

For Review and Approval

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Project Records (2)

November 15, 1994

Mr. James W. Thomas  
Project Manager  
U.S. Department of Energy  
Chicago Operations Office  
505 King Avenue  
Columbus, OH 43201

Dear Mr. Thomas:

**Remediation Status Report for the West Jefferson North Site Outfalls SS-JN1-2 and SS-JN1-4 Bog Area**

Enclosed is the final "Remediation Status Report for the West Jefferson North Site Outfalls SS-JN1-2 and SS-JN1-4 Bog Area," dated November 1994.

If there are any questions regarding the report, please contact Joe Poliziani (4-7776) of my staff.

Sincerely,

V. Edward Castleberry  
BCLDP Operations Manager

VEC:rho  
Enclosure

cc: T. Baillieul  
B. Patel



**REMEDIATION STATUS REPORT FOR THE  
WEST JEFFERSON NORTH SITE  
OUTFALLS SS-JN1-2 AND SS-JN1-4 BOG AREA**

**November 1994**

**BATTELLE  
505 King Avenue  
Columbus, Ohio 43201**

**CHARACTERIZATION STATUS REPORT FOR REMEDIATION  
OF OUTFALLS SS-JN1-2 AND SS-JN1-4 BOG**

November 1994

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11-14-94

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11-15-94

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# **CHARACTERIZATION STATUS REPORT FOR REMEDIATION OF OUTFALLS SS-JN1-2 AND SS-JN1-4 BOG**

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## **Introduction**

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The remediation of two storm sewer outfalls, SS-JN1-2 and the bog area adjacent to SS-JN1-4, at Battelle's Columbus Operations West Jefferson North Site was completed in September 1994 under Work Instruction 557 and Work Instruction 591, respectively. The location of each outfall is shown in Figure 1. In general, characterization support of remediation activities included:

- sampling excavated soil and performing a gross screening with a sodium iodide (NaI) detector to provide timely results and direction for the excavation work
- submittal for gamma spectroscopic analysis of samples of excavated soil to determine the possible presence of radioactive contamination
- verification soil sampling and screening with a sodium iodide (NaI) detector to ensure remediation efforts were complete
- submittal for gamma spectroscopic analysis of verification soil samples to demonstrate remaining outfall soils satisfied release criteria.

Table 1 identifies soil sample locations and corresponding characterization sample numbers, laboratory identification numbers, requested analyses, and work instructions. All sampling and screening activities were conducted in accordance with Battelle Columbus Laboratories Decommissioning Project (BCLDP) procedures SC-SP-004.2, "*Manual Collection of Surface and Subsurface Soil Samples In Support of Site Characterization*", SC-SP-006, "*Sampling of Sediment and Sludge for Chemical and Radiological Characterization*", and DD-CP-015, "*Use of a Gamma Scintillation Detector*".

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## **Training**

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All technicians were formally trained and qualified on the procedures used prior to the initiation of the sampling effort. The entire project was overseen by a Certified Health Physicist and several National Registry of Radiological Protection Technologists (NRRPT) certified technicians.

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## Instrumentation

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Direct reading proportional survey instruments sensitive to alpha and beta radiation were used to monitor soils and sampling equipment for residual radioactive materials. NE Technology Delta 3/DP6 and Electra/DP3 instruments were used for this purpose. Daily source checks were conducted as required in BCLDP procedure DD-CP-004, *"Radioactive Contamination Monitoring Requirements for Facility Surface Characterization"*.

Other instrumentation used during support activities included:

- Gamma radiation measurements were conducted during the remediation support using a Bicron Microrem meter.
  - Screening of soil samples was performed using a NaI scintillation detector with an Eberline ESP-2 instrument.
  - Smear samples were counted using a Tennelec Model LB5100 Simultaneous Alpha and Beta Gas Proportional Counter.
  - Gamma spectroscopy was performed using a Nuclear Data 661680 data acquisition system in conjunction with a germanium-lithium detector.
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## Background Determination

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In order to perform soil screening the NaI detector, a mean background count and its 95 percent confidence interval were determined from thirty, one-minute counts on pristine West Jefferson North Site soil. The soil was placed in a 586 milliliter marinelli container and counted in a well house with a low ambient background. Excavated soils were then sampled and counted in the same well house using the NaI method. Soil samples with counts exceeding two standard deviations of the mean (95 percent confidence interval) were considered suspect and were then submitted to the Battelle Radioanalytical Laboratory (RAL) for further investigation.

Background activity concentration ranges (95 percent confidence intervals) for West Jefferson North soil were established by gamma spectroscopy. These background activity concentrations are

documented in the "Characterization Report For Storm Sewer Outfalls At West Jefferson Site" (Reference 1).

Mean background gamma radiation levels for dose rate surveys were determined from survey data by the application of Chauvenet's Criterion. The calculated mean gamma radiation background level for the West Jefferson North Site is  $5 \pm 4 \mu\text{rem}/\text{hour}$  ( $2\sigma$ ).

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## Survey Results

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### SS-JN1-2

Characterization of outfall SS-JN1-2 was conducted in September 1993. Radiological conditions of outfall SS-JN1-2 prior to remediation are described in Reference 1. Remediation of outfall SS-JN1-2 included rerouting the outfall piping (approximately 30 feet east), installing a sanitary system-type 1,000 gallon vault, and removal of the pipe in the front of JN-1, as well as soil removal at the original outfall location.

Characterization technicians supported the rerouting/remediation effort by sampling, screening, and submittal for analysis of soil from the following locations:

- the new outfall site,
- on top of the original outfall piping, prior to removal
- the trench after the original outfall piping had been removed, and
- the trench after all contaminated soil had been removed (verification).
- sand and gravel used for backfill

Analytical results of soil from the new outfall site and from the overburden showed residual radioactivity concentrations to be within the normal range of background. Core samples were collected from beneath the original pipe joints (bells) and at several locations from the mouth of the original outfall to the edge of Battelle Lake. Samples were collected to a depth of 12 inches from the surface at all locations. Two additional core samples were collected at Location #1 at 12 to 24 inches (#1-2) and at 24 to 36 inches (#1-3). Sample locations are shown in Figure 2. Gamma spectroscopy analysis of these samples showed concentrations of cobalt-60 (Co-60) and cesium-137 (Cs-137) which were greater than the volumetric release criteria established by DD-93-03, "Volumetric Release Criteria Technical Basis Document for Battelle Columbus Laboratories

*Decommissioning Project (BCLDP)*" (Reference 2). The volumetric release criteria for Co-60 and Cs-137 are 8 picocuries/gram (pCi/g) and 15 pCi/g, respectively. Cobalt-60 concentrations ranged from <1 pCi/g at sample location #1 to 7 pCi/g at Bell #2. Cesium-137 concentrations ranged from <1 pCi/g at sample location #4 to 137 pCi/g at Bell #2 (Figure 2). Pre-remediation sample results are listed in Table 2.

Soil was removed to a depth of approximately two feet from the original outfall trench. Soil samples were collected in the bottom of the trench from the original mouth of the outfall to the shore of Battelle Lake. Verification sampling locations are shown in Figure 3. Final screening of soil samples showed activity levels to be less than release criteria. Analytical results of soil samples confirmed levels of residual radioactivity less than release criteria listed in Reference 2. These confirmatory results are listed in Table 3.

Gamma radiation measurements were also collected along the centerline of the trench at soil sampling locations, at the edges of the trench (approximately three feet from centerline) and at ten feet east and west of the centerline (Figure 3). Measurements were taken at three feet above the ground surface and the results are listed in Table 4. All post-remediation gamma radiation measurements were within 5  $\mu$ rem of the upper confidence interval of the mean background for the West Jefferson North Site.

Samples of the sand and gravel used to backfill the SS-JN1-2 area were collected and submitted for analysis. Analytical results are shown in Table 5.

#### SS-JN1-4

Outfall SS-JN1-4 is routinely sampled as part of the ongoing site environmental monitoring program. The SS-JN1-4 bog area includes the environmental sediment sampling location, ED-1, (Figure 1). Previous radiological conditions of outfall SS-JN1-4 can be found in the annual site environmental reports. Primary radiological constituents of concern for this area were Co-60, Cs-137, americium-241 (Am-241), and plutonium (Pu) isotopes. Total plutonium activity was assumed to be present in a 1:1 ratio with the Am-241 as reported in "*Site Characterization of the West Jefferson North Site, Stage 2 Sampling and Analysis*" (Reference 3).

Characterization technicians supported the bog remediation by:

- collecting and screening the soil samples taken from excavated soil as it was being loaded into shipping boxes and submitting the samples for analysis,
- collecting and screening the verification soil samples taken from the remediated bog area and submitting the samples for analysis, and
- collecting soil samples from topsoil to be used as backfill for the remediated bog area and submitting the samples for analysis.

Verification soil core samples were collected to a depth of six inches along an established grid pattern, shown in Figure 4. Analytical results of the final verification soil samples showed the levels of residual radioactivity to be less than release criteria established in Reference 2. Analytical results for verification soil samples from the SS-JN1-4 bog are listed in Table 6.

Samples of the topsoil used to backfill the bog area were collected and submitted for analysis. Analytical results are shown in Table 7.

Dose rate measurements were not collected at the SS-JN1-4 bog area since this outfall will remain active and the area will not be submitted for free-release at any time in the near future. The remediation work in the bog area was performed primarily to prevent the movement of radioactivity into the environment and not for the purpose of free-release.

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## Conclusions

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Radiologically contaminated soil was remediated from storm sewer outfalls SS-JN1-2 and SS-JN1-4. Previous sampling and analysis of soil from SS-JN1-2 show Co-60 and Cs-137 to be the major radiological constituents of concern. The nuclides of concern for the SS-JN1-4 area are Co-60, Cs-137, Am-241, and plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241, and Pu-242). Volumetric release criteria values (Reference 2) for these radionuclides are:

- Co-60 - 8 pCi/g
- Cs-137 - 15 pCi/g
- Am-241 - 270 pCi/g
- Pu-238 - 320 pCi/g
- Pu-239 - 290 pCi/g

- Pu-240 - 290 pCi/g
- Pu-241 - 13,000 pCi/g
- Pu-242 - 310 pCi/g

Characterization surveys and sample analyses confirmed that remediation activities had reduced levels of these constituents to less than the stated guideline values. Outfall SS-JN1-2 should be considered for free release since it is inactive and satisfies the criteria established in Reference 2.

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## References

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1. Battelle, "Characterization Report For Storm Sewer Outfalls At West Jefferson Site", July 1994.
2. Battelle, "Volumetric Release Criteria Technical Basis Document for Battelle Columbus Laboratories Decommissioning Project (BCLDP)", DD-93-03.
3. Battelle, "Site Characterization of the West Jefferson North Site, Stage 2 Sampling and Analysis", October 1990.

**TABLE 1.**  
**IDENTIFICATION OF SOIL SAMPLES**  
**FROM WEST JEFFERSON OUTFALL REMEDIATION**

Characterization Sample ID	Location	EL Number <sup>a</sup>	Analyses Requested		WT <sup>b</sup>
			Gross $\alpha/\beta$	$\gamma$ Spectroscopy	
N/A <sup>c</sup>	Bell #1	EL94-1243		X	557
N/A	Bell #2	EL94-1244		X	557
N/A	Bell #1	EL94-2104		X	557
N/A	Bell #2	EL94-2105		X	557
N/A	SS-JN1-2 #1-1	EL94-1272		X	557
N/A	SS-JN1-2 #1-2	EL94-1273		X	557
N/A	SS-JN1-2 #1-3	EL94-1274		X	557
N/A	SS-JN1-2 #2	EL94-1275		X	557
N/A	SS-JN1-2 #3	EL94-1276		X	557
N/A	SS-JN1-2 #4	EL94-1277		X	557
N/A	SS-JN1-2 #6	EL94-1301		X	557
N/A	SS-JN1-2 #7	EL94-1302		X	557
N/A	SS-JN1-2 #8	EL94-1303		X	557
N/A	SS-JN1-2 #9	EL94-1304		X	557
94-OLIN-57LS-1	Gravel-Olen NE <sup>d</sup>	EL94-1096		X	557
94-OLIN-57LS-2	Gravel-Olen SE <sup>d</sup>	EL94-1097		X	557
94-OLIN-57LS-3	Gravel-Olen SW <sup>d</sup>	EL94-1098		X	557
94-OLIN-57LS-4	Gravel-Olen NW <sup>d</sup>	EL94-1099		X	557
94-OLIN-SAND-1	Sand-Olen N <sup>d</sup>	EL94-1100		X	557
94-OLIN-SAND-2	Sand-Olen E <sup>d</sup>	EL94-1101		X	557
94-OLIN-SAND-3	Sand-Olen W <sup>d</sup>	EL94-1102		X	557
94-WJN-BOG-01	SS-JN1-4 Bog	EL94-1618	X	X	591
94-WJN-BOG-02	SS-JN1-4 Bog	EL94-1619	X	X	591
94-WJN-BOG-03	SS-JN1-4 Bog	EL94-1620	X	X	591
94-WJN-BOG-04	SS-JN1-4 Bog	EL94-1621	X	X	591

**TABLE 1.**  
**(Continued)**

Characterization Sample ID	Location	EL Number <sup>a</sup>	Analyses Requested		WI <sup>b</sup>
			Gross $\alpha/\beta$	$\gamma$ Spectroscopy	
94-WJN-BOG-05	SS-JN1-4 Bog	EL94-1622	X	X	591
94-WJN-BOG-06	SS-JN1-4 Bog	EL94-1623	X	X	591
94-WJN-BOG-07	SS-JN1-4 Bog	EL94-1643	X	X	591
94-WJN-BOG-08	SS-JN1-4 Bog	EL94-1644	X	X	591
94-WJN-BOG-09	SS-JN1-4 Bog	EL94-1645	X	X	591
94-WJN-BOG-10	SS-JN1-4 Bog	EL94-1646	X	X	591
94-WJN-BOG-11	SS-JN1-4 Bog	EL94-1647	X	X	591
94-WJN-BOG-12	SS-JN1-4 Bog	EL94-1648	X	X	591
94-WJN-BOG-13	SS-JN1-4 Bog	EL94-1649	X	X	591
94-WJN-BOG-14	SS-JN1-4 Bog	EL94-1650	X	X	591
94-WJN-BOG-15	SS-JN1-4 Bog	EL94-1651	X	X	591
94-WJN-BOG-16	SS-JN1-4 Bog	EL94-1652	X	X	591
94-WJN-BOG-17	SS-JN1-4 Bog	EL94-1653	X	X	591
94-WJN-BOG-18	SS-JN1-4 Bog	EL94-1654	X	X	591
94-WJN-BOG-19	SS-JN1-4 Bog	EL94-1655	X	X	591
94-WJN-BOG-20	SS-JN1-4 Bog	EL94-1656	X	X	591
94-WJN-BOG-21	SS-JN1-4 Bog	EL94-1657	X	X	591
94-WJN-BOG-22	SS-JN1-4 Bog	EL94-1664	X	X	591
94-WJN-BOG-23	SS-JN1-4 Bog	EL94-1665	X	X	591
94-WJN-BOG-24	SS-JN1-4 Bog	EL94-1666	X	X	591
94-WJN-BOG-25	SS-JN1-4 Bog	EL94-1667	X	X	591
94-WJN-BOG-26	SS-JN1-4 Bog	EL94-1668	X	X	591
94-WJN-BOG-27	SS-JN1-4 Bog	EL94-1669	X	X	591
94-WJN-BOG-28	SS-JN1-4 Bog	EL94-1670	X	X	591
94-WJN-BOG-29	SS-JN1-4 Bog	EL94-1671	X	X	591

**TABLE 1.**  
**(Continued)**

Characterization Sample ID	Location	EL Number <sup>a</sup>	Analyses Requested		WI <sup>b</sup>
			Gross $\alpha/\beta$	$\gamma$ Spectroscopy	
94-WJN-BOG-30	SS-JN1-4 Bog	EL94-1672	X	X	591
94-TOPSOIL-01	BV Topsoil <sup>c</sup>	EL94-1692	X	X	591
94-TOPSOIL-02	BV Topsoil <sup>c</sup>	EL94-1693	X	X	591
94-TOPSOIL-03	BV Topsoil <sup>c</sup>	EL94-1694	X	X	591

<sup>a</sup> EL Number refers to the identification number assigned to the sample by the RAL.

<sup>b</sup> WI refers to the Work Instruction number under which the sampling was performed.

<sup>c</sup> N/A = not applicable

<sup>d</sup> Samples of #57LS gravel and #10 fill sand collected at Olen Quarry, Amity Rd., Columbus, OH

<sup>e</sup> Samples collected at Buckeye Valley Topsoil, 6292 Cosgray Rd., Dublin, OH

**TABLE 2.**  
**ANALYTICAL RESULTS FOR PRE-REMEDIATION SOIL SAMPLES**  
**FROM SS-JN1-2 TRENCH**

		EL# 94-1243		EL# 94-1244		EL# 94-1272	
Analytical Parameter	Result (pCi/g)	2 σ (pCi/g)	Result (pCi/g)	2 σ (pCi/g)	Result (pCi/g)	2 σ (pCi/g)	
Gross α	NR <sup>a</sup>	NR	NR	NR	NR	NR	
Gross β	NR	NR	NR	NR	NR	NR	
<b>RAL Gamma Spectroscopy Results</b>							
Be-7	<MDA <sup>b</sup>	<MDA	<MDA	<MDA	<MDA	<MDA	
K-40	1.02E+01	2.12E+00	3.98E+00	1.18E+00	1.26E+01	2.18E+00	
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-60	4.25E+00	4.73E-01	7.19E+00	6.97E-01	1.46E+00	1.89E-01	
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-134	<MDA	<MDA	6.30E-01	1.98E-01	<MDA	<MDA	
Cs-137	4.35E+00	5.80E-01	1.37E+02	1.57E+01	5.16E+00	6.12E-01	
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Tl-208	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Bi-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-214	1.29E+00	3.20E-01	<MDA	<MDA	1.45E+00	2.45E-01	
Ra-226	<MDA	<MDA	<MDA	<MDA	4.15E+00	2.10E+00	
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	

**TABLE 2.**  
**(Continued)**

	EL# 94-1243		EL# 94-1244		EL# 94-1272	
Analytical Parameter	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

<sup>a</sup> NR = Analysis not requested

<sup>b</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 2.**  
**(Continued)**

		EL# 94-1273		EL# 94-1274		EL# 94-1275	
Analytical Parameter	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	
Gross $\alpha$	NR <sup>a</sup>	NR	NR	NR	NR	NR	
Gross $\beta$	NR	NR	NR	NR	NR	NR	
<b>RAL Gamma Spectroscopy Results</b>							
Be-7	<MDA <sup>b</sup>	<MDA	<MDA	<MDA	<MDA	<MDA	
K-40	1.22E+01	2.06E+00	1.24E+01	2.32E+00	1.39E+01	2.42E+00	
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-60	1.11E+00	1.39E-01	9.10E-01	1.45E-01	1.75E+00	2.16E-01	
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-137	3.01E+00	3.96E-01	8.51E+00	1.01E+00	2.02E+00	3.06E-01	
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Tl-208	2.95E-01	1.16E-01	<MDA	<MDA	4.07E-01	1.18E-01	
Bi-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-212	8.21E-01	1.25E-01	<MDA	<MDA	8.35E-01	1.54E-01	
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-214	1.05E+00	1.88E-01	1.09E+00	3.02E-01	1.15E+00	2.19E-01	
Ra-226	1.98E+00	1.29E+00	<MDA	<MDA	2.67E+00	1.48E+00	
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	

<sup>a</sup> NR = Analysis not requested

<sup>b</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 2.**  
**(Continued)**

Analytical Parameter	EL# 94-1276		EL# 94-1277	
	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)
Gross $\alpha$	NR <sup>a</sup>	NR	NR	NR
Gross $\beta$	NR	NR	NR	NR
<b>RAL Gamma Spectroscopy Results</b>				
Be-7	<MDA <sup>b</sup>	<MDA	<MDA	<MDA
K-40	1.28E+01	2.28E+00	1.52E+01	2.48E+00
Mn-54	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA
Co-60	3.80E+00	4.09E-01	5.51E-01	1.06E-01
Zn-65	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA
I-131	<MDA	<MDA	<MDA	<MDA
Cs-134	<MDA	<MDA	<MDA	<MDA
Cs-137	4.60E+01	5.04E+00	7.08E-01	1.58E-01
Ce-139	<MDA	<MDA	<MDA	<MDA
Eu-152	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA
Tl-208	<MDA	<MDA	2.85E-01	1.04E-01
Bi-212	<MDA	<MDA	<MDA	<MDA
Pb-212	<MDA	<MDA	9.62E-01	1.42E-01
Bi-214	<MDA	<MDA	<MDA	<MDA
Pb-214	1.63E+00	3.68E-01	9.89E-01	1.91E-01
Ra-226	<MDA	<MDA	2.87E+00	1.40E+00
Ac-228	<MDA	<MDA	<MDA	<MDA
Th-234	<MDA	<MDA	<MDA	<MDA
U-235	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA

<sup>a</sup> NR = Analysis not requested

<sup>b</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 3.**  
**ANALYTICAL RESULTS FOR VERIFICATION SOIL SAMPLES**  
**FROM SS-JN-1-2 TRENCH**

Analytical Parameter	EL# 94-1301		EL# 94-1302		EL# 94-1303	
	Result (pCi/g)	2 σ (pCi/g)	Result (pCi/g)	2 σ (pCi/g)	Result (pCi/g)	2 σ (pCi/g)
Gross α	NR <sup>a</sup>	NR	NR	NR	NR	NR
Gross β	NR	NR	NR	NR	NR	NR
<b>RAL Gamma Spectroscopy Results</b>						
Be-7	<MDA <sup>b</sup>	<MDA	<MDA	<MDA	<MDA	<MDA
K-40	1.52E+01	2.63E+00	1.26E+01	2.65E+00	1.70E+01	2.72E+00
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-60	2.26E-01	7.90E-02	1.79E-01	6.01E-02	1.26E+00	1.79E-01
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-137	<MDA	<MDA	1.35E+00	2.47E-01	3.03E+00	3.97E-01
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Tl-208	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Bi-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-214	9.42E-01	1.89E-01	9.47E-01	2.14E-01	1.06E+00	2.17E-01
Ra-226	2.26E+00	1.78E+00	2.85E+00	1.56E+00	4.18E+00	1.85E+00
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

**TABLE 3.**  
**(Continued)**

	EL# 94-1301		EL# 94-1302		EL# 94-1303	
Analytical Parameter	Result (pCi/g)	$2\sigma$ (pCi/g)	Result (pCi/g)	$2\sigma$ (pCi/g)	Result (pCi/g)	$2\sigma$ (pCi/g)
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

<sup>a</sup> NR = analysis not requested

<sup>b</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 3.**  
**(Continued)**

Analytical Parameter	EL# 94-1304		EL# 94-2104		EL# 94-2105	
	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)
Gross $\alpha$	NR <sup>a</sup>	NR	NR	NR	NR	NR
Gross $\beta$	NR	NR	NR	NR	NR	NR
<b>RAL Gamma Spectroscopy Results</b>						
Be-7	<MDA <sup>b</sup>	<MDA	<MDA	<MDA	<MDA	<MDA
K-40	1.38E+01	2.71E+00	1.49E+01	1.86E+00	1.46E+01	1.83E+00
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-60	6.13E-01	1.24E-01	8.11E-01	7.83E-02	1.67E+00	1.60E-01
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-137	2.19E-01	1.07E-01	1.08E+00	1.35E-01	6.67E-01	8.09E-02
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Tl-208	3.57E-01	1.22E-01	3.16E-01	5.01E-02	2.70E-01	4.18E-02
Bi-212	<MDA	<MDA	9.39E-01	3.52E-01	8.72E-01	3.86E-01
Pb-212	8.65E-01	1.71E-01	7.97E-01	8.07E-02	6.72E-01	8.48E-02
Bi-214	<MDA	<MDA	1.32E+00	1.20E-01	8.41E-01	7.86E-02
Pb-214	1.12E+00	2.20E-01	1.39E+00	1.33E-01	9.49E-01	9.78E-02
Ra-226	<MDA	<MDA	2.90E+00	5.40E-01	2.30E+00	6.13E-01
Ac-228	<MDA	<MDA	8.62E-01	1.12E-01	9.74E-01	9.56E-02
Th-234	<MDA	<MDA	9.65E-01	2.76E-01	<MDA	<MDA
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

<sup>a</sup> NR = analysis not requested

<sup>b</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 4.**  
**GAMMA RADIATION MEASUREMENTS IN SS-JN1-2 OUTFALL TRENCH**  
**AND SURROUNDING AREA**

Measurement Location	Reading @ 3 feet above surface <sup>a</sup> ( $\mu$ rem/hr)
10' west of soil sampling location #6	11
3' west of soil sampling location #6	12
Center trench at soil sampling location #6	N/A <sup>b</sup>
3' east of soil sampling location #6	11
10' east of soil sampling location #6	9
10' west of soil sampling location #7	10
3' west of soil sampling location #7	11
Center trench at soil sampling location #7	N/A
3' east of soil sampling location #7	10
10' east of soil sampling location #7	13
10' west of soil sampling location #8	10
3' west of soil sampling location #8	9
Center trench at soil sampling location #8	N/A
3' east of soil sampling location #8	9
10' east of soil sampling location #8	12
10' west of soil sampling location #9	10
3' west of soil sampling location #9	10
Center trench at soil sampling location #9	N/A
3' east of soil sampling location #9	10
10' east of soil sampling location #9	12

<sup>a</sup> The calculated mean gamma radiation background level for the West Jefferson North Site is  $5 \pm 4 \mu$ rem/hour ( $2\sigma$ ).

<sup>b</sup> N/A = not applicable; dose rates were not measured at 3 feet above the ground surface along the centerline of the trench

**TABLE 5.**  
**ANALYTICAL RESULTS FOR PRISTINE (BACKGROUND) GRAVEL AND SAND**

Analytical Parameter	EL# 94-1096		EL# 94-1097		EL# 94-1098	
	Result (pCi/g)	2 σ (pCi/g)	Result (pCi/g)	2 σ (pCi/g)	Result (pCi/g)	2 σ (pCi/g)
Gross α	NR <sup>a</sup>	NR	NR	NR	NR	NR
Gross β	NR	NR	NR	NR	NR	NR
<b>RAL Gamma Spectroscopy Results</b>						
Be-7	<MDA <sup>b</sup>	<MDA	<MDA	<MDA	<MDA	<MDA
K-40	1.91E+00	1.22E+00	<MDA	<MDA	<MDA	<MDA
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-60	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-137	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Tl-208	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Bi-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-214	9.96E-01	1.96E-01	5.90E-01	1.49E-01	6.95E-01	1.60E-01
Ra-226	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

<sup>a</sup> NR = analysis not requested

<sup>b</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 5.**  
**(Continued)**

Analytical Parameter	EL# 94-1099		EL# 94-1100		EL# 94-1101	
	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)
Gross $\alpha$	NR <sup>a</sup>	NR	NR	NR	NR	NR
Gross $\beta$	NR	NR	NR	NR	NR	NR
<b>RAL Gamma Spectroscopy Results</b>						
Be-7	<MDA <sup>b</sup>	<MDA	<MDA	<MDA	<MDA	<MDA
K-40	<MDA	<MDA	4.19E+00	1.64E+00	5.25E+00	1.55E+00
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-60	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-137	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Tl-208	<MDA	<MDA	1.05E-01	6.23E-02	1.20E-01	8.05E-02
Bi-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-214	<MDA	<MDA	1.05E+00	1.81E-01	9.61E-01	2.08E-01
Ra-226	<MDA	<MDA	2.44E+00	1.56E+00	2.84E+00	1.55E+00
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

<sup>a</sup> NR = analysis not requested

<sup>b</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 5.**  
**(Continued)**

EL# 94-1102		
Analytical Parameter	Result (pCi/g)	2 σ (pCi/g)
Gross α	NR <sup>a</sup>	NR
Gross β	NR	NR
<b>RAL Gamma Spectroscopy Results</b>		
Be-7	<MDA <sup>b</sup>	<MDA
K-40	5.47E+00	1.47E+00
Mn-54	<MDA	<MDA
Co-58	<MDA	<MDA
Co-60	<MDA	<MDA
Zn-65	<MDA	<MDA
Sb-125	<MDA	<MDA
I-131	<MDA	<MDA
Cs-134	<MDA	<MDA
Cs-137	<MDA	<MDA
Ce-139	<MDA	<MDA
Eu-152	<MDA	<MDA
Eu-154	<MDA	<MDA
Tl-208	1.61E-01	5.86E-02
Bi-212	<MDA	<MDA
Pb-212	<MDA	<MDA
Bi-214	<MDA	<MDA
Pb-214	8.77E-01	1.89E-01
Ra-226	2.07E+00	1.10E+00
Ac-228	<MDA	<MDA
Th-234	<MDA	<MDA
U-235	<MDA	<MDA
Am-241	<MDA	<MDA

<sup>a</sup> NR = analysis not requested.

<sup>b</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 6.**  
**ANALYTICAL RESULTS FOR VERIFICATION SOIL SAMPLES FROM SS-JN1-4 BOG**

Analytical Parameter	EL# 94-1618		EL# 94-1619		EL# 94-1620	
	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)
Gross $\alpha$	1.68E+01	1.34E+01	3.38E+01	1.90E+01	2.47E+01	1.62E+01
Gross $\beta$	2.77E+01	5.13E+00	3.06E+01	5.39E+00	2.32E+01	4.70E+00
<b>RAL Gamma Spectroscopy Results</b>						
Be-7	<MDA <sup>a</sup>	<MDA	<MDA	<MDA	<MDA	<MDA
K-40	9.90E+00	1.92E+00	1.01E+01	1.66E+00	5.45E+00	1.08E+00
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-60	<MDA	<MDA	3.45E-01	5.99E-02	1.08E+00	1.23E-01
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-137	1.51E-01	7.81E-02	2.14E-01	6.86E-02	3.47E-01	7.45E-02
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Tl-208	2.36E-01	7.38E-02	2.28E-01	7.17E-02	9.74E-02	4.62E-02
Bi-212	<MDA	<MDA	1.32E+00	7.31E-01	<MDA	<MDA
Pb-212	7.22E-01	1.07E-01	<MDA	<MDA	3.50E-01	6.93E-02
Bi-214	<MDA	<MDA	1.31E+00	1.76E-01	<MDA	<MDA
Pb-214	8.69E-01	1.51E-01	1.34E+00	1.77E-01	6.80E-01	1.12E-01
Ra-226	2.20E+00	1.14E+00	3.40E+00	1.35E+00	1.73E+00	9.56E-01
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	3.82E-01	1.58E-01

<sup>a</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 6.**  
**(Continued)**

		EL# 94-1621		EL# 94-1622		EL# 94-1623	
Analytical Parameter	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	
Gross $\alpha$	2.36E+01	1.58E+01	2.58E+01	1.66E+01	2.82E+01	1.73E+01	
Gross $\beta$	3.02E+01	5.36E+00	3.34E+01	5.64E+00	3.02E+01	5.36E+00	
<b>RAL Gamma Spectroscopy Results</b>							
Be-7	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
K-40	1.34E+01	2.16E+00	1.12E+01	1.82E+00	9.14E+00	1.49E+00	
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-60	<MDA	<MDA	4.43E-01	7.77E-02	7.08E-01	9.71E-02	
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-137	1.06E-01	5.44E-02	1.81E-01	1.04E-01	3.92E-01	9.83E-02	
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Tl-208	2.65E-01	8.42E-02	2.46E-01	9.35E-02	1.97E-01	6.32E-02	
Bi-212	2.06E+00	1.05E+00	<MDA	<MDA	<MDA	<MDA	
Pb-212	8.99E-01	1.50E-01	7.12E-01	1.08E-01	<MDA	<MDA	
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-214	1.18E+00	1.88E-01	1.18E+00	1.80E-01	1.21E+00	1.63E-01	
Ra-226	3.63E+00	1.34E+00	3.04E+00	1.01E+00	1.93E+00	1.07E+00	
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Am-241	<MDA	<MDA	<MDA	<MDA	1.00E+00	4.10E-01	

<sup>a</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 6.**  
**(Continued)**

		EL# 94-1643		EL# 94-1644		EL# 94-1645	
Analytical Parameter	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	
Gross $\alpha$	3.84E+01	2.02E+01	2.58E+01	1.66E+01	2.93E+01	1.76E+01	
Gross $\beta$	3.09E+01	5.42E+00	3.39E+01	5.68E+00	3.43E+01	5.71E+00	
<b>RAL Gamma Spectroscopy Results</b>							
Be-7	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
K-40	1.33E+01	2.16E+00	1.07E+01	2.28E+00	1.15E+01	2.24E+00	
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-60	1.01E-01	6.10E-02	<MDA	<MDA	4.59E-01	1.14E-01	
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-137	4.05E-01	8.42E-02	1.01E-01	1.06E-01	1.78E-01	1.22E-01	
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Tl-208	<MDA	<MDA	2.55E-01	1.20E-01	2.70E-01	1.13E-01	
Bi-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-212	<MDA	<MDA	7.89E-01	1.45E-01	6.33E-01	1.40E-01	
Bi-214	1.27E+00	1.81E-01	<MDA	<MDA	<MDA	<MDA	
Pb-214	1.52E+00	1.86E-01	1.20E+00	2.19E-01	1.07E+00	2.10E-01	
Ra-226	3.25E+00	1.30E+00	4.13E+00	1.86E+00	3.96E+00	1.83E+00	
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	

<sup>a</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 6.**  
**(Continued)**

		EL# 94-1646		EL# 94-1647		EL# 94-1648	
Analytical Parameter	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	
Gross $\alpha$	3.50E+01	1.93E+01	3.38E+01	1.90E+01	4.18E+01	2.11E+01	
Gross $\beta$	2.87E+01	5.22E+00	2.90E+01	5.25E+00	3.04E+01	5.37E+00	
<b>RAL Gamma Spectroscopy Results</b>							
Be-7	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
K-40	1.03E+01	1.99E+00	1.08E+01	2.20E+00	1.06E+01	2.03E+00	
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-60	6.97E-01	1.13E-01	<MDA	<MDA	1.53E+00	2.01E-01	
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-137	1.32E+00	2.20E-01	<MDA	<MDA	1.33E+00	2.46E-01	
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Tl-208	<MDA	<MDA	2.91E-01	9.86E-02	<MDA	<MDA	
Bi-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-212	<MDA	<MDA	5.48E-01	1.46E-01	<MDA	<MDA	
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-214	1.18E+00	2.25E-01	1.45E+00	2.19E-01	1.07E+00	2.42E-01	
Ra-226	2.31E+00	1.99E+00	1.88E+00	1.61E+00	2.91E+00	1.66E+00	
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Am-241	<MDA	<MDA	<MDA	<MDA	9.90E-01	7.36E-01	

<sup>a</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 6.**  
**(Continued)**

		EL# 94-1649		EL# 94-1650		EL# 94-1651	
Analytical Parameter	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	
Gross $\alpha$	3.50E+01	1.93E+01	2.92E+01	1.76E+01	2.59E+01	1.66E+01	
Gross $\beta$	2.99E+01	5.33E+00	3.18E+01	5.50E+00	3.70E+01	5.94E+00	
<b>RAL Gamma Spectroscopy Results</b>							
Be-7	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
K-40	1.19E+01	2.00E+00	1.20E+01	2.17E+00	9.73E+00	1.95E+00	
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-60	<MDA	<MDA	<MDA	<MDA	4.49E-01	9.18E-02	
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-137	<MDA	<MDA	<MDA	<MDA	2.75E-01	8.98E-02	
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Tl-208	3.42E-01	9.34E-02	2.79E-01	1.06E-01	<MDA	<MDA	
Bi-212	<MDA	<MDA	1.79E+00	9.50E-01	1.70E+00	1.21E+00	
Pb-212	7.41E-01	1.22E-01	8.82E-01	1.74E-01	<MDA	<MDA	
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-214	1.25E+00	1.94E-01	1.70E+00	2.48E-01	1.26E+00	2.04E-01	
Ra-226	2.59E+00	1.16E+00	2.42E+00	1.71E+00	2.36E+00	1.52E+00	
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Am-241	<MDA	<MDA	<MDA	<MDA	1.44E+00	5.58E-01	

<sup>a</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 6.**  
**(Continued)**

		EL# 94-1652		EL# 94-1653		EL# 94-1654	
Analytical Parameter	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	
Gross $\alpha$	3.16E+01	1.83E+01	3.50E+01	1.93E+01	3.27E+01	1.86E+01	
Gross $\beta$	3.00E+01	5.34E+00	3.50E+01	5.77E+00	3.91E+01	6.10E+00	
<b>RAL Gamma Spectroscopy Results</b>							
Be-7	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
K-40	1.34E+01	2.22E+00	1.27E+01	2.45E+00	1.01E+01	1.97E+00	
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-60	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-137	9.66E-02	5.62E-02	9.20E-02	8.95E-02	3.14E-01	1.19E-01	
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Tl-208	3.26E-01	1.03E-01	<MDA	<MDA	<MDA	<MDA	
Bi-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-212	6.04E-01	1.15E-01	<MDA	<MDA	<MDA	<MDA	
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-214	1.22E+00	1.79E-01	1.29E+00	2.49E-01	1.13E+00	2.22E-01	
Ra-226	2.98E+00	1.19E+00	3.14E+00	1.81E+00	3.73E+00	1.48E+00	
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Am-241	<MDA	<MDA	<MDA	<MDA	1.95E+00	4.50E-01	

<sup>a</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 6.**  
**(Continued)**

Analytical Parameter	EL# 94-1655		EL# 94-1656		EL# 94-1657	
	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)
Gross $\alpha$	4.06E+01	2.08E+01	3.04E+01	1.80E+01	1.56E+01	1.29E+01
Gross $\beta$	2.96E+01	5.31E+00	2.91E+01	5.26E+00	2.31E+01	4.69E+00
<b>RAL Gamma Spectroscopy Results</b>						
Be-7	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
K-40	1.57E+01	2.42E+00	1.06E+01	2.33E+00	8.99E+00	1.80E+00
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-60	<MDA	<MDA	1.37E+00	1.91E-01	<MDA	<MDA
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-137	5.99E-02	6.48E-02	5.25E-01	1.48E-01	2.17E-01	1.03E-01
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Tl-208	3.16E-01	9.15E-02	2.81E-01	1.13E-01	<MDA	<MDA
Bi-212	1.48E+00	7.04E-01	<MDA	<MDA	1.04E+00	9.89E-01
Pb-212	9.25E-01	1.65E-01	7.43E-01	1.43E-01	<MDA	<MDA
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-214	1.38E+00	1.84E-01	1.05E+00	2.02E-01	1.32E+00	1.96E-01
Ra-226	2.44E+00	1.31E+00	2.74E+00	1.56E+00	2.90E+00	1.56E+00
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	1.33E+00	6.37E-01

<sup>a</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 6.**  
**(Continued)**

	EL# 94-1664		EL# 94-1665		EL# 94-1666	
Analytical Parameter	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)
Gross $\alpha$	4.29E+01	2.13E+01	2.14E+01	1.51E+01	3.27E+01	1.86E+01
Gross $\beta$	3.07E+01	5.41E+00	2.60E+01	4.98E+00	3.18E+01	5.50E+00
RAL Gamma Spectroscopy Results						
Be-7	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
K-40	1.22E+01	2.23E+00	9.39E+00	1.97E+00	1.03E+01	2.06E+00
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-60	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-137	8.53E-02	7.98E-02	1.79E-01	1.13E-01	4.19E-01	1.36E-01
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Tl-208	2.28E-01	9.88E-02	1.29E-01	7.36E-02	<MDA	<MDA
Bi-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-212	7.99E-01	1.64E-01	6.24E-01	1.23E-01	<MDA	<MDA
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-214	1.25E+00	2.16E-01	1.16E+00	2.19E-01	1.10E+00	1.96E-01
Ra-226	2.09E+00	1.39E+00	3.75E+00	1.47E+00	1.80E+00	1.39E+00
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

<sup>a</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 6.**  
**(Continued)**

		EL# 94-1667		EL# 94-1668		EL# 94-1669	
Analytical Parameter	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	
Gross $\alpha$	2.24E+01	1.54E+01	2.70E+01	1.69E+01	1.79E+01	1.38E+01	
Gross $\beta$	3.57E+01	5.83E+00	2.82E+01	5.19E+00	3.02E+01	5.36E+00	
<b>RAL Gamma Spectroscopy Results</b>							
Be-7	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
K-40	1.11E+01	2.14E+00	1.05E+01	2.03E+00	9.36E+00	1.92E+00	
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Co-60	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Cs-137	<MDA	<MDA	2.94E-01	1.18E-01	6.00E-01	1.45E-01	
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Tl-208	1.85E-01	9.66E-02	<MDA	<MDA	<MDA	<MDA	
Bi-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-212	6.19E-01	1.34E-01	<MDA	<MDA	<MDA	<MDA	
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Pb-214	1.13E+00	2.06E-01	1.36E+00	2.16E-01	7.23E-01	1.76E-01	
Ra-226	<MDA	<MDA	4.65E+00	1.99E+00	1.31E+00	9.57E-01	
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
Am-241	<MDA	<MDA	<MDA	<MDA	6.80E-01	3.79E-01	

<sup>a</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

**TABLE 6.**  
**(Continued)**

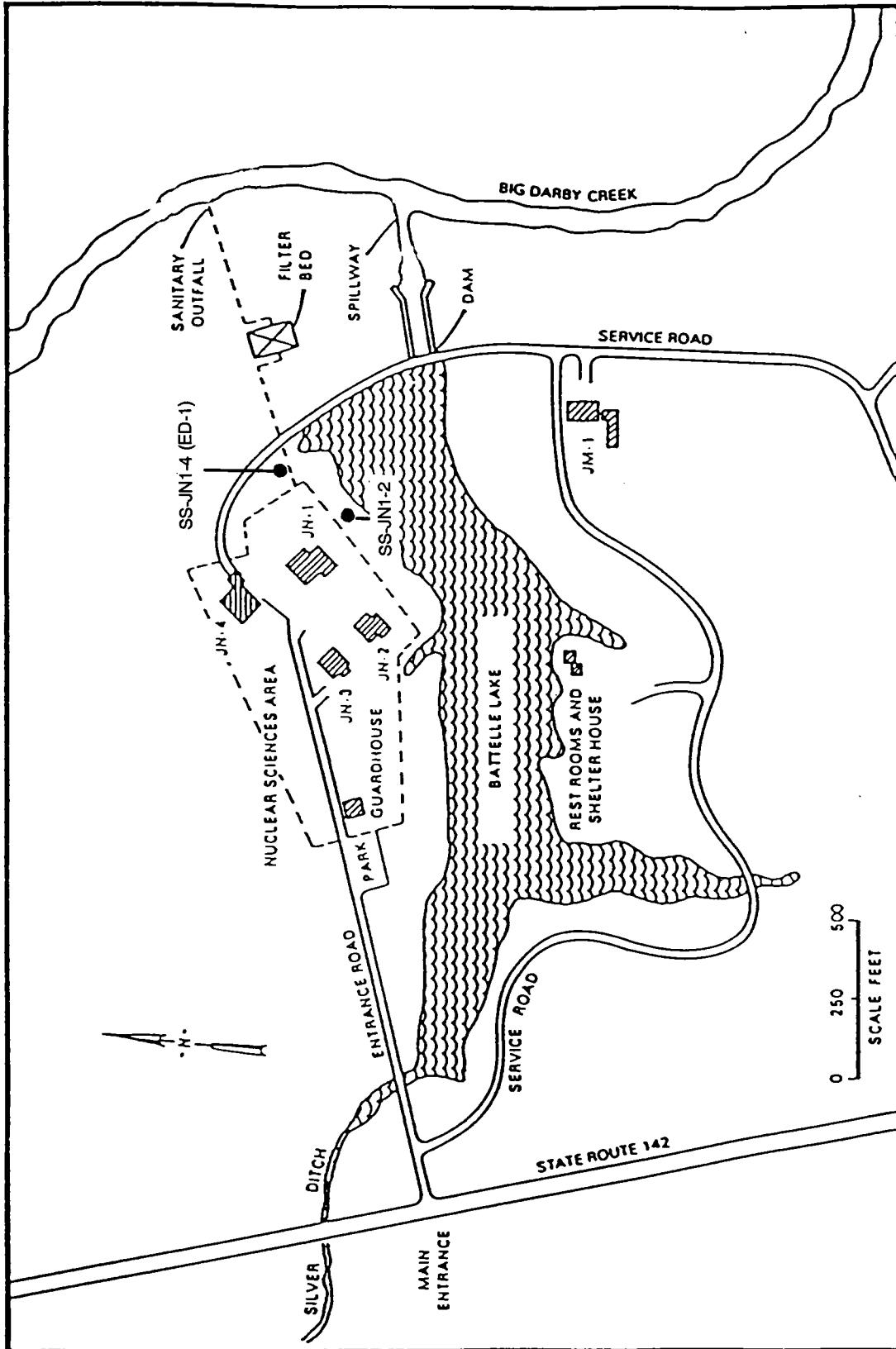
Analytical Parameter	EL# 94-1670		EL# 94-1671		EL# 94-1672	
	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)	Result (pCi/g)	2 $\sigma$ (pCi/g)
Gross $\alpha$	2.70E+01	1.69E+01	3.04E+01	1.80E+01	3.38E+01	1.90E+01
Gross $\beta$	3.80E+01	6.02E+00	3.23E+01	5.54E+00	2.42E+01	4.80E+00
<b>RAL Gamma Spectroscopy Results</b>						
Be-7	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
K-40	1.20E+01	2.21E+00	1.06E+01	2.14E+00	9.17E+00	1.85E+00
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-60	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-137	4.55E-01	1.23E-01	1.63E-01	7.92E-02	3.78E-01	1.20E-01
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Tl-208	<MDA	<MDA	3.21E-01	9.11E-02	<MDA	<MDA
Bi-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-212	<MDA	<MDA	7.59E-01	1.43E-01	<MDA	<MDA
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-214	1.18E+00	2.08E-01	1.00E+00	2.11E-01	1.04E+00	1.76E-01
Ra-226	<MDA	<MDA	2.98E+00	1.52E+00	<MDA	<MDA
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

<sup>a</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.

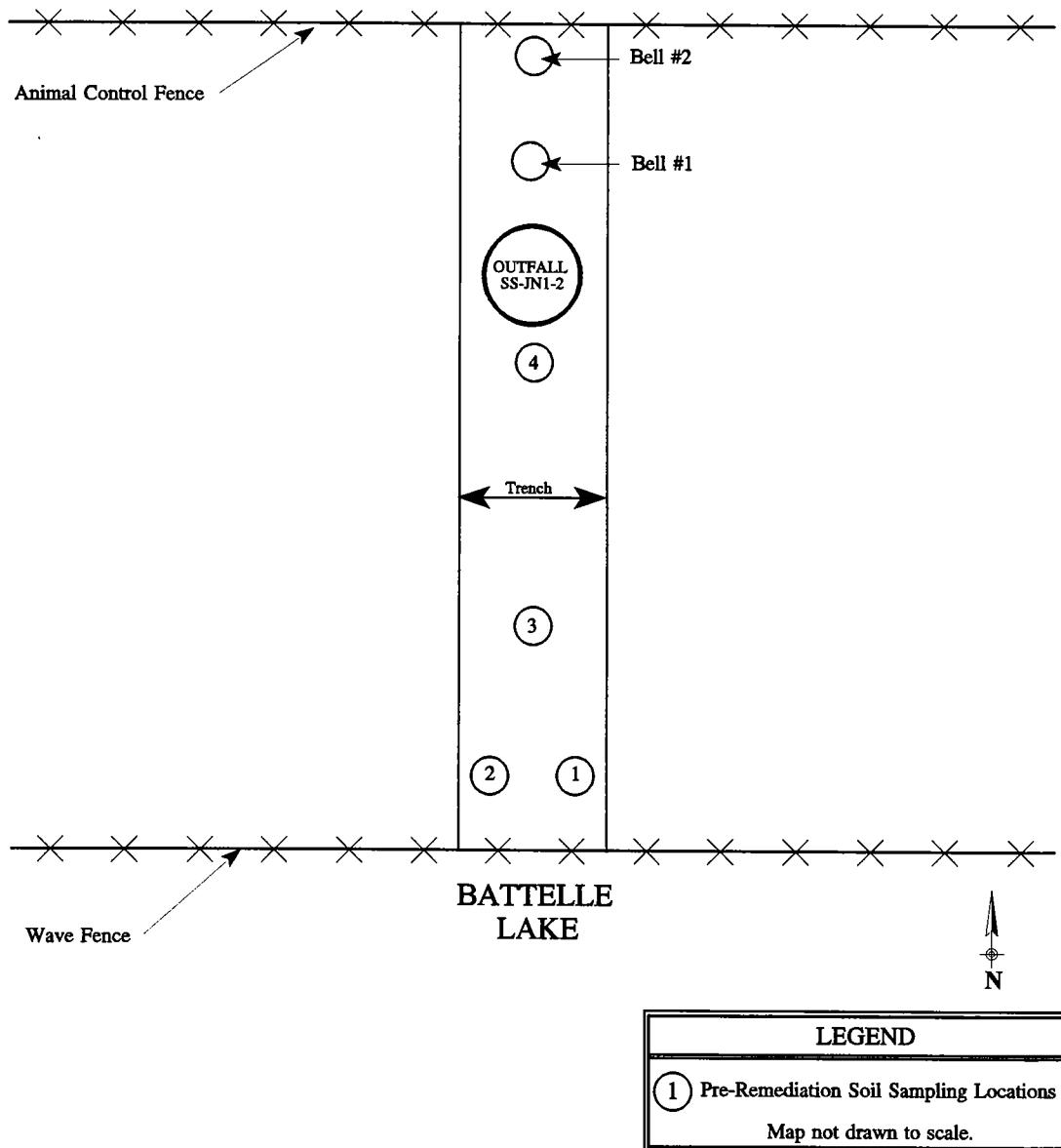
**TABLE 7.**  
**ANALYTICAL RESULTS FOR PRISTINE (BACKGROUND) TOPSOIL SAMPLES**

	EL# 94-1692		EL# 94-1693		EL# 94-1694	
Analytical Parameter	Result (pCi/g)	2 σ (pCi/g)	Result (pCi/g)	2 σ (pCi/g)	Result (pCi/g)	2 σ (pCi/g)
Gross α	3.43E+01	1.81E+01	2.52E+01	1.55E+01	3.94E+01	1.93E+01
Gross β	2.74E+01	4.74E+00	2.57E+01	4.59E+00	2.94E+01	4.90E+00
<b>RAL Gamma Spectroscopy Results</b>						
Be-7	<MDA <sup>a</sup>	<MDA	<MDA	<MDA	<MDA	<MDA
K-40	1.14E+01	2.01E+00	1.25E+01	2.11E+00	1.04E+01	1.85E+00
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-60	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-131	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-137	1.80E-01	9.05E-02	2.12E-01	8.33E-02	1.29E-01	6.85E-02
Ce-139	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Tl-208	1.86E-01	7.73E-02	2.84E-01	8.90E-02	3.18E-01	9.68E-02
Bi-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-212	8.50E-01	1.49E-01	7.72E-01	1.55E-01	8.04E-01	1.20E-01
Bi-214	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-214	1.21E+00	1.82E-01	1.29E+00	1.93E-01	1.19E+00	1.73E-01
Ra-226	3.72E+00	1.17E+00	3.86E+00	1.73E+00	3.69E+00	1.36E+00
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

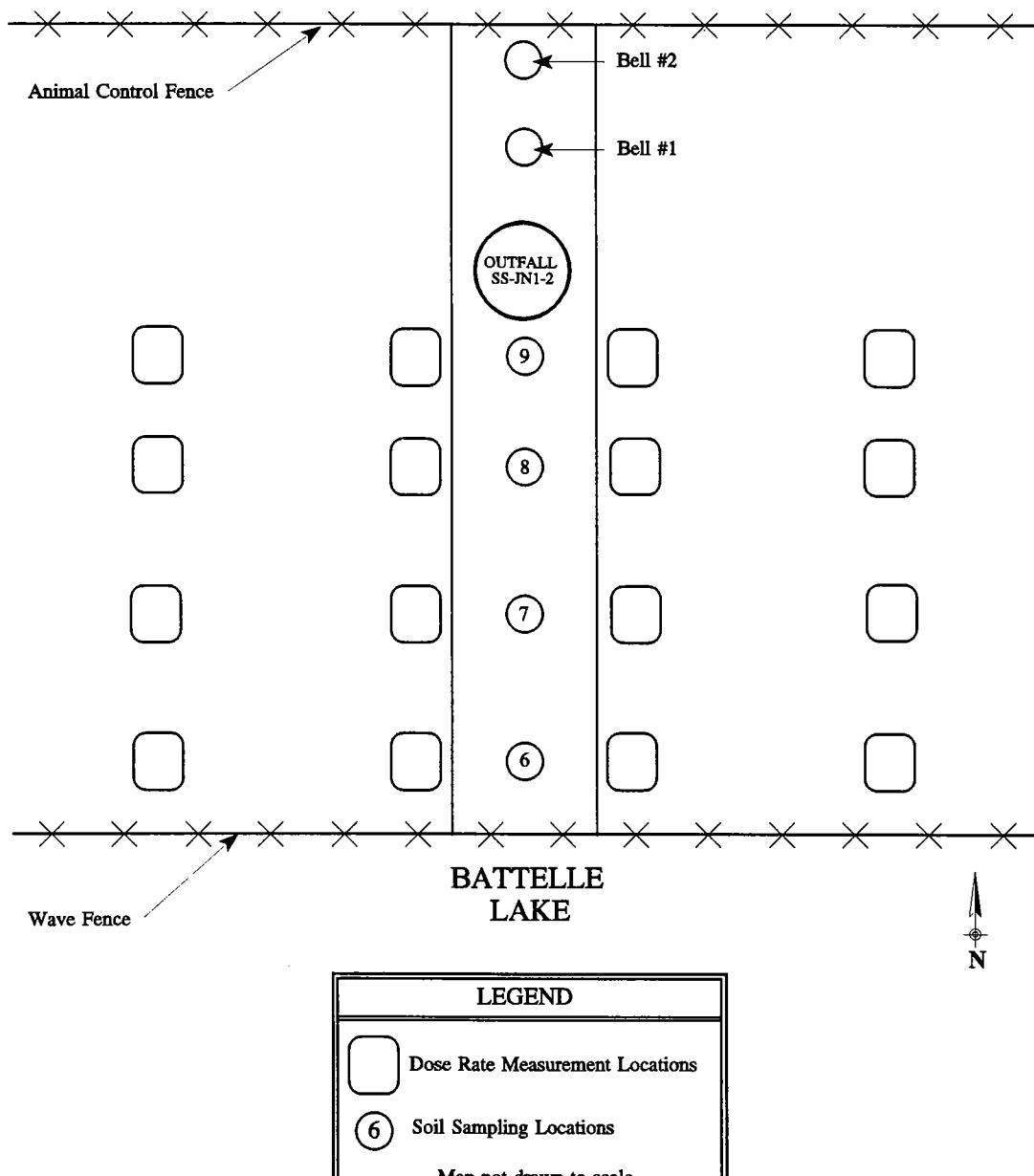
<sup>a</sup> <MDA indicates sample result for specific parameter was less than the minimum detectable activity.



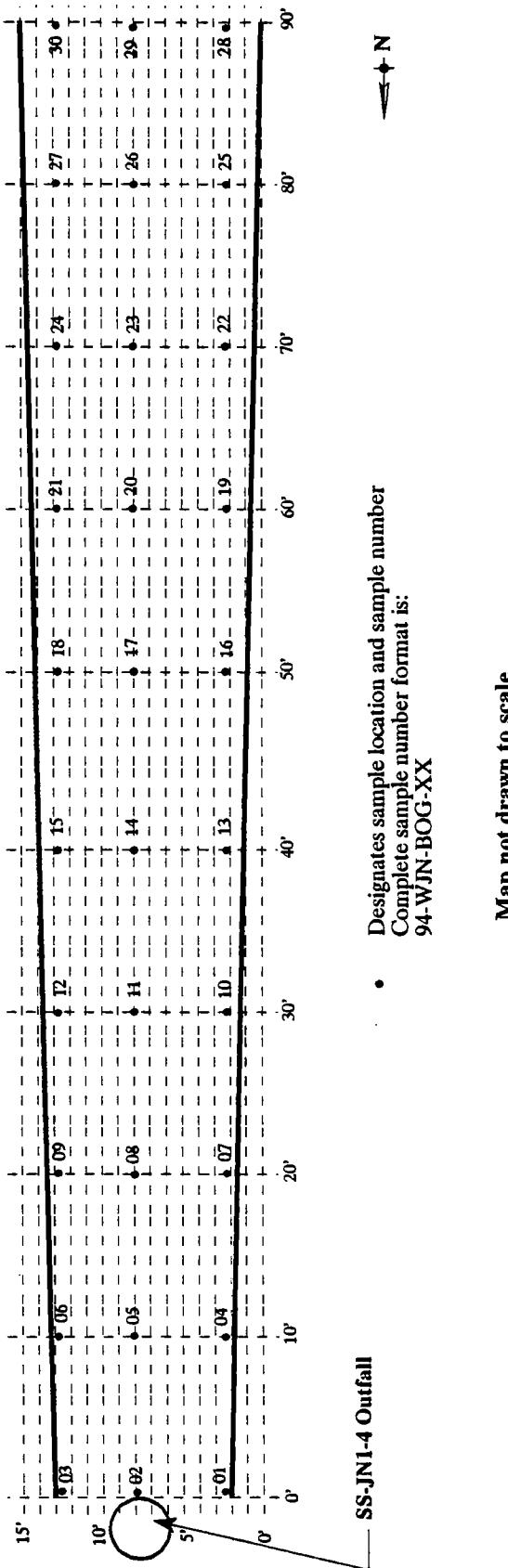
**FIGURE 1. LOCATION OF OUTFALLS SS-JN1-2 AND SS-JN1-4 (ED-1)**



**FIGURE 2. LOCATION OF CONTAMINATED SOIL SAMPLES FROM SS-JN1-2**



**FIGURE 3. LOCATION OF VERIFICATION SOIL SAMPLES FROM SS-JN1-2**



**FIGURE 4. LOCATION OF VERIFICATION SOIL SAMPLES FROM SS-JN1-4 BOG**