEET

N W E S

Frog Pond Outlet
Twin Culvert Sample Locations

Figure: 3-1

REPORT NO.: DOE/OR/21548-840		EXHIBIT NO.: G/CP/277/1299	
ORIGINATOR: EMR	DRAWN BY: WSSRAP GIS	DATE: 2/8/00	

as a dam. Rain was forecast and it was imperative that rainwater not be allowed to flow through the contaminated area into Lake 36 in addition to water seeping from the lake into the outlet.

Additional sampling along the edge and within Lake 36 was conducted in accordance with the *Sampling Plan for Radiological Characterization of Sediments and Soil Within the Southeast Corner of Busch Lake 36* (Ref. 12). Sample locations were established by creating a 20 ft by 20 ft grid encompassing 40,000 sq ft. Grid intersections were identified as potential sample locations. Numerous sample locations were eliminated because surface water and sediment runoff from the chemical plant site would not flow uphill to the identified grid intersection. It was determined that a total of 38 sample locations would be sufficient for characterization of the southeast end of Lake 36 (Figure 3-2). As shown in Figure 3-2, extensive sampling was conducted in the southeast corner of the lake where the subcontractor was directed to discontinue excavation.

Analytical results generated from the sampling revealed none of the 106 total samples taken exceeded the 30 pCi/g ALARA level for U-238, let alone the 120 pCi/g ROD cleanup criteria level. Additional details of the sampling activity may be referenced in the *Closure Report for Radiological Characterization of Sediments and Soil within the Southeast Corner of Busch Lake 36 Sampling Plan* (Ref. 13).

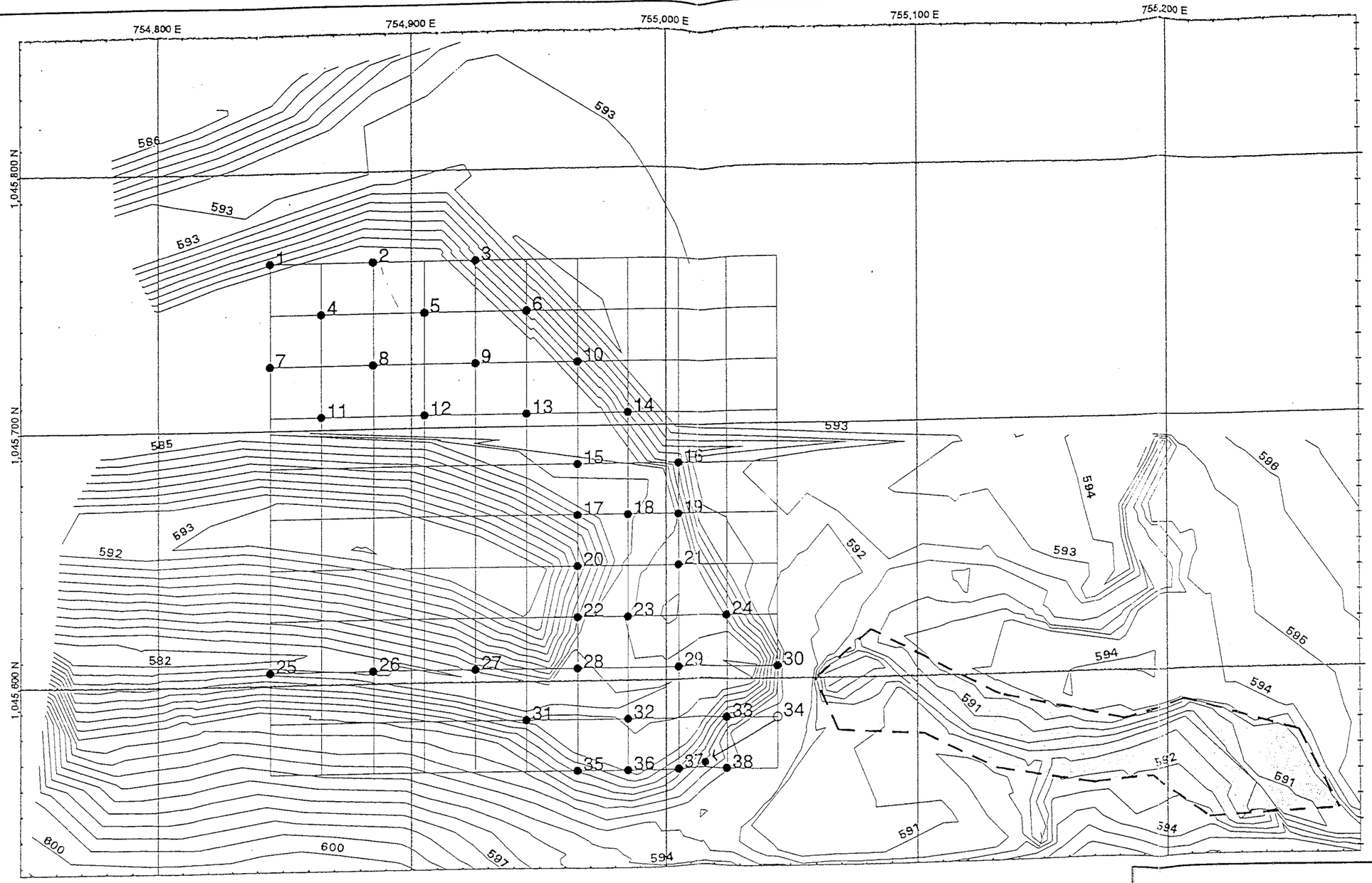
3.4 Changes Affecting CERCLA Compliance

No changes affecting CERCLA were required during the remediation of either Frog Pond or the Frog Pond outlet.

3.5 Emergency Response Activities

No emergency response activities were required as a result of work conducted and completed under work package 437 and 505F. In regard to site procedural violations, an incident occurred under each of the work packages. On July 18, 1998, contaminated water within Frog Pond was improperly released. In an attempt to de-water the pond, the WP-437 contractor cut a gap in the dam allowing approximately 7,000 gallons of water to be released. The water contained a uranium concentration of approximately 4,000 pCi/l which exceeds the DOE Derived Concentration Guideline of 600 pCi/l adhered to by the WSSRAP. It was determined that there was sufficient in-stream pool storage capacity and that the water released from the pond remained within the WSSRAP site boundary. Over time additional water accumulated within the drainage and began to flow out the NP-0002 outfall. Samples collected from the NP-0002 outfall averaged 709 pCi/l which was above the 600 pCi/l guideline but below the 1,360 pCi/l MDNR reporting criterion of the NPDES permit. Additional details may be found in the July 29, 1998, transmittal letter from the PMC to the DOE (Document Number: 78845).

On August 7, 1999, approximately 1.25 in. of rain fell in the area creating a large volume of water flow into the Frog Pond outlet area. The excavated sumps at the time were contaminated



Sampling Grid Location

Offset Sample Location

Topographic Contour

WP-505 Task F
Design Excavation Area

30 15 0 METERS

100 50 0 FEET

N W E S

BUSCH LAKE 36
SAMPLE LOCATIONS

Figure: 3-2

REPORT NO.: DOE/OR/21548-840		EXHIBIT NO.: G/CP/268/1199	
ORIGINATOR: EMR	DRAWN BY: WSSRAP GIS	DATE: 2/8/00	

areas and were not large enough to contain the volume of water. Water completely filled both excavations and then began to flow into Lake 36. Water samples were taken within both excavations, the 42 in. culvert exiting into the lake, and within the lake. All four samples were below the DOE Derived Concentration Guideline of 600 pCi/l with the highest concentration being 50.9 pCi/l. Since the radiological concentrations of the water were below the 600 pCi/l discharge criteria, the overflow of water from the sumps into the lake was not an issue.

3.6 Real Estate License Agreements

A real estate license agreement was not required for remediation of Frog Pond because the area is within the DOE property boundaries. Prior to remediation of the Missouri Department of Conservation (MDC) Frog Pond outlet, a real estate license agreement with the MDC was obtained. Real estate license 7-96-0152 was executed between the DOE and the MDC on July 22, 1996. This license granted the DOE permission to access, characterize, and perform remediation of contaminated soil within MDC properties. The real estate license will expire July 28, 2001.

In addition to real estate license 7-96-0152, permit number 6-98-01074 was obtained from the Missouri Highway and Transportation Commission. This permit granted permission for construction and maintenance of a temporary haul road running from the Frog Pond outlet to the area across from Gate D the Weldon Spring Site. Upon completion of the remediation activities the road was removed and the area seeded and mulched. Permit 6-98-01074 expired on December 31, 1999.

4. POST-REMEDIATION SAMPLING RESULTS

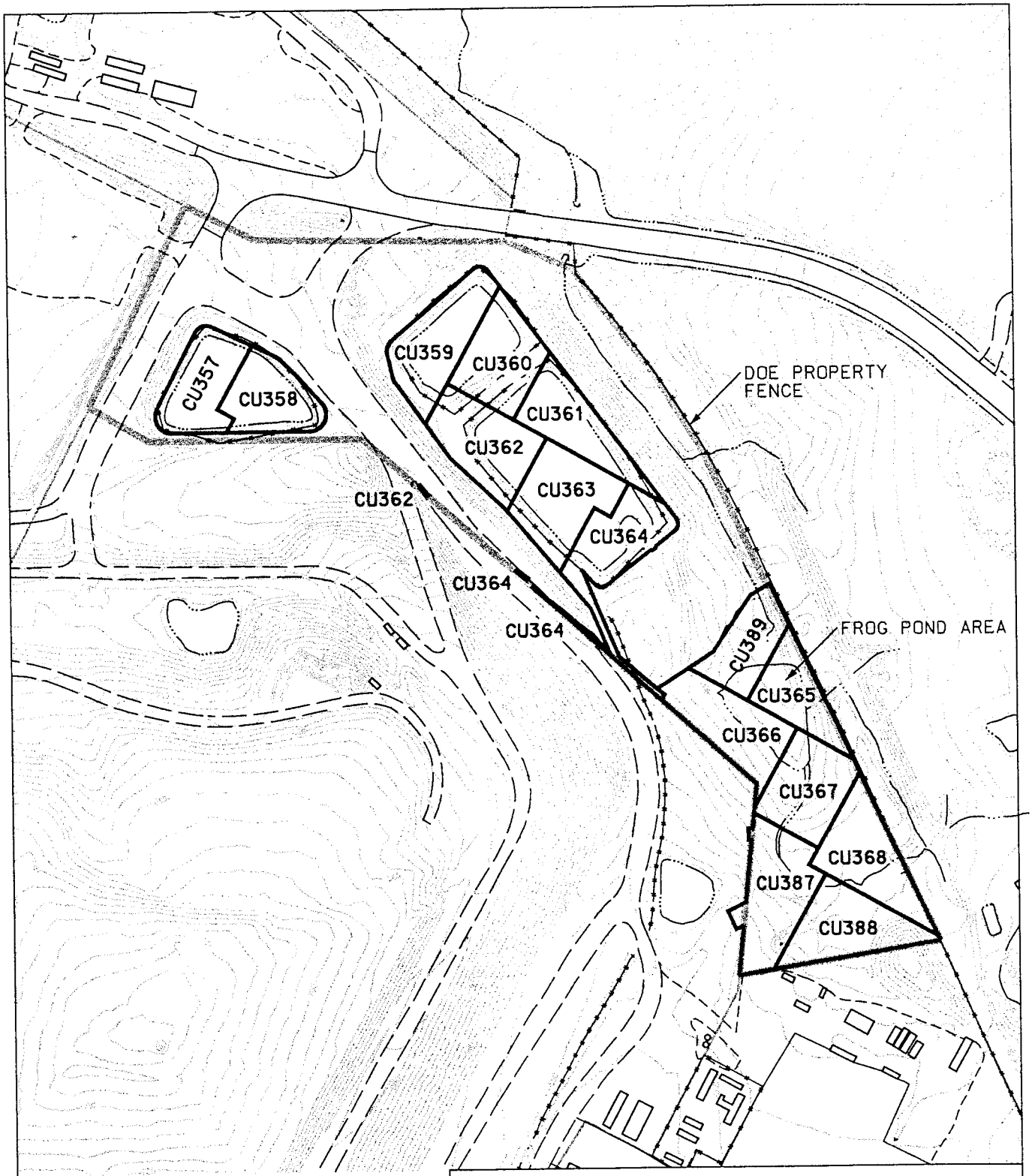
For confirmation purposes, Frog Pond and the surrounding area was designated as Remedial Unit 16 (RU016). RU016 was assigned 15 separate and distinct confirmation unit (CU) numbers. Confirmation units are approximately 2,000 m^2 and are the basis of confirmation per the *Chemical Plant Area Cleanup Attainment Confirmation Plan* (Ref. 14). Confirmation units 365, 366, 367, and 389 encompassed the actual Frog Pond area. Confirmation units 368, 387, and 388 represented property directly south of the Frog Pond area and a small section of confirmation unit 364 was northwest of the pond. All eight of these confirmation units were included in the original 10,500 cu yd contaminated material in the engineering estimate. The remaining seven confirmation units were northwest of the pond area and were not part of the drainage leading from Frog Pond to Lake 36. All confirmation units encompassing Frog Pond and the surrounding property are detailed in Figure 4-1.

The Frog Pond outlet was designated as Remedial Unit 27 (RU027) and encompassed only one confirmation unit (CU390). This CU was smaller than 2,000 m^2. Smaller confirmation units were confirmed in the same manner as 2,000 m^2 units; however, the confirmation was conservative since it reduced the area over which the average concentration was calculated. Table 4-1 summarizes the confirmation unit designations for both Frog Pond and the Frog Pond outlet.

Table 4-1 Summary of Confirmation Units for RU016 and RU027

Confirmation Area	CU Designation	Area (m^2)	Minimum Number of Samples Required	Actual Number of Samples
Frog Pond	CU365	1474.3	21	21
	CU366	2079.7	29	29
	CU367	1985.8	28	28
	CU389	1496.2	21	21
Frog Pond Outlet	CU390	700.7	10	11

After walkover surveys had verified the entire CU to be less than 1.5 times the background gamma radioactivity level, confirmation sampling locations were surveyed and identified with pin flags. Sample locations were selected by superimposing a 10 meter grid over the work zone. All grid line intersections (nodes) and some center points that lay within the area targeted for contaminated soil removal were selected for sampling. Two separate sampling plans were used to perform confirmation sampling in the two areas. The *Confirmation Sampling Plan Details for the Disposal Cell Facility (WP-437)* (Ref. 15) was used for confirmation sampling at the Frog Pond area and the *Confirmation Sampling Plan Details for the Frog Pond Drainage Outlet (WP-519/505F)* (Ref. 16) was used for confirmation sampling at the Frog Pond outlet.



N

0 250 500

SCALE FEET

CONFIRMATION UNITS IN REMEDIAL UNIT 16

FIGURE 4-1

REPORT NO.: DOE/OR/21548-840		EXHIBIT NO.: A/CP/008/0200	
ORIGINATOR: EMR	DRAWN BY: GLN	DATE: 2/8/00	

Confirmation sampling at each sample location was performed by collecting soil from the remediation cut surface to a depth of 6 in. for laboratory analysis.

The Weldon Spring Site Remedial Action Project (WSSRAP) uses two major criteria for unrestricted release of property that has been remediated. The first is whether the average parameter concentration for all sample points within the confirmation unit are below the as low as reasonably achievable (ALARA) goal concentration. The second is whether any single sample exceeded the parameter cleanup criteria concentration. Upon successful completion of the confirmation sampling and unrestricted release of the vicinity property, the excavation is backfilled and graded.

4.1 Frog Pond Cleanup Confirmation

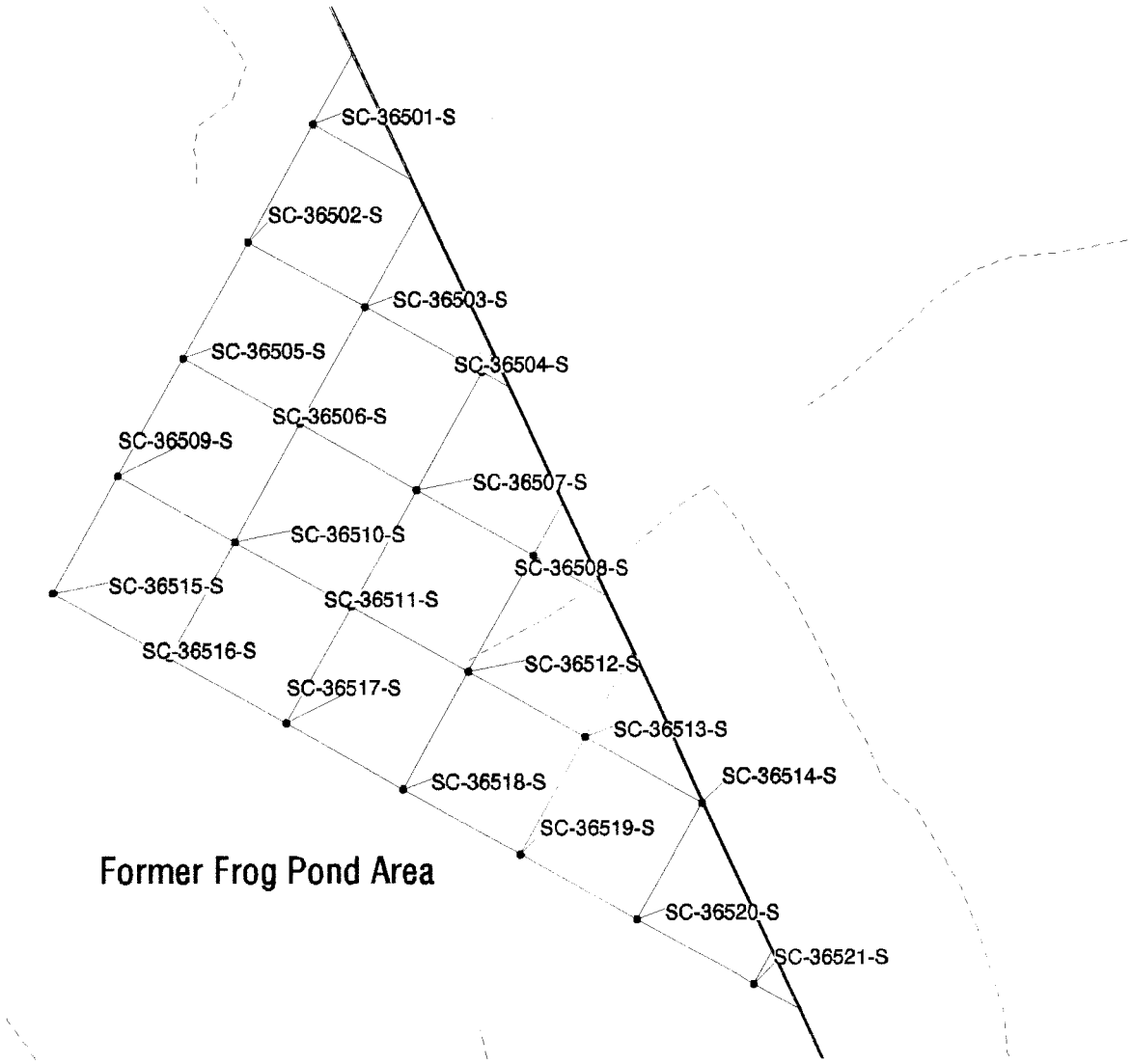
Based on the sampling results of the ORAU survey, the UNC Geotech characterization, and the PMC Engineering characterization, the contaminants of concern within the Frog Pond area selected for confirmation purposes were Ra-226, Ra-228, Th-230, Th-232, U-238, arsenic, thallium, PCBs, PAHs, and 2,4,6-TNT. Prior characterization activities had shown the other chemical parameters to be less than ALARA goals. Sample locations for confirmation units are detailed in Figures 4-2 through 4-5. The locations of the confirmation units in relation to the WSSRAP are provided in Figure 4-6. Analytical results for confirmation units 366, 367, and 389 revealed that all average parameter concentrations were below the ALARA goal concentrations. In addition, no single sample point exceeded the cleanup criteria concentration for any of the parameters.

Confirmation unit 365 did not initially meet the criteria for unrestricted release. In this CU, the average PAH concentration exceeded the ALARA goal of 0.44 mg/kg. In addition, the CU contained one sample point that exceeded the arsenic cleanup criteria concentration of 75.0 mg/kg. On August 26, 1998, four samples surrounding sample point SC-36512-S were taken in an attempt to delineate the extent of the arsenic hot spot. All four locations contained arsenic levels below ALARA levels (45 mg/kg). The area represented by sample point SC-36512-S was determined to be less than 25 m^2 and allowable under the "hot spot rule."

The ALARA committee convened on August 28, 1998, to discuss the average PAH concentrations within CU365. Because the number of confirmation units with an average PAH concentration less than the ALARA level outnumbered the confirmation units above the ALARA level, it was determined CU365 could be released. The four confirmation units (CU365, CU366, CU367, and CU389) were released for unrestricted use on September 9, 1998. A summary of the confirmation data is provided in Table 4-2.

Table 4-2 Summary of Confirmation Units 365, 366, 367, and 389 Analytical Results

Contaminant of Concern	Concentration Range	Concentration Average	Surface ALARA Goal Concentration	Maximum Concentration	Surface Cleanup Criteria	No. of Samples > ALARA
Confirmation Unit 365						
Th-232 (pCi/g)	0.57 – 2.73	1.66	5.0	2.73	6.2	0
U-238 (pCi/g)	1.28 – 49.43	12.59	30.0	49.43	120.0	3
Arsenic (mg/kg)	5.2 - 123	18.18	45.0	123	75.0	1
Thallium (mg/kg)	1.1 – 19	3.64	16.0	19	20.0	1
PAH's (mg/kg)	0 – 3.43	.486	0.44	3.43	5.6	3
PCB's (mg/kg)	0 – .110	.014	0.65	.11	8.0	0
2,4,6-TNT (mg/kg)	0.12 - 0.42	0.14	14.0	0.42	140.0	0
Confirmation Unit 366						
Ra-226 (pCi/g)	0.191 – 2.57	1.42	5.0	2.57	6.2	0
Ra-228 (pCi/g)	0.52 – 2.66	1.22	5.0	2.66	6.2	0
Th-230 (pCi/g)	0.13 – 2.68	0.98	5.0	2.68	6.2	0
Th-232 (pCi/g)	0.53 – 2.73	0.91	5.0	2.73	6.2	0
U-238 (pCi/g)	0.78 – 49.43	7.28	30.0	49.43	120.0	3
Arsenic (mg/kg)	4.9 – 19.7	9.75	45.0	19.7	75.0	0
Thallium (mg/kg)	0.37 – 3.9	1.94	16.0	3.90	20.0	0
PAH's (mg/kg)	0 – 3.43	.273	0.44	3.43	5.6	2
PCB's (mg/kg)	0 – 0.11	.014	0.65	0.11	8.0	0
2,4,6-TNT (mg/kg)	0.07 – 0.42	0.12	14.0	0.42	140.0	0
Confirmation Unit 367						
Ra-226 (pCi/g)	0.61 – 2.41	1.88	5.0	2.41	6.2	0
Ra-228 (pCi/g)	0.56 – 2.13	1.17	5.0	2.13	6.2	0
Th-230 (pCi/g)	0.58 – 2.25	1.21	5.0	2.25	6.2	0
Th-232 (pCi/g)	0.57 – 2.18	1.20	5.0	2.98	6.2	0
U-238 (pCi/g)	1.28 – 30.91	4.84	30.0	30.91	120.0	1
Arsenic (mg/kg)	7.1 – 12.8	9.36	45.0	12.8	75.0	0
Thallium (mg/kg)	1.1 – 2.7	1.93	16.0	2.7	20.0	0
PAH's (mg/kg)	0 – 0.83	.132	0.44	0.83	5.6	1
PCB's (mg/kg)	0 – 0.056	.006	0.65	0.056	8.0	0
2,4,6-TNT (mg/kg)	0.12 – 0.12	0.12	14.0	0.12	140.0	0
Confirmation Unit 389						
Ra-226 (pCi/g)	0.4 – 2.59	1.97	5.0	2.59	6.2	0
Ra-228 (pCi/g)	0.61 – 1.93	1.21	5.0	1.93	6.2	0
Th-230 (pCi/g)	0.76 – 1.58	1.11	5.0	1.58	6.2	0
Th-232 (pCi/g)	0.63 – 1.98	1.25	5.0	1.98	6.2	0
U-238 (pCi/g)	1.31 – 19.06	5.37	30.0	19.06	120.0	0
Arsenic (mg/kg)	5.8 – 13.2	9.37	45.0	13.2	75.0	0
Thallium (mg/kg)	0.88 – 3.9	2.34	16.0	3.9	20.0	0
PAH's (mg/kg)	0 – 0.15	0.023	0.44	0.15	5.6	0
PCB's (mg/kg)	0 – 0	0	0.65	0	8.0	0
2,4,6-TNT (mg/kg)	0.12 – 0.12	0.12	14.0	0.12	140.0	0



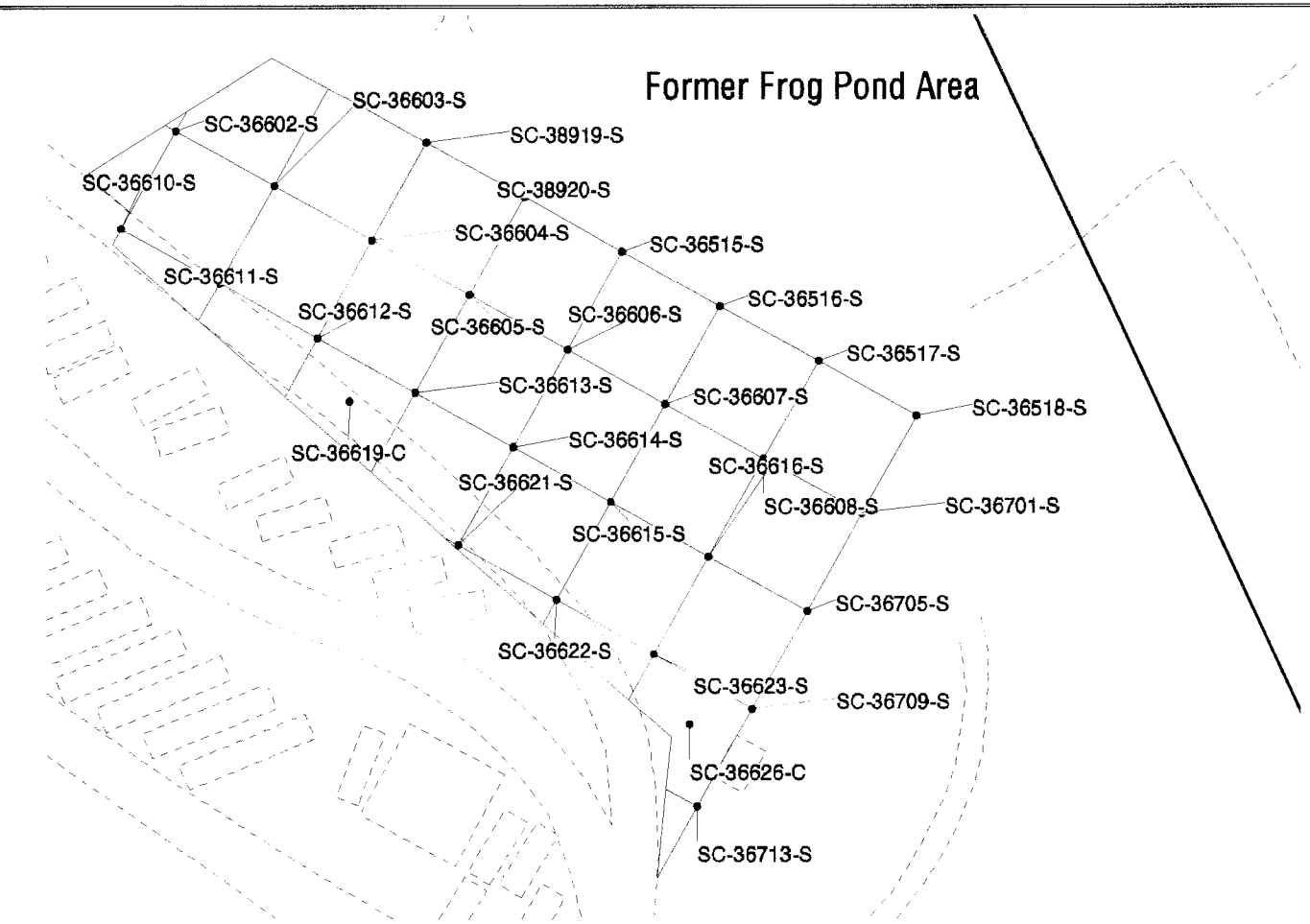
10 5 0 METERS

30 15 0 FEET

Sample Locations in Remedial Unit RU016
Confirmation Unit CU365

Figure 4-2

EXHIBIT NO.: G/CP/095/0300		REPORT NO.: DOE/OR/21548-840	
ORIGINATOR: EMR	DRAWN BY: AMM	DATE: 02-MAR-2000	



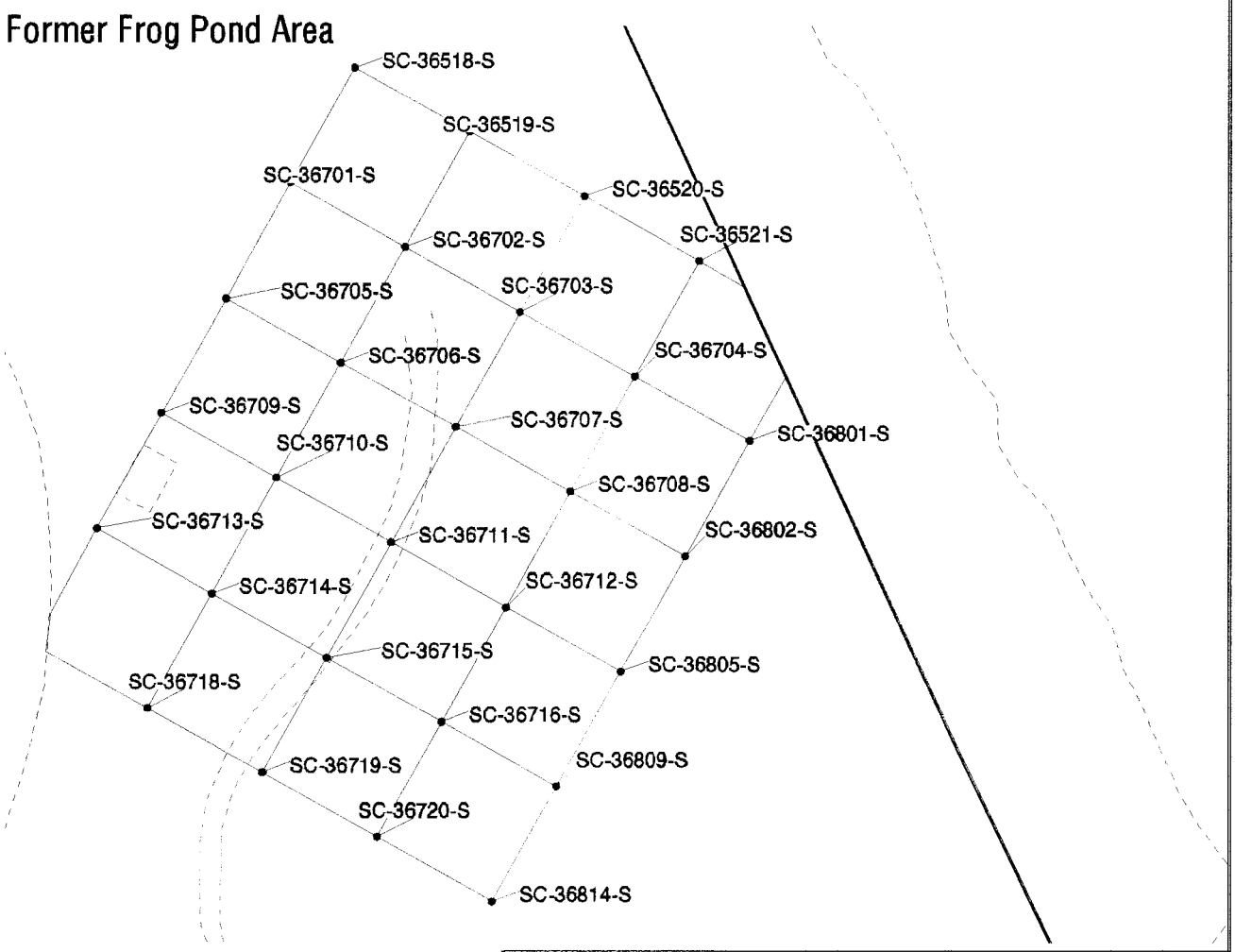
15 7.5 0 METERS

45 22.5 0 FEET

Sample Locations in Remedial Unit RU016
Confirmation Unit CU366

Figure 4-3

EXHIBIT NO.: G/CP/096/0300		REPORT NO.: DOE/OR/21548-840	
ORIGINATOR: EMR	DRAWN BY: AMM	DATE: 02-MAR-2000	



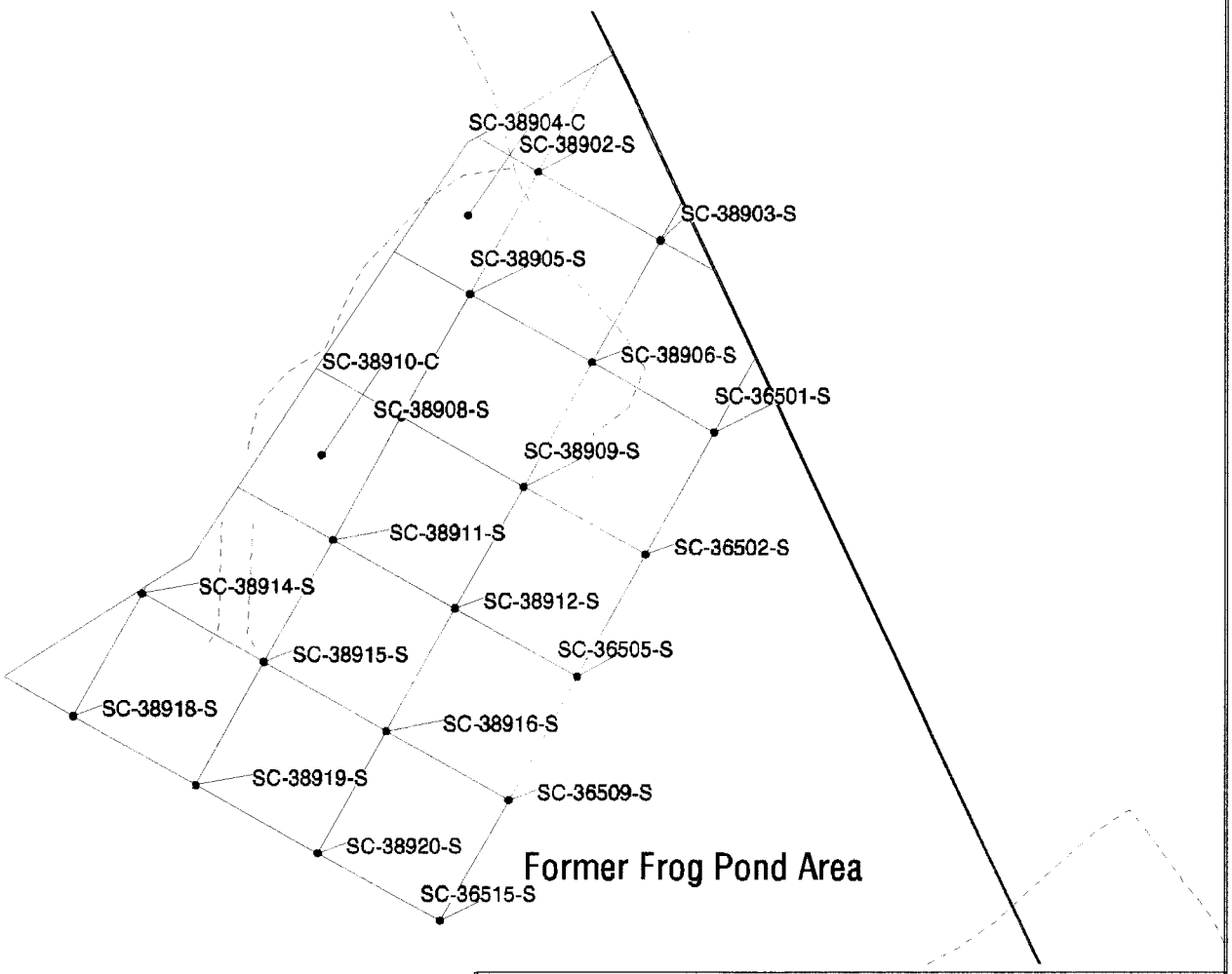
10 5 0 METERS

30 15 0 FEET

Sample Locations in Remedial Unit RU016
Confirmation Unit CU367

Figure 4-4

EXHIBIT NO.: G/CP/097/0300		REPORT NO.: DOE/OR/21548-840	
ORIGINATOR: EMR	DRAWN BY: AMM	DATE: 02-MAR-2000	



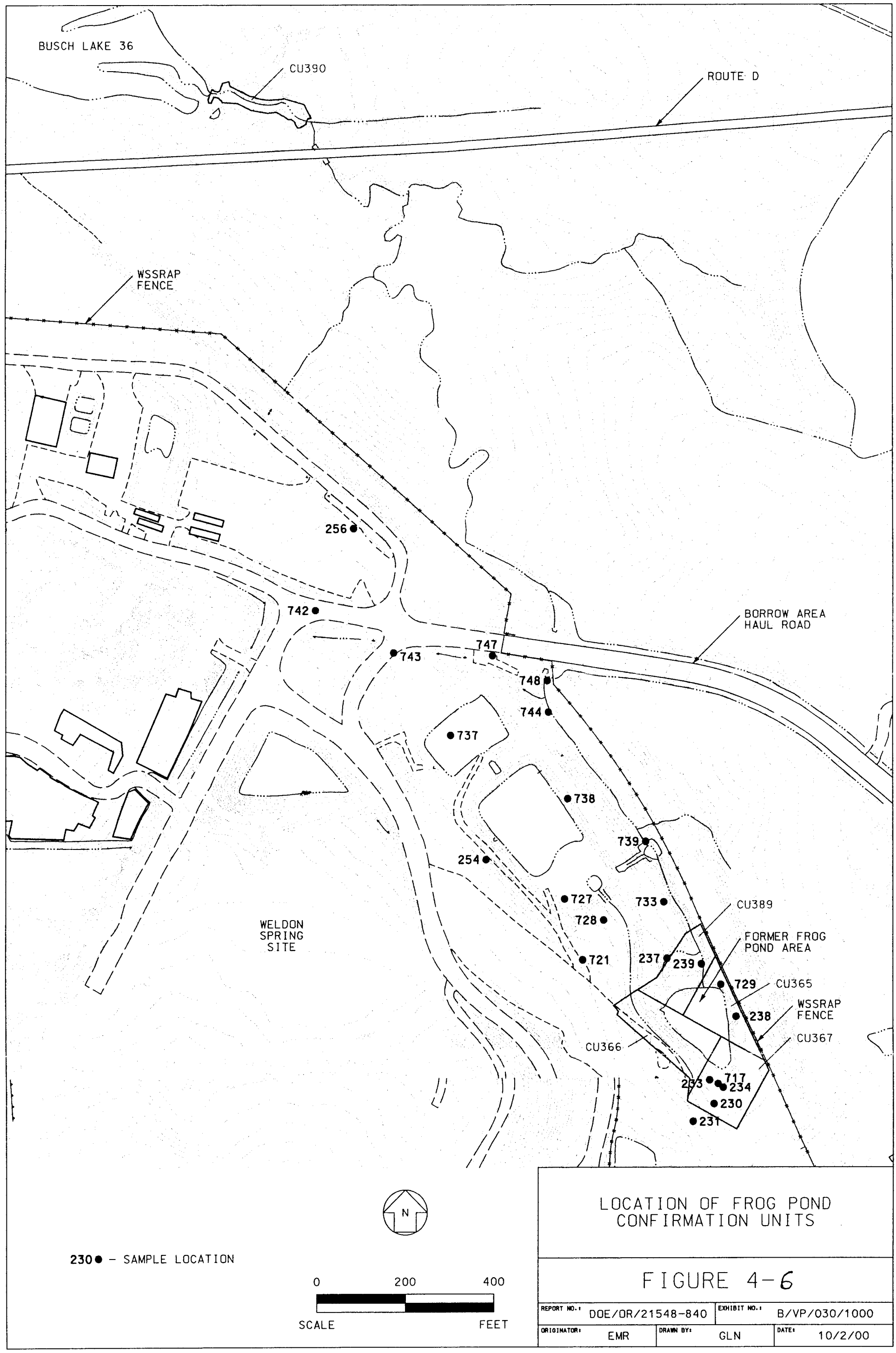
10 5 0 METERS

30 15 0 FEET

Sample Locations in Remedial Unit RU016
Confirmation Unit CU389

Figure 4-5

EXHIBIT NO.: G/CP/098/0300		REPORT NO.: DOE/OR/21548-840	
ORIGINATOR: EMR	DRAWN BY: AMM	DATE: 02-MAR-2000	



LOCATION OF FROG POND CONFIRMATION UNITS

FIGURE 4-6

REPORT NO.: DOE/OR/21548-840		EXHIBIT NO.: B/VP/030/1000	
ORIGINATOR: EMR	DRAWN BY: GLN	DATE: 10/2/00	

4.2 Frog Pond Outlet Cleanup Confirmation

Prior characterization activities had limited the contaminants of concern for the Frog Pond outlet to Th-230 and U-238. All other radiological and chemical parameters were less than ALARA goals. The area was sampled in two separate stages because of the "chasing" of contaminated material toward Lake 36 as described in Section 3.3. The first section consisted of nine sample points in the eastern section of the outlet and was sampled on September 1, 1999. The second section consisted of two sample points in the western section of the outlet and was sampled on September 8, 1999. A total of 11 samples were taken within the Frog Pond outlet and are illustrated in Figure 4-7. As detailed in Table 4-3, all average concentrations were below their respective ALARA goal concentrations and no single data point exceeded its respective cleanup criteria concentration. The entire confirmation unit (CU390) was released for unrestricted use on September 10, 1999.

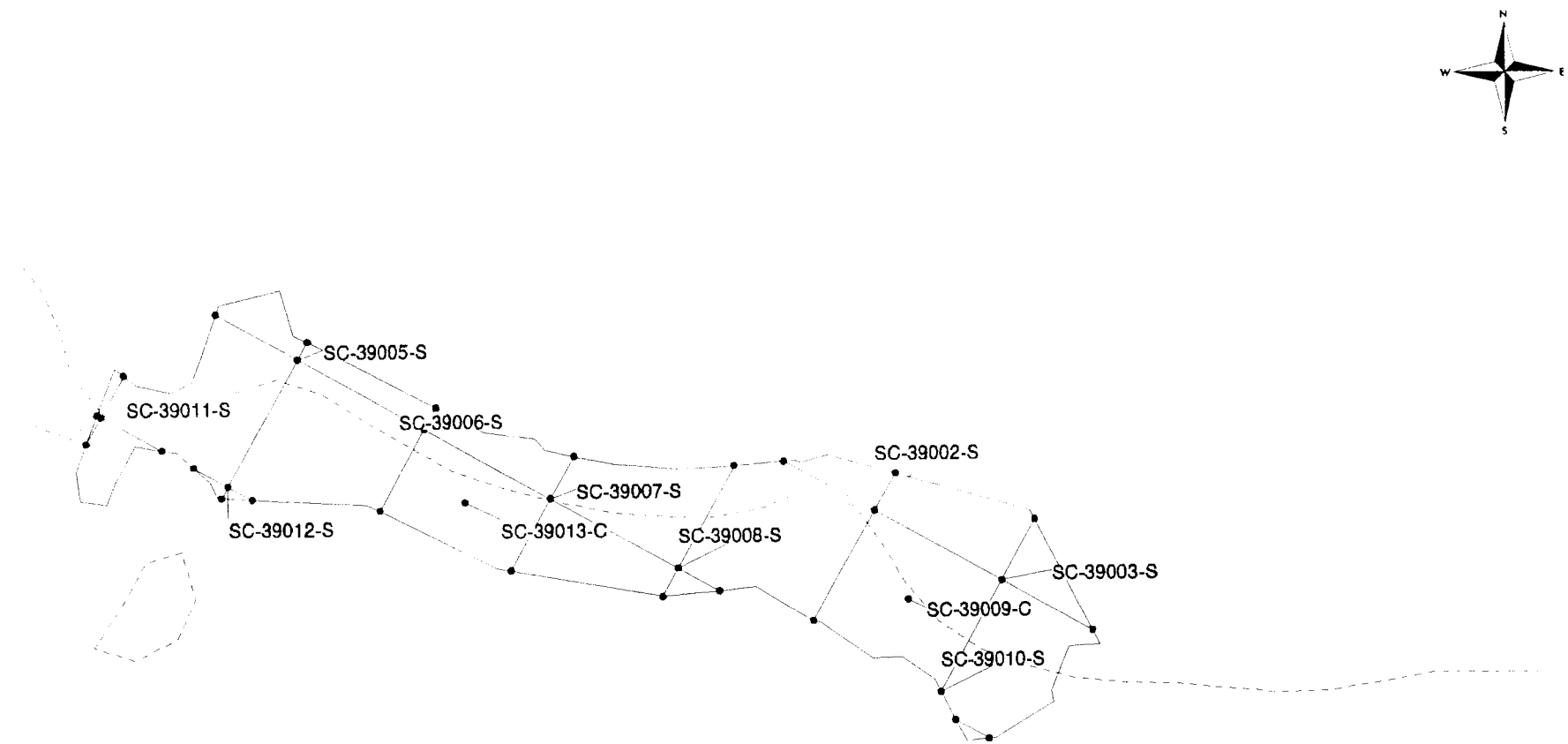
Table 4-3 Summary of Confirmation Unit 390 Analytical Results

Contaminant of Concern	Concentration Range	Concentration Average	Surface ALARA Goal Concentration	Maximum Concentration	Surface Cleanup Criteria	No. of Samples > ALARA
Th-230 (pCi/g)	0.78 – 1.14	0.92	5.0	1.14	6.2	0
U-238 (pCi/g)	1.10 – 5.22	2.00	30.0	5.22	120.0	0

4.3 Confirmation QA/QC Results

Specific data quality requirements (DQRs) were developed for the WSSRAP in accordance with Environmental Protection Agency guidance for unrestricted release of vicinity properties. Quality control sample results were compared to DQR goals to assess the precision and accuracy of the data and to identify samples that might require further validation activities. Precision is a measurement, expressed as a percentage, which represents the repeatability of the analytical data by the analysis method used. This measurement is based on the relative percent differences (RPDs) between laboratory duplicates and their respective parent analyses. The recommended RPD for radiological and chemical parameters is less than, or equal to, 50% and 35%, respectively. RPDs are not calculated when one or both of the results are not detected by the laboratory (non-detects). Also, if one or both of the results are less than five times the detection limit; the RPD value is considered of limited value due to higher tolerance limits near the analytical detection limit and, therefore, no further analysis is required. In cases where the RPDs are greater than the recommended limit, the data are further evaluated.

Accuracy is a statistical measurement, expressed as a percentage, that represents how close the analytical data are to the "true" value. Matrix spike and matrix spike duplicate samples are intralaboratory splits of a single sample that receive identical spike concentrations of the



15 7.5 0 METERS

45 22.5 0 FEET

Sample Locations in Remedial Unit RU027
Confirmation Unit CU390

Figure 4-7

EXHIBIT NO.: G/CP/099/0300		REPORT NO.: DOE/OR/21548-840	
ORIGINATOR: EMR	DRAWN BY: AMM	DATE: 02-MAR-2000	

target analyte and are used to document the accuracy and bias of a method in a given sample matrix.

To assess the precision of the Frog Pond area data sets, three duplicate, three field replicate, and three secondary duplicates were taken. Arsenic exceeded the RPD recommended limit in two of the four samples. This was probably a result of sample non-homogeneity. The seven other samples results that exceeded the RPD recommended limit were less than five times the detection levels, and no further analysis was performed. All other radiological and chemical parameters were within recommended RPD limits.

To assess the precision of the Frog Pond outlet data sets, one duplicate sample and one field replicate sample was taken. RPDs for the duplicate and field replicate samples ranged between 2.5% to 41%. No RPD results exceeded recommended limits. Accuracy for samples requiring only radiological analysis is addressed in the calibration of the analytical equipment. All calibration analysis was within recommended limits.

Equipment blanks (EB) are used to evaluate potential cross contamination from the field sampling equipment. Equipment blanks were analyzed for the Frog Pond sampling activity but not the Frog Pond outlet sampling activity. No contamination was detected in any of the equipment blank samples for the Frog Pond area.

Disposable plastic scoops were used to sample the Frog Pond outlet. This eliminated the need for decontamination of re-usable sample equipment along with the possibility of potential cross-contamination. Consequently no equipment blank samples were required.

4.4 Frog Pond Outlet ALARA Committee Meeting

The ALARA committee met on March 23, 2000, to discuss the contamination remaining under the culverts under Highway D at the Frog Pond outlet (Appendix B). The committee decided that the area met the "hot spot rule" and should remain without additional remediation or sampling. This decision was based on the following information:

1. No sample results from pre-remediation characterization activities performed at both the Frog Pond drainage and the Frog Pond outlet exceeded three times criteria.

2. Two locations sampled on the opposite end of the culverts were less than U-238 and Th-230 ALARA concentrations.

3. With a maximum allowable hot spot of 15 m^2 and assuming the U-238 concentration of 310 pCi/g extended the entire length of the culvert, the resulting hot spot size would be 8 m^2.

4. A risk assessment conducted by Argonne National Laboratories indicated that exposure to the residual contaminant levels at the culvert area would result in very low potential risk to an industrial worker or recreational visitor.

4.5 ORISE Verification

The Oak Ridge Institute for Science and Education (ORISE) is contracted by the DOE to audit the confirmation soil sampling in the chemical plant area and vicinity properties. No confirmation verification was performed by ORISE on either the Frog Pond area or the Frog Pond outlet.

5. OPERATIONS AND MAINTENANCE

5.1 Long-Term Monitoring

No long-term monitoring is planned for the soils within the Frog Pond area or the Frog Pond outlet. The soil radiological concentrations within all areas satisfy the established criteria for unrestricted use.

5.2 Facilities and Equipment

No facilities or permanent equipment were constructed or installed as part of this remedial action. No long-term operations or maintenance activities are necessary.

6. REFERENCES

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2. Boerner, A.J. *Radiological Survey of the August A. Busch and Weldon Spring Wildlife Areas Weldon Spring Site, St. Charles County, Missouri*, Final Report. Prepared by Oak Ridge Associated Universities, for U.S. Department of Energy, Division of Remedial Action Projects. April 1986.

3. MK-Ferguson Company and Jacobs Engineering Group. *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site.* Rev. O. DOE/OR/21548-376. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. September 1993.

4. UNC Geotech Inc. *Radiologic Characterization of the Weldon Spring, Missouri, Remedial Action Site.* Rev. 0. Prepared by UNC Geotech, for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. February 1988.

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6. MK-Ferguson Company and Jacobs Engineering Group. *Frog Pond Characterization Sampling Plan.* Rev. 1. DOE/OR/21548-712. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. January 1998.

7. MK-Ferguson Company and Jacobs Engineering Group. *Analytical Data Results for the Frog Pond Characterization Sampling Plan.* Rev. 0. DOE/OR/21548-841. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. March 2000.

8. MK-Ferguson Company and Jacobs Engineering Group. *Engineering Soils Sampling Plan for Army and MDC Vicinity Properties: Addendum 4; Soil Sampling at Frog Pond Drainage Outlet and MDC-6.* Rev. 1. DOE/OR/21548-622. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. October 1998.

9. MK-Ferguson Company and Jacobs Engineering Group. *Closure Report for Soil Sampling at Frog Pond Drainage Outlet and MDC-6; Addendum 4 of the Engineering Soil Sampling Plan for Army and MDC Vicinity Properties.* Rev. 0. DOE/OR/21548-791. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. June 1999.

10. MK-Ferguson Company and Jacobs Engineering Group. *Engineering Soils Sampling Plan for Army and MDC Vicinity Properties: Addendum 6: Engineering Characterization Sampling at the Frog Pond Drainage Outlet.* Rev. 0. DOE/OR/21548-622. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. September 1999. (Note: This document was prepared and transmitted to the DOE as an IOC).

11. MK-Ferguson Company and Jacobs Engineering Group. *Closure Report for Soil Sampling at the Frog Pond Outlet, Addendum 6 of the Engineering Soil Sampling Plan for Army and MDC Vicinity Properties.* Rev. 0. DOE/OR/21548-829. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. January 2000.

12. MK-Ferguson Company and Jacobs Engineering Group. *Sampling Plan for the Radiological Characterization of Sediments and Soil Within the Southeast Corner of Busch Lake 36.* Rev. 0. DOE/OR/21548-827. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. November 1999.

13. MK-Ferguson Company and Jacobs Engineering Group. *Closure Report for the Radiological Characterization of Sediments and Soil Within the Southeast Corner of Busch Lake 36 Sampling Plan.* Rev. 0. DOE/OR/21548-835. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. March 2000.

14. MK-Ferguson Company and Jacobs Engineering Group. *Chemical Plant Area Cleanup Attainment Confirmation Plan.* Rev. 3. DOE/OR/21548-491. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. December 1995.

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APPENDIX A
Non-Significant Change to the ROD

NOTIFICATION OF POST-ROD CHANGES AT THE WELDON SPRING SITE

EDD LOG # 19

☐ Mr. Daniel Wall Remedial Project Manager U.S. EPA Region VII FAX (913) 551-7063	MDNR ☐ Mr. Larry Erickson/Bob Geller Federal Facilities Section Fax: (573) 751-7869 ☐ Ed Sadler Hazardous Waste Division Fax: (573) 751-7869 ☐ WSSRAP Field Office Fax: (314) 447-0729	☐ Karen Reed DOE ☐ Project Manager Gene Valett ☐ Citizens Commission Fax: (314) 949-7546 or Fax: (314) 949-7532 Phone: (314) 949-7545

Date: July 24, 1998

Contact Person: Gene Valett

Work Package/Activity: Frog Pond Outlet Remediation Area

Type of Change: (Check One)

_____ Fundamental Change to ROD
_____ Significant Change to ROD
_x_ Non-Significant Change to ROD
_____ Variance to Work Plan and/or Work Control Documents

DOCUMENTATION REVIEWED: *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site.*

DESCRIPTION OF ACTIVITY: Previously unidentified contamination detected in the Frog Pond Outlet area will be remediated using the guidelines in the ROD for Vicinity Properties. Refer to: *Engineering Soil Sampling Plan for Army and MDC Properties: Addendum 4: Soil Sampling at Frog Pond Drainage and MDC-6*, March, 1998, Transmitted April 1, 1998.

DESCRIPTION OF CHANGE: This area was not previously identified as contaminated or in need of remediation. This area will now be addressed as though it were a vicinity property.

JUSTIFICATION FOR CHANGE: Recently conducted radiological surface scans and soil sampling have detected elevated uranium and thorium levels in the drainage outlet leading from the Frog Pond. Soil characterization results indicate contamination above the uranium criteria (120 pCi/g) and Thorium-230 criteria (6.2 pCi/g)

LEVEL OF FOLLOW-UP: No follow-up is required.

Julie M Kutinger ORIGINATOR	August 4, 1998 DATE	[illegible] DOE PROJECT ENGINEER	8-4-98 DATE
Gene Valett PMC PROJECT MANAGER	4 August 98 DATE	[illegible] DOE PROJECT MANAGER	8/4/98 DATE
Steve DeLaney PMC PROJECT/DEPUTY DIRECTOR	8/4/98 DATE		

cc: Administrative Record Coordinator
RC-31-08
FFA Coordinator

X FINAL NOTIFICATION; ACTIVITY MAY PROCEED

APPENDIX B
ALARA Committee Meeting Summary March 23, 2000

ALARA Committee Meeting
March 23, 2000

Attendees:	S. Warren*	T. Uhlmeyer	T. Pauling*
	D. Hixson*	E. Ripp	A. Pickett
	M. Peterson	G. Valett	L. Broody
	M. Lutz*	M. Wesley*	H. Hufker

* Denotes ALARA Committee member/alternate

The ALARA committee met to discuss the contamination remaining under the Frog Pond Outlet culverts at Highway D. The question was whether this area could remain without making changes to the Chemical Plant ROD and/or applying for supplemental standards.

Eric Ripp provided details of remediation activities and current status of this area. Handouts were provided, including figures and characterization data (attached). The following is a summary of that presentation:

Sequence of events: Frog Pond Outlet excavation was conducted in accordance with engineering design. During walkovers, contamination was found to extend beneath the two culverts, therefore additional contaminated soil was removed along with approximately 20 ft of the culverts. Scanning still showed elevated readings, however no additional excavation was performed for the following reasons:
(1) continued excavation would enter into the Missouri Department of Transportation right-of-way,
(2) a buried fiber optic line and overhead power lines were present between Highway D and the existing excavation, and
(3) the work required was outside the scope of the existing subcontract based upon (1) and (2).

A decision was made with DOE (during an August 26, 1999 meeting) to cease excavation activities. Prior to replacing culverts and backfilling with clean material, the soil around the culverts was surveyed (2x2 meter) and the area with the highest reading beneath each culvert was surveyed and sampled. Results were 310 pCi/g beneath the east culvert and 48.4 pCi/g beneath the west culvert for U238. These had NaI readings of approximately 10 – 30kcpm and 1.5kcpm, respectively.

Additional Information:

- None of the characterization results for Frog Pond Outlet or the Frog Pond Drainage exceeded three times criteria. Several small areas of approximately 300 pCi/g were found. The results are attached and Figure C shows the locations. The other end of the culverts was sampled, but samples were not collected directly under the culverts per the locations designated in the respective sampling plan (i.e. no material was accessible under the culverts for surveying and therefore not targeted). Two locations were sampled in soil/sediment within a few feet of the culvert and results for these samples were less than ALARA.

- Approximately 20 ft of the original deteriorated culvert was removed and replaced with new culverts. There is approximately 85 ft of original culverts remaining. See Figure A.

- Harry Hufker discussed the survey results and KPA samples. During excavation around the culverts, readings fluctuated, sometimes at background and other times above 1.5 times background, therefore showing that contamination was spotty. During excavation activities, KPA water samples were also collected from the excavation and also from the culvert. All results were low (i.e., this water never required treatment).

• The hotspot calculation was done on 310 pCi/g, giving a maximum allowable hotspot of 15 m^2 (see attached calculation). Assuming the standard practice of going ½ way between a contaminated and uncontaminated sample (in this case, 42.5 ft) and 1 ft across (the approximate width of the lens of elevated sediment), the hotspot size would be 4 m^2. Even if the assumption was made that the 310 pCi/g extended the entire length of the remaining culvert (85 ft), the resulting hotspot size is only 8 m^2.

• ORISE reviewed the Draft Post Remedial Action Report for the Frog Pond Outlet (Rev. A) and has requested that more details concerning the contamination under the culverts be included in the report for clarification purposes and inquired if a risk assessment had been done. The risk assessment done by Argonne, as discussed below, will be transmitted to ORISE upon response to their comments.

• Argonne completed the risk assessment for this area. The estimate indicates that exposure to the residual contaminant levels at the culvert area would result in very low potential risk to an industrial worker or recreational visitor. A copy of the risk assessment summary is attached. This information will be transmitted to MDC - Busch, MDNR, and Highway Department.

• It is recommended that this area be identified on Highway Department drawings, if possible, so that DOE could be notified if any work were to take place around these culverts in the future. This decision is deferred and will be evaluated as part of the Institutional Controls Plan for the project.

• The Frog Pond Outlet was added as a Vicinity Property to the Chemical Plant ROD on July 24, 1998. There was discussion whether a change to the ROD was necessary to leave this contamination or were supplemental standards required. Terri Uhlmeyer reviewed the ROD and Chemical Plant Area Cleanup Attainment Confirmation Plan, Rev. 3 (DOE/OR/21548-491) and did not see that any changes to the ROD were required. The Confirmation Attainment Plan states:

> (1) that remediation will be deemed complete either when the data indicate that the ALARA goal concentrations have been met or when it is determined that the ALARA principle has been met even though the actual goal concentrations have not. Throughout the remainder of this document, when it is stated that ALARA goals will be met, it includes both options of meeting either the ALARA goal concentrations or the general principle of ALARA (page 4, section 1.4), and
> (2) In addition to meeting the ALARA goal concentrations in the statistical manner prescribed above, there may be instances when the spirit of ALARA will be deemed to have been met in a CU when the goal concentrations have not. The decision will be made and documented by the (ALARA) committee (page 41, section 8.3).

It was also decided that supplemental standards were not required. We would use supplemental standards only when leaving an area with a result greater than three times criteria or failing the hotspot rule. Also, we would apply for supplemental standards if we knew for sure that we were leaving something behind that does not meet the attainment plan.

• The question was asked whether additional samples could be obtained. The original sampling locations can no longer be reached since the ~~new~~ MCL 20 ft culverts have been replaced, grouted around the connections, and backfilled. The most common method, vertical drilling did not seem feasible. Gene Valett thought that drilling through the corroded culvert to collect soil samples would compromise what culvert integrity was remaining. This would also require the Highway Department's approval. Other alternatives, such as angle drilling could possibly be used. Again this would require the Highway Departments approval since we would be on their right of way. It also may compromise the culvert's integrity by removing soil supporting the bottom of the culvert. Do to the difficulty in trying to get additional samples and the fact that existing data makes it a reasonable assumption that the contaminated area meets the hot spot criteria, no additional sampling is planned.

ALARA Committee Decision:

It does not seem reasonable to remove the remaining contamination due to the presence of Highway D and the fiber optic cable running above the culvert. It is reasonable to conclude that this area meets the hotspot rule, based upon conservative assumptions regarding its size. Based upon the above information, the ALARA committee agreed that this area should remain without additional remediation or sampling required.

Attachments (hotspot calculation, Figures, Characterization results, and ANL's risk assessmet)

cc: B. Moore
J. Bennett
K. Greenwell

ATTACHMENT

Hotspot Calculation

$$\text{Maximum Concentration} = \text{Criteria}(100/A)^{1/2}$$

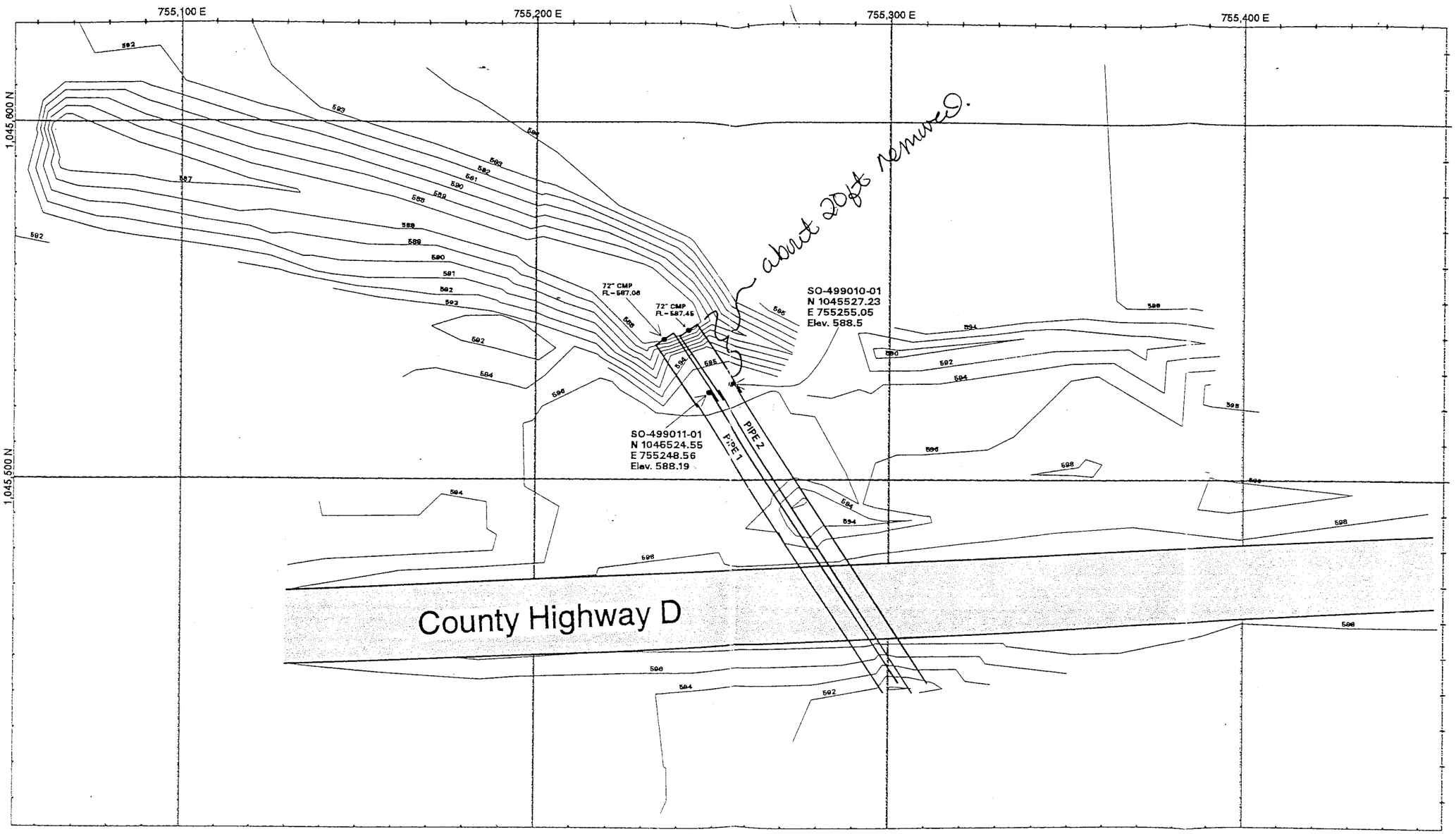
$$310 = 120(100/A)^{1/2}$$

$$A = 15\ m^2$$

ALARA Committee Meeting
March 23, 2000

Frog Pond Outlet

Figure A



30 15 0 METERS

Scale: 1 inch = 30 feet

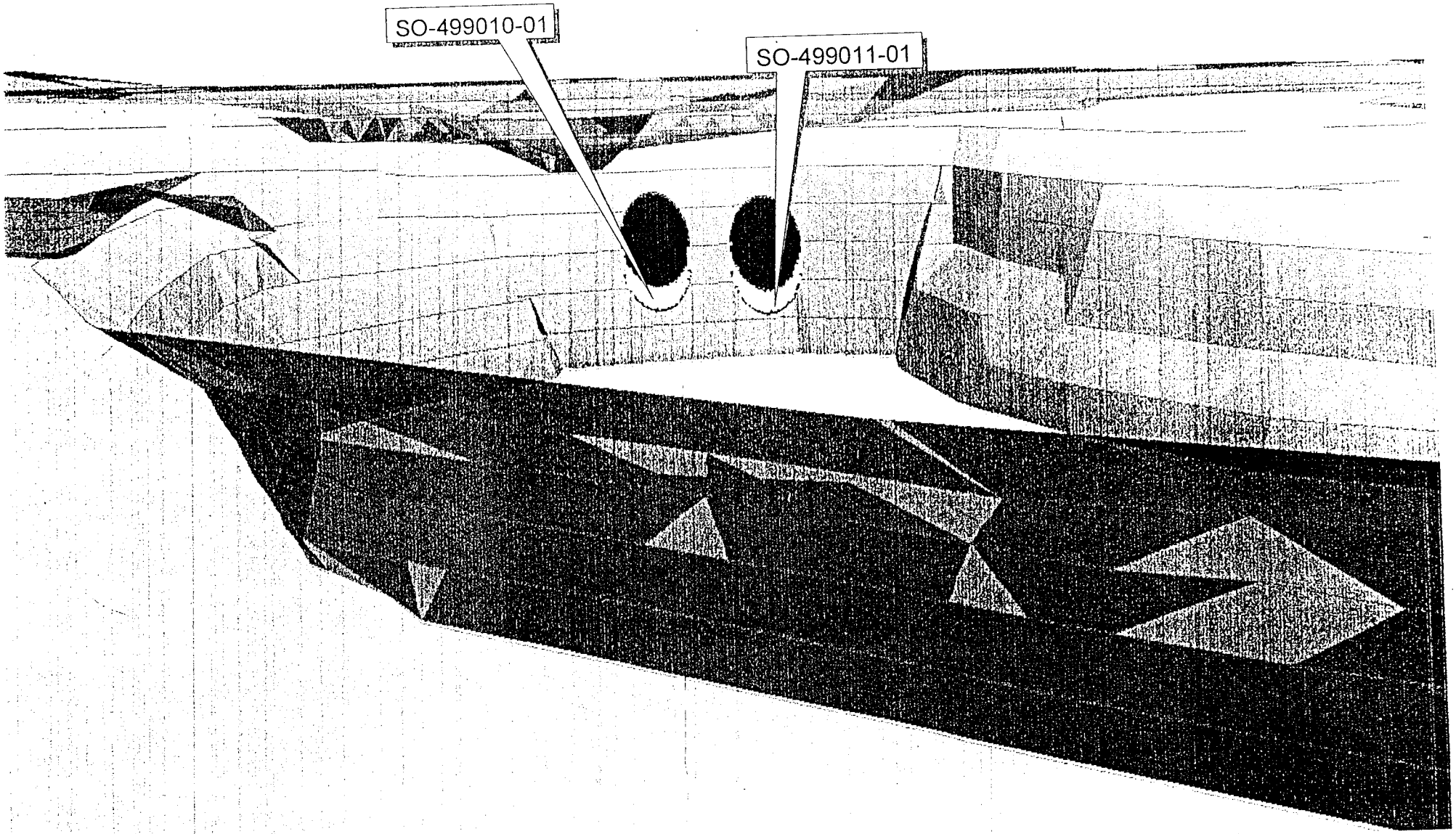
100 50 0 FEET

Frog Pond Outlet
Twin Culvert Sample Locations

Figure: 2-1

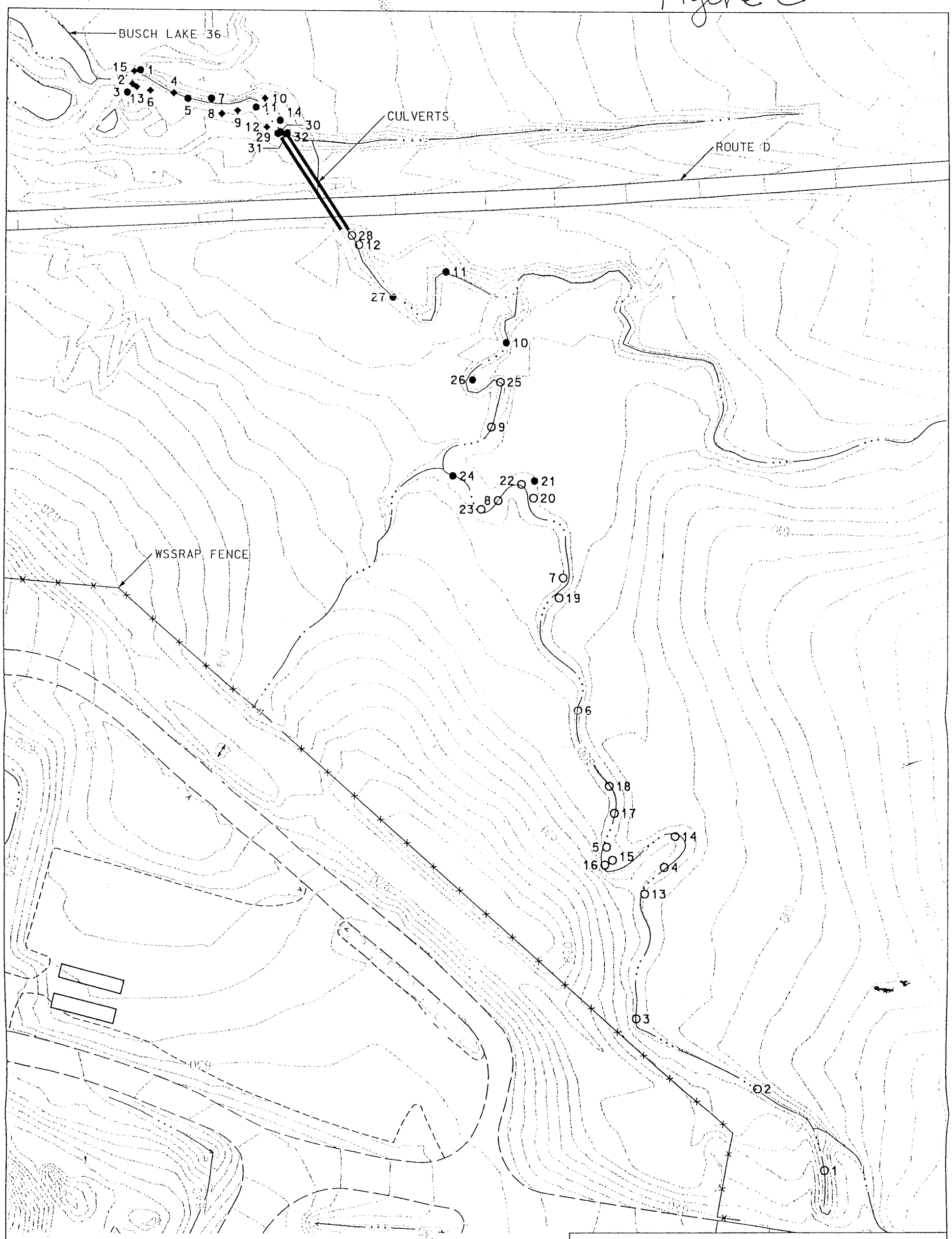
REPORT NO.: DOE/OR/21548-829		EXHIBIT NO.: G/CP/277/1299	
ORIGINATOR: EMR	DRAWN BY: WSSRAP GIS	DATE: 12/17/99	

Figure 13



Sample ID #	Northing	Easting	Surface Elevation	U-238 Concentration
SO-499010-01	1045527.23	755255.05	588.50	310.0 pCi/g
SO-499011-01	1045524.55	755248.56	588.19	48.4 pCi/g

Figure C



O – SAMPLE LOCATION LESS THAN U-238 ALARA LEVELS (30 pCi/g)

● – SAMPLE LOCATION GREATER THAN U-238 ALARA LEVELS (30 pCi/g) BUT LESS THAN CRITERIA LEVELS (120 pCi/g)

◆ – SAMPLE LOCATION GREATER THAN U-238 CRITERIA LEVELS (120 pCi/g)

N

0 100 200

SCALE FEET

FROG POND OUTLET
FROG POND DRAINAGE

FIGURE 2-1

REPORT NO.: DOE/OR/21548-840	EXHIBIT NO.: B/VP/016/0300	
ORIGINATOR: EMR	DRAWN BY: GLN	DATE: 3/23/00

Frog Pond Drainage Sample Locations

Bold Typeface = Above ALARA

Bold Typeface = Above both ALARA and Criteria

Location Number	Sample ID #'s	Sample Depth Retrieval	Type of Sample	Radionuclides in pCi/g					Northing	Easting	Elevation
				Ra-226	Ra-228	Th-230	Th-232	U-238			
1	SO-498401-01	0' - 1'	Unbiased	0.63	< 0.99	1.00	< 0.99	2.81	1044441.24	755817.33	608.6
1	SO-498401-02	1' - 2'	Unbiased	1.02	1.14	1.29	1.17	4.49	1044441.24	755817.33	
2	SO-498402-01	0' - 1'	Unbiased	0.95	< 1.10	1.23	< 1.10	3.73	1044530.00	755745.60	607.06
3	SO-498403-01	0' - 1'	Unbiased	0.93	1.26	1.15	1.29	4.48	1044605.53	755617.04	605.46
3	SO-498403-01-DU	0' - 1'	Unbiased	0.90	1.41	1.00	1.45	4.98	1044605.53	755617.04	
3	SO-498403-01-FR	0' - 1'	Unbiased	0.87	1.25	1.03	1.28	4.95	1044605.53	755617.04	
3	SO-498403-02	1' - 2'	Unbiased	0.89	< 1.05	1.07	< 1.05	5.65	1044605.53	755617.04	
4	SO-498404-01	0' - 1'	Unbiased	0.80	1.01	2.28	1.04	28.87	1044766.03	755646.81	602.94
4	SO-498404-02	1' - 2'	Unbiased	0.97	0.90	2.12	0.92	23.85	1044766.03	755646.81	
5	SO-498405-01	0' - 1'	Unbiased	0.84	1.09	1.46	1.12	21.62	1044787.00	755585.54	601.37
6	SO-498406-01	0' - 1'	Unbiased	0.67	1.23	0.98	1.26	4.80	1044932.44	755555.67	598.45
7	SO-498407-01	0' - 1'	Unbiased	0.87	1.03	1.08	1.06	19.53	1045074.28	755539.21	596.89
7	SO-498407-01-DU	0' - 1'	Unbiased	0.91	1.29	1.13	1.32	17.93	1045074.28	755539.21	
7	SO-498407-01-FR	0' - 1'	Unbiased	1.19	1.33	1.31	1.36	17.06	1045074.28	755539.21	
7	SO-498407-02	1' - 2'	Unbiased	0.95	1.35	0.98	1.38	28.53	1045074.28	755539.21	
8	SO-498408-01	0' - 1'	Unbiased	0.75	0.96	1.10	0.98	20.85	1045154.83	755469.22	595.43
9	SO-498409-01	0' - 1'	Unbiased	0.82	1.24	1.23	1.27	16.38	1045232.78	755461.77	593.44
10	SO-498410-01	0' - 1'	Unbiased	0.90	1.25	1.05	1.28	15.04	1045322.82	755477.55	592.88
10	**SO-498410-02**	1' - 2'	Unbiased	0.84	0.85	1.00	0.87	**37.20**	1045322.82	755477.55	
11	**SO-498411-01**	0' - 1'	Unbiased	0.71	0.67	1.34	0.69	**31.63**	1045398.31	755412.72	592.4
11	**SO-498411-02**	1' - 2'	Unbiased	0.91	0.81	1.35	0.83	**70.37**	1045398.31	755412.72	
12	SO-498412-01	0' - 1'	Unbiased	0.65	< 1.21	1.28	< 1.21	10.61	1045425.96	755320.02	591.71
12	SO-498412-02	1' - 2'	Unbiased	0.74	< 0.78	1.17	< 0.78	11.52	1045425.96	755320.02	
13	SO-498413-01	0' - 1'	Biased - sediment deposition area	0.85	1.19	1.28	1.22	17.71	1044737.93	755626.02	603.42
14	SO-498414-01	0' - 1'	Biased - sediment deposition area	0.96	1.18	0.91	1.21	20.11	1044798.55	755658.19	603.28
14	SO-498414-02	1' - 2'	Biased - sediment deposition area	1.01	< 1.14	1.51	< 1.14	17.98	1044798.55	755658.19	
14	SO-498414-03	2' - 3'	Biased - sediment deposition area	0.75	0.96	2.08	0.98	17.79	1044798.55	755658.19	
15	SO-498415-01	0' - 1'	Biased - sediment deposition area	0.80	1.05	1.62	1.08	13.40	1044773.33	755591.91	601.39
15	SO-498415-02	1' - 2'	Biased - sediment deposition area	0.90	1.39	1.83	1.42	15.57	1044773.33	755591.91	
16	SO-498416-01	0' - 1'	Biased - sediment deposition area	0.73	0.79	1.48	0.81	9.43	1044768.35	755583.67	600.84
16	SO-498416-02	1' - 2'	Biased - sediment deposition area	0.82	0.97	1.22	0.99	22.78	1044768.35	755583.67	
17	SO-498417-01	0' - 1'	Biased - sediment deposition area	0.68	< 0.94	1.02	< 0.94	5.54	1044822.81	755593.73	600.3
17	SO-498417-02	1' - 2'	Biased - sediment deposition area	0.76	1.01	1.15	1.04	13.81	1044822.81	755593.73	

Bold Typeface = Above ALARA

Bold Typeface = Above both ALARA and Criteria

Location Number	Sample ID #'s	Sample Depth Retrieval	Type of Sample	Radionuclides in pCi/g					Northing	Easting	Elevation
				Ra-226	Ra-228	Th-230	Th-232	U-238			
18	SO-498418-01	0' - 1'	Biased - sediment deposition area	0.58	< 1.02	0.95	< 1.02	11.57	1044851.39	755588.34	600
19	SO-498419-01	0' - 1'	Biased - sediment deposition area	0.69	0.85	1.09	0.87	12.32	1045053.27	755534.95	597.75
20	SO-498420-01	0' - 1'	Biased - sediment deposition area	< 0.62	1.01	1.13	1.04	6.49	1045157.66	755507.16	596.52
21	SO-498421-01	0' - 1'	Biased - sediment deposition area	0.77	1.10	1.38	1.13	15.19	1045175.69	755508.12	596.84
21	**SO-498421-02**	1' - 2'	Biased - sediment deposition area	0.76	1.15	1.48	1.18	**31.14**	1045175.69	755508.12	
22	SO-498422-01	0' - 1'	Biased - sediment deposition area	0.60	0.87	1.32	0.89	22.41	1045172.07	755494.15	597
22	SO-498422-02	1' - 2'	Biased - sediment deposition area	< 0.65	0.93	1.72	0.95	24.96	1045172.07	755494.15	
23	SO-498423-01	0' - 1'	Biased - sediment deposition area	0.68	0.91	1.18	0.93	17.23	1045145.48	755451.13	596.12
23	SO-498423-02	1' - 2'	Biased - sediment deposition area	0.74	< 1.00	1.50	< 1.00	23.86	1045145.48	755451.13	
24	SO-498424-01	0' - 1'	Biased - sediment deposition area	0.51	1.07	1.15	1.10	10.84	1045180.78	755420.82	594.95
24	**SO-498424-02**	1' - 2'	Biased - sediment deposition area	0.81	1.08	1.22	1.11	**60.84**	1045180.78	755420.82	
25	SO-498425-01	0' - 1'	Biased - sediment deposition area	0.69	0.95	1.21	0.97	18.45	1045280.38	755471.29	593.56
25	SO-498425-02	1' - 2'	Biased - sediment deposition area	0.97	0.81	0.98	0.83	29.42	1045280.38	755471.29	
26	SO-498426-01	0' - 1'	Biased - sediment deposition area	0.89	1.17	1.19	1.20	24.86	1045282.74	755441.46	593.73
26	SO-498426-01-DU	0' - 1'	Biased - sediment deposition area	0.76	1.01	1.26	1.04	23.46	1045282.74	755441.46	
26	SO-498426-01-FR	0' - 1'	Biased - sediment deposition area	0.96	1.31	1.07	1.34	22.73	1045282.74	755441.46	
26	**SO-498426-02**	1' - 2'	Biased - sediment deposition area	1.11	< 1.27	1.23	< 1.27	**70.81**	1045282.74	755441.46	
27	**SO-498427-01**	0' - 1'	Biased - sediment deposition area	1.04	1.43	1.77	1.47	**43.12**	1045371.17	755356.49	592.1
27	**SO-498427-02**	1' - 2'	Biased - sediment deposition area	1.14	1.44	1.93	1.48	**55.73**	1045371.17	755356.49	
28	SO-498428-01	0' - 1'	Biased - sediment deposition area	0.84	1.06	1.10	1.09	17.28	1045435.74	755312.22	591.76
29	SO-498429-01	0' - 1'	Biased - sediment deposition area	0.72	1.35	1.05	1.38	6.11	1045543.51	755232.54	587.86
29	SO-498429-02	1' - 2'	Biased - sediment deposition area	0.76	1.19	1.39	1.22	12.63	1045543.51	755232.54	
29	**SO-498429-03**	2' - 3'	Biased - sediment deposition area	0.87	< 1.17	2.23	< 1.17	**53.74**	1045543.51	755232.54	
30	SO-498430-01	0' - 1'	Biased - sediment deposition area	0.73	1.06	1.17	1.09	9.58	1045545.08	755234.93	587.91
30	SO-498430-02	1' - 2'	Biased - sediment deposition area	0.69	1.21	1.56	1.24	20.25	1045545.08	755234.93	
30	**SO-498430-03**	2' - 3'	Biased - sediment deposition area	0.85	1.02	2.21	1.05	**47.99**	1045545.08	755234.93	
31	SO-498431-01	0' - 1'	Biased - sediment deposition area	< 0.77	1.14	1.17	1.17	4.38	1045543.18	755241.50	587.83
31	**SO-498431-02**	1' - 2'	Biased - sediment deposition area	0.75	1.23	1.69	1.26	**31.94**	1045543.18	755241.50	
32	SO-498432-01	0' - 1'	Biased - sediment deposition area	0.59	1.33	1.02	1.36	10.05	1045544.09	755242.56	587.75
32	**SO-498432-02**	1' - 2'	Biased - sediment deposition area	0.88	1.15	2.20	1.18	**44.29**	1045544.09	755242.56	

Frog Pond Drainage Outlet Sample Locations (Rev. 1 18DEC98)

Bold Typeface = Above ALARA

Bold Typeface = Above both ALARA and Criteria

Location Number	Sample ID #'s	Sample Depth Retrieval	Type of Sample	Radionuclides in pCi/g					Northing	Easting	Elevation
				Ra-226	Ra-228	Th-230	Th-232	U-238			
1	SO-V97301-01-FPO	0' - 1'	Unbiased - 1st Transect	1.21	1.17	1.35		18.7	1045609.62	755087.39	588.33
1	**SO-V97301-02-FPO**	1' - 2'	Unbiased - 1st Transect	1.43	1.59	2.29		**41.0**	1045609.62	755087.39	588.33
1	SO-V97301-03-FPO	2' - 3'	Unbiased - 1st Transect	1.31	1.02	1.72		19.7	1045609.62	755087.39	588.33
1	SO-V97301-04-FPO	3' - 4'	Unbiased - 1st Transect	1.05	1.31	1.06		6.56	1045609.62	755087.39	588.33
1	SO-V97301-05-FPO	4' - 5'	Unbiased - 1st Transect	1.35	1.30	1.13		4.64	1045609.62	755087.39	588.33
2	**SO-V97302-01-FPO**	0' - 1'	Unbiased - 1st Transect	1.42	1.50	2.62		**56.8**	1045594.56	755078.76	586.65
2	**SO-V97302-02-FPO**	1' - 2'	Unbiased - 1st Transect	1.79	1.64	**6.32**		**123.0**	1045594.56	755078.76	586.65
2	**SO-V97302-03-FPO**	2' - 3'	Unbiased - 1st Transect	1.79	1.07	**9.01**		**219.0**	1045594.56	755078.76	586.65
2	**SO-V97302-04-FPO**	3' - 4'	Unbiased - 1st Transect	1.53	1.10	**7.42**		**203.0**	1045594.56	755078.76	586.65
2	**SO-V97302-05-FPO**	4' - 5'	Unbiased - 1st Transect	1.45	0.99	4.47		**91.8**	1045594.56	755078.76	586.65
2	**SO-V97302-06-FPO**	5' - 6'	Unbiased - 1st Transect	1.16	1.29	2.49		**40.5**	1045594.56	755078.76	586.65
3	SO-V97303-01-FPO	0' - 1'	Unbiased - 1st Transect	1.08	1.01	1.28		17.7	1045585.45	755073.68	588.08
3	**SO-V97303-02-FPO**	1' - 2'	Unbiased - 1st Transect	1.57	1.86	3.28		**88.2**	1045585.45	755073.68	588.08
3	**SO-V97303-03-FPO**	2' - 3'	Unbiased - 1st Transect	1.25	1.24	3.08		**36.6**	1045585.45	755073.68	588.08
3	**SO-V97303-04-FPO**	3' - 4'	Unbiased - 1st Transect	1.25	1.14	2.72		**32.8**	1045585.45	755073.68	588.08
3	**SO-V97303-04-FPO-RS**	3' - 4'	Unbiased - 1st Transect	1.38	1.48	2.40		**40.5**	1045585.45	755073.68	588.08
3	SO-V97303-05-FPO	4' - 5'	Unbiased - 1st Transect	1.46	1.09	1.09		9.25	1045585.45	755073.68	588.08
3	SO-V97303-06-FPO	5' - 6'	Unbiased - 1st Transect	1.25	1.12	1.23		8.87	1045585.45	755073.68	588.08
4	SO-V97304-01-FPO	0' - 1'	Unbiased - 2nd Transect	1.38	1.14	0.94		14.7	1045585.13	755122.46	588.94
4	SO-V97304-02-FPO	1' - 2'	Unbiased - 2nd Transect	1.36	0.84	1.23		26.1	1045585.13	755122.46	588.94
4	**SO-V97304-03-FPO**	2' - 3'	Unbiased - 2nd Transect	1.48	< 1.12	1.52		**44.8**	1045585.13	755122.46	588.94
4	**SO-V97304-04-FPO**	3' - 4'	Unbiased - 2nd Transect	1.51	1.10	2.38		**71.5**	1045585.13	755122.46	588.94
4	**SO-V97304-05-FPO**	4' - 5'	Unbiased - 2nd Transect	1.46	1.45	**2.79**		**55.3**	1045585.13	755122.46	588.94
4	**SO-V97304-06-FPO**	5' - 6'	Unbiased - 2nd Transect	1.49	1.17	**5.17**		**181**	1045585.13	755122.46	588.94
5	SO-V97305-01-FPO	0' - 1'	Unbiased - 2nd Transect	1.24	1.21	1.07		17.2	1045579.26	755137.20	588.85
5	SO-V97305-01-FPO-FR	0' - 1'	Unbiased - 2nd Transect	1.52	1.09	1.32		17.8	1045579.26	755137.20	588.85
5	SO-V97305-02-FPO	1' - 2'	Unbiased - 2nd Transect	1.40	< 1.16	1.21		27.9	1045579.26	755137.20	588.85
5	**SO-V97305-03-FPO**	2' - 3'	Unbiased - 2nd Transect	1.41	0.72	1.39		**50.8**	1045579.26	755137.20	588.85
5	**SO-V97305-04-FPO**	3' - 4'	Unbiased - 2nd Transect	1.59	1.35	2.69		**60.1**	1045579.26	755137.20	588.85
5	**SO-V97305-05-FPO**	4' - 5'	Unbiased - 2nd Transect	1.57	1.62	3.80		**57.4**	1045579.26	755137.20	588.85
6	SO-V97306-01-FPO	0' - 1'	Unbiased - 2nd Transect	1.27	1.24	1.30		13.5	1045587.61	755097.92	589.48
6	SO-V97306-02-FPO	1' - 2'	Unbiased - 2nd Transect	1.16	1.22	1.44		28.8	1045587.61	755097.92	589.48
6	**SO-V97306-03-FPO**	2' - 3'	Unbiased - 2nd Transect	1.32	< 1.33	2.46		**57.8**	1045587.61	755097.92	589.48
6	**SO-V97306-04-FPO**	3' - 4'	Unbiased - 2nd Transect	1.73	2.43	3.77		**71.1**	1045587.61	755097.92	589.48

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Bold Typeface = Above both ALARA and Criteria

Location Number	Sample ID #'s	Sample Depth Retrieval	Type of Sample	Radionuclides in pCi/g					Northing	Easting	Elevation
				Ra-226	Ra-228	Th-230	Th-232	U-238			
6	**SO-V97306-05-FPO**	4' - 5'	Unbiased - 2nd Transect	1.84	1.12	**9.17**		**134**	1045587.61	755097.92	589.48
6	**SO-V97306-06-FPO**	5' - 6'	Unbiased - 2nd Transect	1.59	1.16	4.74		**77.4**	1045587.61	755097.92	589.48
6	**SO-V97306-07-FPO**	6' - 7'	Unbiased - 2nd Transect	1.23	1.01	1.32		**39.1**	1045587.61	755097.92	589.48
7	SO-V97307-01-FPO	0' - 1'	Unbiased - 3rd Transect	1.07	1.15	1.15		13.2	1045579.63	755161.91	589.54
7	SO-V97307-02-FPO	1' - 2'	Unbiased - 3rd Transect	1.18	1.22	1.54		25.0	1045579.63	755161.91	589.54
7	**SO-V97307-03-FPO**	2' - 3'	Unbiased - 3rd Transect	1.67	1.70	3.77		**57.1**	1045579.63	755161.91	589.54
7	SO-V97307-04-FPO	3' - 4'	Unbiased - 3rd Transect	1.44	1.43	1.62		22.5	1045579.63	755161.91	589.54
7	SO-V97307-05-FPO	4' - 5'	Unbiased - 3rd Transect	1.24	1.19	1.22		< 4.49	1045579.63	755161.91	589.54
7	SO-V97307-06-FPO	5' - 6'	Unbiased - 3rd Transect	1.14	1.27	1.30		< 2.77	1045579.63	755161.91	589.54
8	SO-V97308-01-FPO	0' - 1'	Unbiased - 3rd Transect	1.12	< 1.13	1.21		16.1	1045563.59	755173.13	589.33
8	**SO-V97308-02-FPO**	1' - 2'	Unbiased - 3rd Transect	1.20	0.96	1.60		**44.0**	1045563.59	755173.13	589.33
8	**SO-V97308-03-FPO**	2' - 3'	Unbiased - 3rd Transect	1.59	< 1.42	2.97		**80.6**	1045563.59	755173.13	589.33
8	**SO-V97308-04-FPO**	3' - 4'	Unbiased - 3rd Transect	1.35	1.90	**5.12**		**154.0**	1045563.59	755173.13	589.33
8	**SO-V97308-05-FPO**	4' - 5'	Unbiased - 3rd Transect	1.90	1.22	**5.73**		**114.0**	1045563.59	755173.13	589.33
8	**SO-V97308-06-FPO**	5' - 6'	Unbiased - 3rd Transect	1.33	< 1.17	3.76		**35.3**	1045563.59	755173.13	589.33
9	SO-V97309-01-FPO	0' - 1'	Unbiased - 3rd Transect	1.41	1.08	1.22		14.8	1045566.92	755189.79	589.71
9	SO-V97309-01-FPO-D	0' - 1'	Unbiased - 3rd Transect	1.44	1.03	1.27		15.9	1045566.92	755189.79	589.71
9	**SO-V97309-02-FPO**	1' - 2'	Unbiased - 3rd Transect	1.00	< 1.10	1.31		**30.6**	1045566.92	755189.79	589.71
9	**SO-V97309-03-FPO**	2' - 3'	Unbiased - 3rd Transect	1.18	1.21	1.80		**61.0**	1045566.92	755189.79	589.71
9	**SO-V97309-04-FPO**	3' - 4'	Unbiased - 3rd Transect	1.59	< 1.66	2.52		**138.0**	1045566.92	755189.79	589.71
9	**SO-V97309-05-FPO**	4' - 5'	Unbiased - 3rd Transect	1.90	1.71	**5.92**		**322.0**	1045566.92	755189.79	589.71
9	**SO-V97309-06-FPO**	5' - 6'	Unbiased - 3rd Transect	1.73	< 1.33	**9.16**		**255.0**	1045566.92	755189.79	589.71
10	SO-V97310-01-FPO	0' - 1'	Unbiased - 4th Transect	1.16	1.10	1.29		7.83	1045580.19	755218.85	588.97
10	SO-V97310-02-FPO	1' - 2'	Unbiased - 4th Transect	1.20	< 1.17	1.32		18.4	1045580.19	755218.85	588.97
10	**SO-V97310-03-FPO**	2' - 3'	Unbiased - 4th Transect	1.49	1.42	2.46		**78.8**	1045580.19	755218.85	588.97
10	**SO-V97310-04-FPO**	3' - 4'	Unbiased - 4th Transect	1.28	2.34	4.51		**150.0**	1045580.19	755218.85	588.97
10	**SO-V97310-05-FPO**	4' - 5'	Unbiased - 4th Transect	1.86	1.68	**7.25**		**309.0**	1045580.19	755218.85	588.97
10	**SO-V97310-05-FPO-FR**	4' - 5'	Unbiased - 4th Transect	2.16	0.72	**6.87**		**194.0**	1045580.19	755218.85	588.97
11	SO-V97311-01-FPO	0' - 1'	Unbiased - 4th Transect	1.02	< 0.88	1.17		23.3	1045570.64	755209.40	589.01
11	**SO-V97311-02-FPO**	1' - 2'	Unbiased - 4th Transect	1.51	1.13	1.68		**52.6**	1045570.64	755209.40	589.01
11	**SO-V97311-03-FPO**	2' - 3'	Unbiased - 4th Transect	2.47	1.31	3.02		**49.2**	1045570.64	755209.40	589.01
11	**SO-V97311-04-FPO**	3' - 4'	Unbiased - 4th Transect	1.57	1.38	2.78		**65.3**	1045570.64	755209.40	589.01
11	**SO-V97311-05-FPO**	4' - 5'	Unbiased - 4th Transect	1.51	1.02	3.76		**62.6**	1045570.64	755209.40	589.01
12	SO-V97312-01-FPO	0' - 1'	Unbiased - 4th Transect	1.08	1.09	1.03		21.8	1045550.15	755220.77	589.56
12	SO-V97312-02-FPO	1' - 2'	Unbiased - 4th Transect	1.32	< 1.15	1.79		26.3	1045550.15	755220.77	589.56

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Location Number	Sample ID #'s	Sample Depth Retrieval	Type of Sample	Radionuclides in pCi/g					Northing	Easting	Elevation
				Ra-226	Ra-228	Th-230	Th-232	U-238			
12	**SO-V97312-03-FPO**	2' - 3'	Unbiased - 4th Transect	1.40	1.38	2.75		**47.8**	1045550.15	755220.77	589.56
12	**SO-V97312-04-FPO**	3' - 4'	Unbiased - 4th Transect	1.40	< 1.17	3.36		**40.3**	1045550.15	755220.77	589.56
12	**SO-V97312-05-FPO**	4' - 5'	Unbiased - 4th Transect	2.06	0.95	**8.48**		**245.0**	1045550.15	755220.77	589.56
13	**SO-V97313-01-FPO**	0' - 1'	Biased - Elevated Walkover Survey	1.27	1.19	2.20		**37.3**	1045591.40	755083.37	587.13
13	**SO-V97313-02-FPO**	1' - 2'	Biased - Elevated Walkover Survey	1.63	< 1.50	4.14		**77.1**	1045591.40	755083.37	587.13
13	**SO-V97313-03-FPO**	2' - 3'	Biased - Elevated Walkover Survey	1.92	1.51	**8.09**		**163.0**	1045591.40	755083.37	587.13
13	**SO-V97313-04-FPO**	3' - 4'	Biased - Elevated Walkover Survey	1.21	1.20	2.71		**70.6**	1045591.40	755083.37	587.13
14	SO-V97314-01-FPO	0' - 1'	Biased - Elevated Walkover Survey	1.12	1.06	1.46		16.3	1045557.10	755234.89	589.89
14	SO-V97314-01-FPO-D	0' - 1'	Biased - Elevated Walkover Survey	0.96	0.98	1.27		13.3	1045557.10	755234.89	589.89
14	**SO-V97314-02-FPO**	1' - 2'	Biased - Elevated Walkover Survey	1.34	1.21	1.40		**43.5**	1045557.10	755234.89	589.89
14	**SO-V97314-03-FPO**	2' - 3'	Biased - Elevated Walkover Survey	1.62	1.14	2.00		**49.5**	1045557.10	755234.89	589.89
14	**SO-V97314-04-FPO**	3' - 4'	Biased - Elevated Walkover Survey	1.59	1.59	3.00		**81.4**	1045557.10	755234.89	589.89
14	**SO-V97314-05-FPO**	4' - 5'	Biased - Elevated Walkover Survey	1.53	1.46	3.27		**56.0**	1045557.10	755234.89	589.89
15	**SO-V97315-01-FPO**	0' - 1'	Biased - Elevated Walkover Survey	1.46	1.60	2.80		**44.1**	1045608.17	755080.97	586.47
15	**SO-V97315-02-FPO**	1' - 2'	Biased - Elevated Walkover Survey	1.71	1.10	**8.01**		**137**	1045608.17	755080.97	586.47
15	**SO-V97315-03-FPO**	2' - 3'	Biased - Elevated Walkover Survey	1.43	0.90	3.26		**36.9**	1045608.17	755080.97	586.47

ROD chemical contaminants were run on sample locations 2, 10, 13, and 15. All locations were below ALARA levels for the chemical contaminants.

APPENDIX C
Argonne National Laboratory Risk Assessment

ARGONNE NATIONAL LABORATORY
ENVIRONMENTAL ASSESSMENT DIVISION
9700 SOUTH CASS AVENUE, ARGONNE, ILLINOIS 60439
WEB SITE: www.ead.anl.gov

TELEPHONE: 630/252-7669
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March 9, 2000

Mr. Tom Pauling
U.S. Department of Energy
Weldon Spring Site Remedial Action Project
7295 Highway 94 South
St. Charles, MO 63304

Dear Mr. Pauling:

Per your request, we have completed risk calculations using data collected underneath the Frog Pond Outlet culverts during remediation activities in the fall of 1999. We hypothesized two scenarios to address the range of potential future exposure at this location, if any. The risk estimates indicate that exposure to the residual contaminant levels at the culvert area would result in very low (at 10^{-6} or lower) potential risk to an industrial worker or recreational visitor. Attached to this letter is a brief summary of the risk calculations performed.

Please feel free to call me at 630-252-7669 if you have any questions or if we could provide additional information.

Sincerely,

Mary Picel
ANL Program Manager

MP/pk
Attachment

cc: S. McCracken, DOE
Y. Deyo, PAI
D. Blunt, ANL
S.Y. Chen, ANL

RISK ESTIMATE FOR FROG POND OUTLET

Risk calculations were performed to determine potential risk to residual uranium levels in soil underneath the culverts at the Frog Pond Outlet after remediation activities were completed in the fall of 1999 (Ref.1). Two scenarios were evaluated representing the range of likely events that could occur at this area.

Of the two scenarios evaluated, the most likely scenario is that of an industrial/construction worker involved in culvert excavation and repair. It was assumed that the culvert would undergo replacement or repair, whereby the soil would be excavated potentially exposing the worker to the residual contamination. The repair or excavation activity was assumed to be a one-time event for a duration of 40 hours. This is a reasonable assumption given the size of the area in question. The exposure pathways evaluated include external radiation, incidental ingestion and inhalation of fugitive dust or soil.

A second scenario was also evaluated to simulate an event where the soil is excavated, spread over the ground surface in the area and is accessible to a recreational visitor. For this recreational visitor scenario, it was assumed that 10 visits per year would occur for 1 hour each visit over a period of 30 years. The exposure pathways evaluated include incidental ingestion and external radiation. Inhalation of fugitive dust or soil was not considered to be a viable pathway since it is common practice to re-vegetate a construction area. These assumptions are conservative given the proximity of the area in question to the highway. It is unlikely that recreational visitors would visit the area at the frequency assumed.

As a conservative approach, the maximum concentration detected of 310 pCi/g uranium-238 (Ref. 1) was assumed as the exposure point concentration for both scenarios. Therefore, no credit was taken for any mixing with uncontaminated soil that occurred in the area as it was backfilled.

Risk calculations presented in this attachment were performed using standard equations, slope factors, and exposure parameters recommended by the EPA (Ref. 2, 3 and 4). Risk calculations include the contribution from uranium-234. A list of parameters is shown in Table 1 and the results of the risk calculations are summarized in Table 2. The total estimated risks for the construction worker and the recreational visitor are 9×10^{-8} and 1×10^{-6}, respectively.

REFERENCES

1. MK-Ferguson Company and Jacobs Engineering Group. *Closure Report for Soil Sampling at the Frog Pond Outlet, Addendum 6 of the Engineering Soil Sampling Plan for Army and MDC Vicinity Properties.* Rev. 0. DOE/OR/21548-829. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office, St. Charles, MO, January 2000.

2. U.S. Environmental Protection Agency. *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A),* Interim Final, EPA/540/1-89/002, Office of Emergency and Remedial Response, Washington, D.C., December 1989.

3. U.S. Environmental Protection Agency. *Exposure Factors Handbook, Volume 1, General Factors.* EPA/600/P-95/002Fa. Office of Research and Development, Washington, D.C., August, 1997.

4. U.S. Environmental Protection Agency. *Health Effects Assessment Summary Tables, FY 1997 Update.* EPA-540-R-97-036. Office of Solid Waste and Emergency Response, Washington, D.C., July, 1997.

Table 1: Exposure Parameters

Parameter	Construction Worker	Recreational Visitor
Exposure time (hr)	8	1
Exposure frequency (d)	5	10
Exposure duration (y)	NA	30
Inhalation rate (m3/hr)	2.5	NA
Ingestion rate (mg/d)	50	60[a]
Particulate emission factor (m3/g)	4.63×10^{6}	NA

[a]Weighted average: 6 years child ingestion of 100 mg/d, and 24 years adult ingestion 50 mg/d.

Table 2: Risk Estimates for the Construction Worker and Recreational Visitor

Exposure Pathway	Construction Worker	Recreational Visitor
External	9.3×10^{-8}	7.0×10^{-7}
Ingestion	1.6×10^{-9}	5.9×10^{-7}
Inhalation	1.8×10^{-10}	NA
Total Risk	9×10^{-8}	1×10^{-6}

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MK-Ferguson Company
Weldon Spring Site Remedial Action Project

TRANSMITTAL OF CONTRACT DELIVERABLE

Date: **October 30, 2000** Transmittal No.: **CD-0242-00**

Title of Document: **Close Out Report For The Frog Pond Drainage**

Doc. Num.: **840** Rev. No.: **0** Date of Document: **October 2000**

Purpose of Transmittal: Request for Department of Energy acceptance of contract deliverable.

In compliance with the Project Management Contract, MK-Ferguson Company hereby delivers the attached document to the U.S. Department of Energy, Weldon Spring Site Office. The document has been reviewed and approved by Project Management Contractor management.

The document will be considered accepted unless we receive written notification to the contrary within 30 days of the date of this transmittal.

Number of copies transmitted: **One**

Douglas E. Steffen
Project Director

TMP: Form Contract Deliverable