FINAL

GAMMA WALKOVER SURVEY
SAMPLING AND ANALYSIS PLAN

PART I -FIELD SAMPLING PLAN

SHALLOW LAND DISPOSAL AREA (SLDA) SITE
PARKS TOWNSHIP, ARMSTRONG COUNTY, PENNSYLVANIA

USACE CONTRACT NO. DACW49-01-D-0001
DELIVERY ORDER NO. 0010

Prepared for:

DEPARTMENT OF THE ARMY
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APRIL 21, 2003

TABLE OF CONTENTS

FIELD SAMPLING PLAN

Page No.

PART I – FIELD SAMPLING PLAN

FIGURES

On or Following
Page No.

TABLES

APPENDICES

ACRONYMS AND SYMBOLS

Am	Americium
ARCO	Atlantic Richfield Company
bgs	Below Ground Surface
B&W	Babcock & Wilcox
BWXT	BWX Technologies (Formerly Babcock & Wilcox)
CERCLA	Comprehensive Environmental Response Compensation Liability Act
cm	Centimeter
cpm	Counts per Minute
DCGL	Derived Concentration Guideline Level
D.O.	Delivery Order
DOE	Department of Energy
dpm	Disintegrations per Minute
DQCR	Data Quality Control Report
FIDLER	Field Instrument for Detecting Low Energy Radiation
FRER	Fluence Rate to Exposure Rate
FSP	Field Sampling Plan
FUSRAP	Formerly Utilized Sites Remedial Action Program
GIS	Geographical Information System
GPS	Global Positioning System
ha	Hectare
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High-Efficiency Particulate Air
HTRW	Hazardous, Toxic, and Radioactive Waste
ITR	Independent Technical Review
ITRT	Independent Technical Review Team
LCD	Liquid Crystal Display
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Count
MDCR	Minimum Detectable Count Rate
MDER	Minimum Detectable Exposure Rate
MOU	Memorandum of Understanding

ACRONYMS AND SYMBOLS (Continued)

mrem	Millirem
MSL	Mean Sea Level
NaI	Sodium Iodide
NAVD88	North American Vertical Datum of 1988
NCP	National Contingency Plan
NGS	National Geodetic Survey
NOAA	National Oceanic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
NUMEC	Nuclear Materials and Equipment Corporation
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PADEP	Pennsylvania Department of Environmental Protection
pCi/g	PicoCuries per gram
pCi/L	PicoCuries per liter
PPE	Personal Protective Equipment
PRG	Preliminary Remediation Goal
Pu	Plutonium
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RDR	Relative Detector Response
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RTK	Real-Time Kinematics
SAP	Sampling and Analysis Plan
SLDA	Shallow Land Disposal Area
Sqrt	Square Root
SSHP	Site Safety and Health Plan
U	Uranium
μCi/ml	microCuries per Milliliter
μR/h	microRoentgens per hour

ACRONYMS AND SYMBOLS (Continued)

µrad/hr	microrad per hour
URS	URS Corporation
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

1.0 PROJECT DESCRIPTION

URS Corporation (URS) has been retained by the Buffalo District of the United States Army Corps of Engineers (USACE) under Contract No. DACW49-01-D-0001, Delivery Order No. 0010, to perform a gamma walkover survey at the Shallow Land Disposal Area (SLDA) site, located in Parks Township, Armstrong County, Pennsylvania. The purpose of this survey is to generate coverage maps showing variations of gamma radiation levels at the site and to aid in the selection of future remedial and investigative tasks.

In 2002, Public Law 107-117, Section 8143 was enacted directing the USACE to cleanup radioactive waste at the SLDA site. Under this legislation, the SLDA site is considered a Formerly Utilized Sites Remedial Action Program (FUSRAP) site and will be evaluated following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. The investigation and potential cleanup is to be consistent with a Memorandum of Understanding (MOU) between the USACE and the United States Nuclear Regulatory Commission (NRC) signed in July 2001.

The Preliminary Assessment report issued by the USACE (March 2002) was the first major step in the CERCLA process; the next major step is completion of a remedial investigation/feasibility study (RI/FS). The data collected during the gamma walkover survey will be incorporated into the remedial investigation (RI) work plans.

This document, a Field Sampling Plan (FSP), constitutes Part I of the two-part Sampling and Analysis Plan (SAP) for a gamma walkover survey at the SLDA site. Part II of the SAP is a Quality Assurance Project Plan (QAPP). The FSP contains the procedures and methods for the performance of field activities and measurement of field data for the gamma walkover survey. The QAPP contains the methods and procedures required by this delivery order (Appendix A). A separately-bound Site Safety and Health Plan (SSHP) has also been prepared for the gamma walkover survey at the SLDA site that includes radiation protection requirements. This SAP was written in compliance with the USACE document, EM 200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans*.

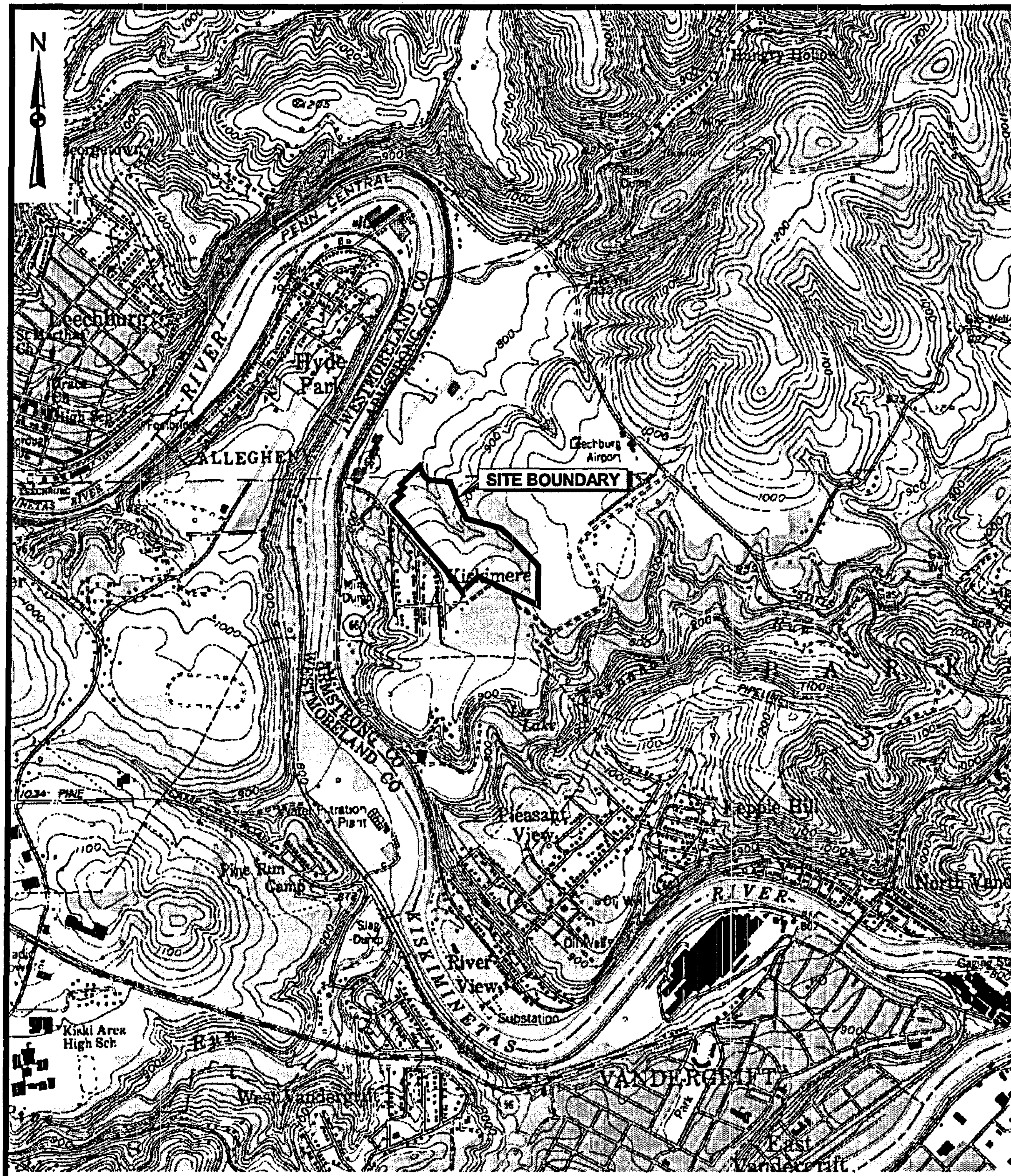
1.1 Site Description and History

The SLDA site occupies approximately 44 acres and is located in Armstrong County, Pennsylvania, about 23 miles east-northeast of Pittsburgh (Figure 1-1). The site is bounded by Kiskimere Road to the southwest, and vacant land to the southeast, northeast and northwest. The Kiskiminetas River is situated approximately 152.4 meters (500 feet) west-northwest of the site.

Land use within the vicinity of the SLDA site is mixed, consisting of small residential communities and individual rural residences, small farms with croplands and pastures, idle farmland, forested areas, and light industrial. The community of Kiskimere is adjacent to and southwest of the site. There are extensive recreational resources within Armstrong County, including: canoeing on the Kiskiminetas River downstream of the SLDA site; hiking; wildlife viewing and picnicking within the Roaring Run Watershed wildlife preserve, south of the site; and boating in the Allegheny River, into which the Kiskiminetas River flows approximately eight miles northwest of the site.

The fenced portion of the SLDA site (approximately 32 acres) was part of the former Parks nuclear fuel fabrication facility until 1995 at which time this area was licensed separately by NRC. The Parks facility consisted of three buildings adjacent to and north of the SLDA, all of which were recently dismantled as part of a decommissioning process completed under NRC oversight. Undeveloped vacant land was also part of the Parks facility and was located northeast, east, and southeast of the original 32-acre SLDA site. In 2002, a 12-acre portion of the undeveloped Parks facility land situated directly southeast of the original SLDA site was added to the SLDA license during the Parks facility decommissioning. This area was added because elevated uranium levels were detected at concentrations consistent with those previously encountered nearby on the SLDA site. Therefore, the current SLDA site is comprised of the original SLDA licensed area (32 acres) and the new 12-acre parcel that was formerly part of the Parks facility license. Figure 1-2 presents a digital orthophoto of the SLDA site and the former Parks facility and Figure 1-3 is the SLDA Site Plan.

The current 44-acre SLDA site can be described as predominantly vacant land. The limited site improvements consist of two trailers, access roads, electric service, and three underground natural gas pipelines. Approximately seventy percent of the site is vegetated with

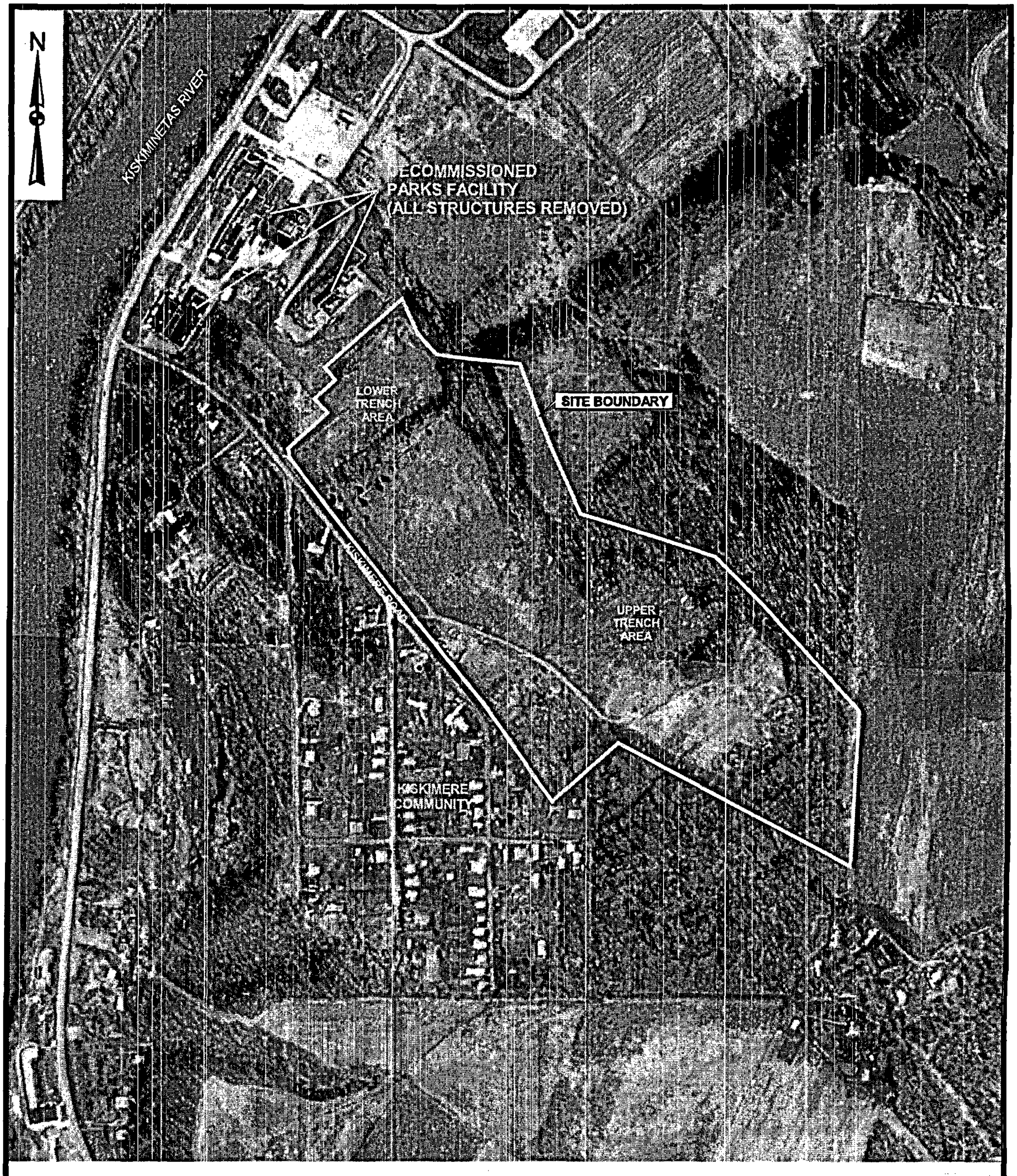


Source: USGS 7.5' Topographic Quadrangles
Vandergrift, PA, 1953 (revised 1979)
Leechburg, PA, 1954 (revised 1969)

2000 0 2000 Feet

URS	SLDA SITE LOCATION MAP	FIGURE 1-1

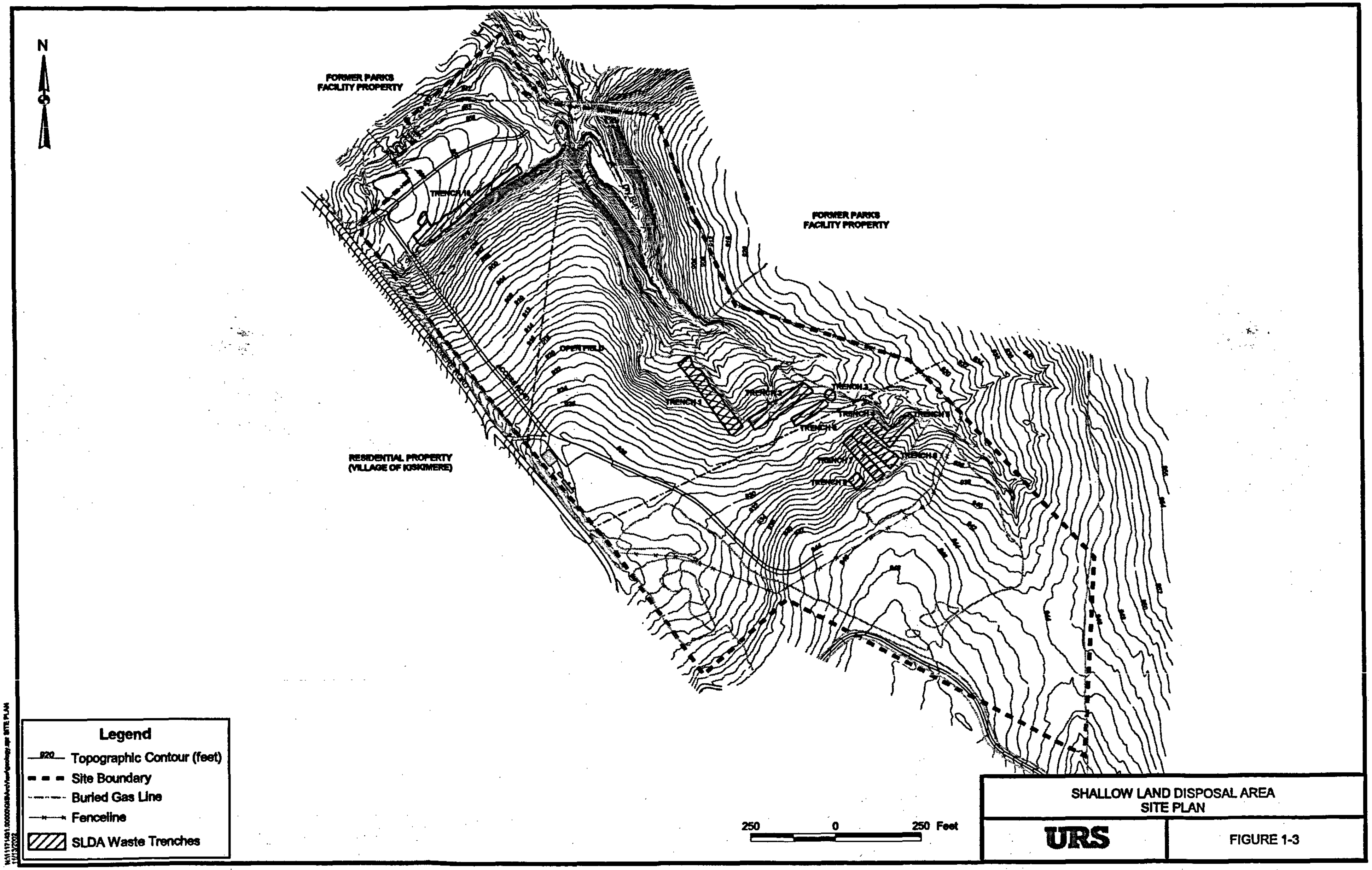
N:\11171431.00000\GIS\ArcView\sitelocation.apr SITE LOCATION
11/13/2002



500 0 500 Feet

URS	SLDA DIGITAL ORTHOPHOTO	FIGURE 1-2

N11171431.00000GISArcViewsitelocation.apr DIGITAL ORTHOPHOTO
11/13/2002



SHALLOW LAND DISPOSAL AREA
SITE PLAN

FIGURE 1-3

grasses and annuals; wooded areas are also present along the northeast, northwest, eastern and southern portions of the site. The fenced area is posted and mowed twice a year.

Although the site topography is variable across the site, the ground surface slopes predominantly toward the Kiskiminetas River. The elevation decreases from about 288 meters (945 feet) above mean sea level (MSL) to about 253 meters (830 feet) above MSL in the northwestern end of the site. This is an elevation change of approximately 35 meters (115 feet) over a distance of approximately 305 meters (1,000 feet). Surface water drainage from the site is primarily into Dry Run, an intermittent stream located along the northeast side of the site that flows into the Kiskiminetas River during periods of high rainfall. The surface water consists of precipitation runoff and, to a much more limited degree, water from seeps along the steep banks above Dry Run.

A review of site history indicates that, in the early 1900s, the Upper Freeport coal seam was deep-mined beneath the majority of the site in the higher elevations (southeastern part of the site). Subsurface mine voids and residual coal underlie the upper trenches at a depth of about 18 to 31 meters (60 to 100 feet) below ground surface (bgs). Later, coal was strip-mined where it outcropped at the northwestern end of the site.

The SLDA site was formerly owned by Nuclear Materials and Equipment Corporation (NUMEC), a manufacturer of nuclear fuels and specialty metals, which also operated the nearby Apollo facility. In the 1960s and 1970s, NUMEC disposed of radioactive and non-radioactive waste generated from the Apollo facility at the SLDA site in accordance with the regulations found in 10 CFR 20.304 (rescinded in 1981).

The Apollo facility processed uranium and, to a lesser extent, thorium. Processing operations included the conversion of uranium hexafluoride (UF_6) to uranium dioxide (UO_2) by the ammonium diuranate process and subsequent metallurgical and ceramic processes to produce uranium products and fuel components. Typical products included uranium metal (UO_2, UC, UC_2, ThO_2-UO_2 and UC-Th) produced as sintered pellets, powder, and other particulate forms. Process wastes, including off-specification products and incinerated high-efficiency particulate air (HEPA) filters and rags, were recycled in a nitric acid solvent extraction scrap recovery process to recover usable uranium. The Apollo plant processed uranium at a capacity of 350 to 450 metric tons per year.

The uranium contaminated materials placed in the trenches are present at various levels of enrichment, from depleted to highly enriched. Activity percentages indicate levels of enrichment from less than 0.2% U-235 (by weight) to greater than 45% U-235.

The waste materials were placed into a series of trenches, including nine trenches in a topographically elevated area in the eastern/central part of the site (Trenches 1 through 9) and one in a topographically lower area about 305 meters (1,000 feet) northwest of the upper trenches (Trench 10). The upper and lower trench areas occupy approximately five acres, with an estimated total trench surface area of approximately 1.2 acres.

Wastes placed within the SLDA trenches consisted of process wastes (slag, crucibles, spent solvent, unrecoverable sludges, organic liquids, debris, etc.), laboratory wastes (sample vials, reagent vials, etc.), old or broken equipment, building materials, protective clothing, general maintenance materials (paint, oil, pipe, used lubricants, etc.), solvents (trichloroethene, methylene chloride, etc.), and trash (shipping containers, paper, wipes, etc.). Some of the wastes were placed in cardboard and metal drums, some were bagged, and some, particularly pieces of equipment and building materials, were placed in trenches with no special packaging or containers.

In 1965, NUMEC exhumed the contents of Trenches 2, 4, and 5 to investigate discrepancies in material accounts of disposed uranium. The materials removed from the trenches were placed on the ground south of the upper trenches and sorted. Some of the exhumed materials were placed back in the trenches in 1966 and the remainder was shipped off-site for disposal at a low level radioactive waste disposal facility.

The trenches at the SLDA site were excavated in the order of their numbering between 1961 and 1970, and reportedly capped with four feet of soil once disposal operations ceased. The estimated average waste thickness in Trenches 1 through 9 reportedly ranged from 2.6 to 4.8 meters (8.5 to 15.8 feet). The estimated waste thickness in Trench 10 is 5.5 meters (18.1 feet).

The total estimated volume of potentially contaminated waste and soil in the ten trenches is between 17,970 and 27,520 cubic meters (23,500 and 36,000 cubic yards).

In 1967, the Atlantic Richfield Company (ARCO) purchased the stock of NUMEC. In 1971, ARCO then sold the stock to Babcock & Wilcox (B&W), the precursor company of the current owner, BWX Technologies (BWXT).

The SLDA site is licensed under NRC license number SNM-2001, Docket Number 070-3085. Under this license, BWXT is required to properly maintain the site in order to ensure protection of workers and members of the public, and to eventually decommission the site in compliance with NRC regulations as part of its license termination activities.

1.2 Summary of Existing Site Data

Numerous site investigations have been completed at the SLDA site over the past two decades. These investigations were focused to identify the nature and extent of radiological and chemical contamination potentially impacting the environment from past site operations with special emphasis on the ten disposal trenches. In 1986 and 1989, B&W performed remedial actions for surface soils in areas where elevated uranium concentrations were detected. As a result, some historical surface soil data is no longer representative. The following is a chronological listing of site investigation reports and remediation projects completed at the SLDA site:

- *Radiological Assessment of the Parks Township Burial Site (Babcock & Wilcox) Leechburg, Pennsylvania*, Oak Ridge Associated Universities, 1981.
- *Remediation of Surface Soils in the Upper Trench Area*, B&W, 1986.
- *Survey of Remediated Areas – Babcock and Wilcox Parks Township Burial Site*, Oak Ridge Associated Universities, 1987.
- *Remediation of Surface Soils in the Upper Trench Area*, B&W, 1989.
- *Survey of Remediated Areas – Babcock and Wilcox Parks Township Burial, Leechburg, Pennsylvania*, Oak Ridge Associated Universities, 1990.
- *Site Characterization Report*, ARCO/B&W, 1995.

- *1995 Field Work Report,* ARCO/B&W, 1996.
- *Inspections 07000364/2000002 and 07003085/2001001, BWXT Services, Inc., Parks Township Facility, and Shallow Land Disposal Area, Vandergrift Pennsylvania*, NRC, 2001.

As indicated by the number of investigations completed, data has been collected for the following media: surface soils, subsurface soils, groundwater, surface water, sediment, vegetation, coal, leachate and waste. For this FSP, only previous gamma survey and surface radiological data (surface soils, surface water, sediments, and vegetation sampling) will be presented in detail since the data obtained from the gamma walkover survey is reflective of surface conditions. In addition, field personnel will come into contact with surface soils, sediments and vegetation. Maximum concentrations of radionuclides detected in other site media will also be presented to provide an overview.

For purposes of this FSP, surface soil samples are defined as soils collected from ground surface to a depth of up to 15 cm (six inches). Subsurface soil samples are defined as soils collected from depths greater than six inches below ground surface. During previous investigations, several composite samples were collected from ground surface to a depth of two feet and technically contained soils defined as surface soils. However, if a sample contained greater than 50% subsurface soils, it is considered a subsurface soil sample.

External gamma radiation levels were measured at the ground surface during a gamma walkover survey completed in 1981. Large portions of the upper trench and lower trench areas were gridded and gamma radiation measurements were taken by traversing the site in a straight line fashion with 1.5 meter spacing using a gamma scintillation ratemeter. In addition, external gamma radiation levels were measured at 50-foot spacings within the gridded areas at elevations of one centimeter (cm) and one meter above ground surface using the same instrument. Beta gamma measurements were also taken at 1 cm above ground surface at each grid point using an energy compensated G-M ratemeter. Both an open- and closed-shield one minute count was taken for each measurement.

The exposure rate measured systematically one meter above ground surface at grid points located in the lower trench area ranged from 9 to 14 microRoentgens per hour (μR/h). The average exposure rate was 11 μR/h. Exposure rates measured systematically on contact with the ground surface at grid points located in the lower trench area ranged from 8 to 15 uR/h with an average of 11 μR/h. The walkover surface scan identified several locations with contact exposure rates greater than 20 μR/h with a maximum level of 670 μR/h.

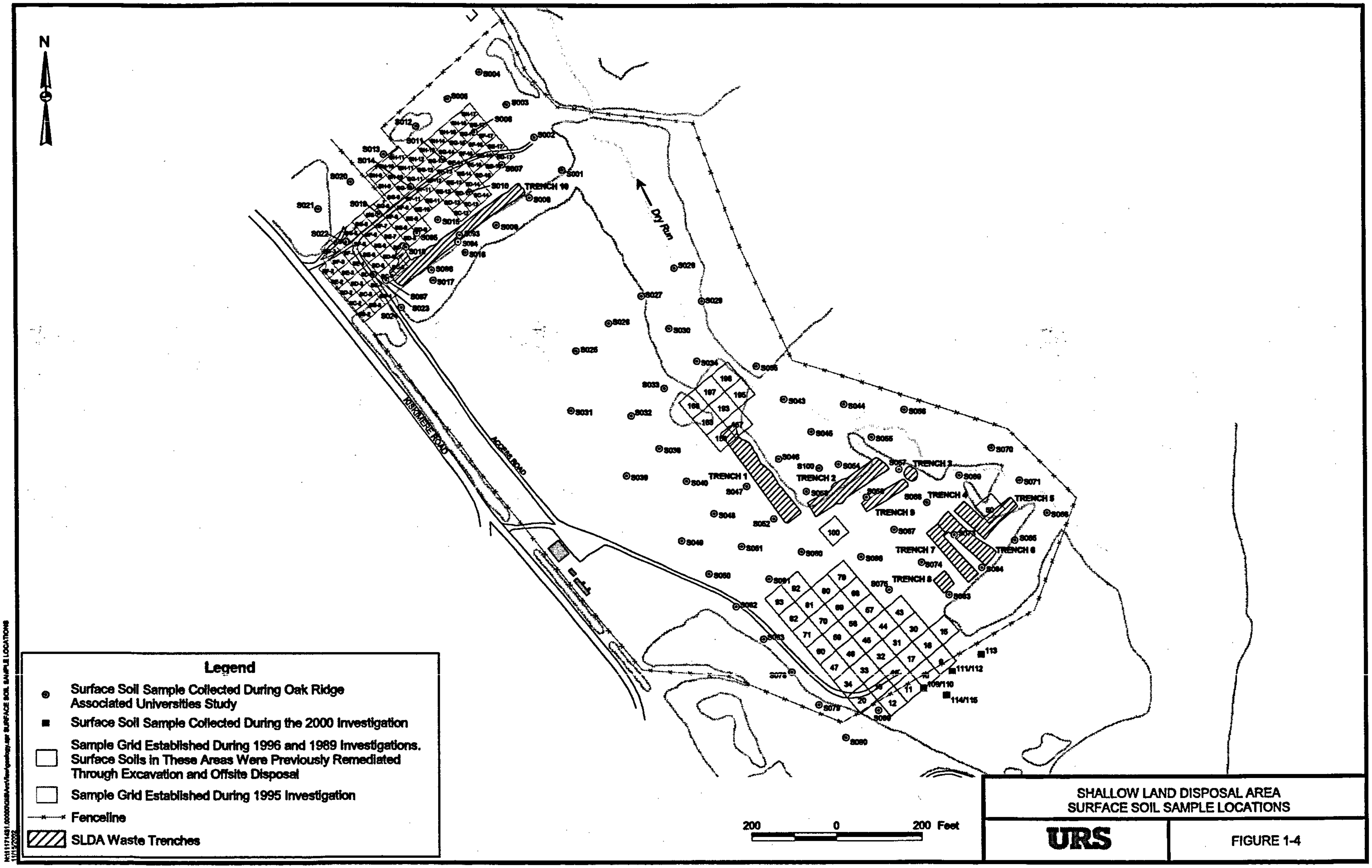
The lower trench beta-gamma surface dose rates at grid points ranged from 11 to 51 microrads per hour (μrad/hr) with an average of 29 μrad/hr. The lack of any significant difference between the open and closed-shield measurements indicated a negligible beta component.

In the upper trench area, the exposure rate measured systematically one meter above ground surface at grid points ranged from 6 to 19 μR/h. The average exposure rate was 11 μR/h. Exposure rates measured systematically on contact with the ground surface at grid points located in the upper trench area ranged from 6 to 32 μR/h with an average of 11 μR/h. The walkover surface scan identified numerous locations, primarily south of the upper trenches, with elevated contact exposure rates and a maximum exposure rate of 1,300 μR/h. It should be noted that the vast majority of the surface soils where these elevated exposures were measured were removed during the remediation work completed in 1986 and 1989.

The upper trench area beta-gamma surface dose rates at grid points ranged from 8 to 54 urad/hr with an average of 27 μrad/hr. The lack of any significant difference between the open and closed-shield measurements indicates a negligible beta component.

Figure 1-4 presents the surface soil sample locations at the SLDA site. Much of the surface soil data collected in 1981 were presented only as statistical summaries. Compounding the lack of original data, the statistical summaries presented from the upper trench area are no longer accurate since several samples from this data set have been removed from the site during the surface soil remediation completed in 1986 and 1989.

Sample data from the upper trench area reported that elevated levels of U-235 and U-238 were detected in surface soil samples. U-235 was detected in several samples collected from within the remediated areas at concentrations above background ranging as high as 2.24



N
Dry Run
TRENCH 1
TRENCH 2
TRENCH 3
TRENCH 4
TRENCH 5
TRENCH 6
TRENCH 7
TRENCH 8
TRENCH 9
TRENCH 10
KISKIMERE ROAD
ACCESS ROAD
Legend
Surface Soil Sample Collected During Oak Ridge Associated Universities Study
Surface Soil Sample Collected During the 2000 Investigation
Sample Grid Established During 1996 and 1989 Investigations. Surface Soils in These Areas Were Previously Remediated Through Excavation and Offsite Disposal
Sample Grid Established During 1995 Investigation
Fenceline
SLDA Waste Trenches
200 0 200 Feet
SHALLOW LAND DISPOSAL AREA
SURFACE SOIL SAMPLE LOCATIONS
URS
FIGURE 1-4

picoCuries per gram (pCi/g). U-238 was also detected in several samples collected from within the remediated areas at a concentration as high as 17.66 pCi/g.

Four surface soil samples collected by NRC in 2000 from just south of the 1986 remediation area contained the highest U-235 concentrations on-site (19.1 to 236 pCi/g). Similarly, U-238 levels in three of the four samples collected from this area were the highest levels detected on-site ranging between 14 and 278 pCi/g.

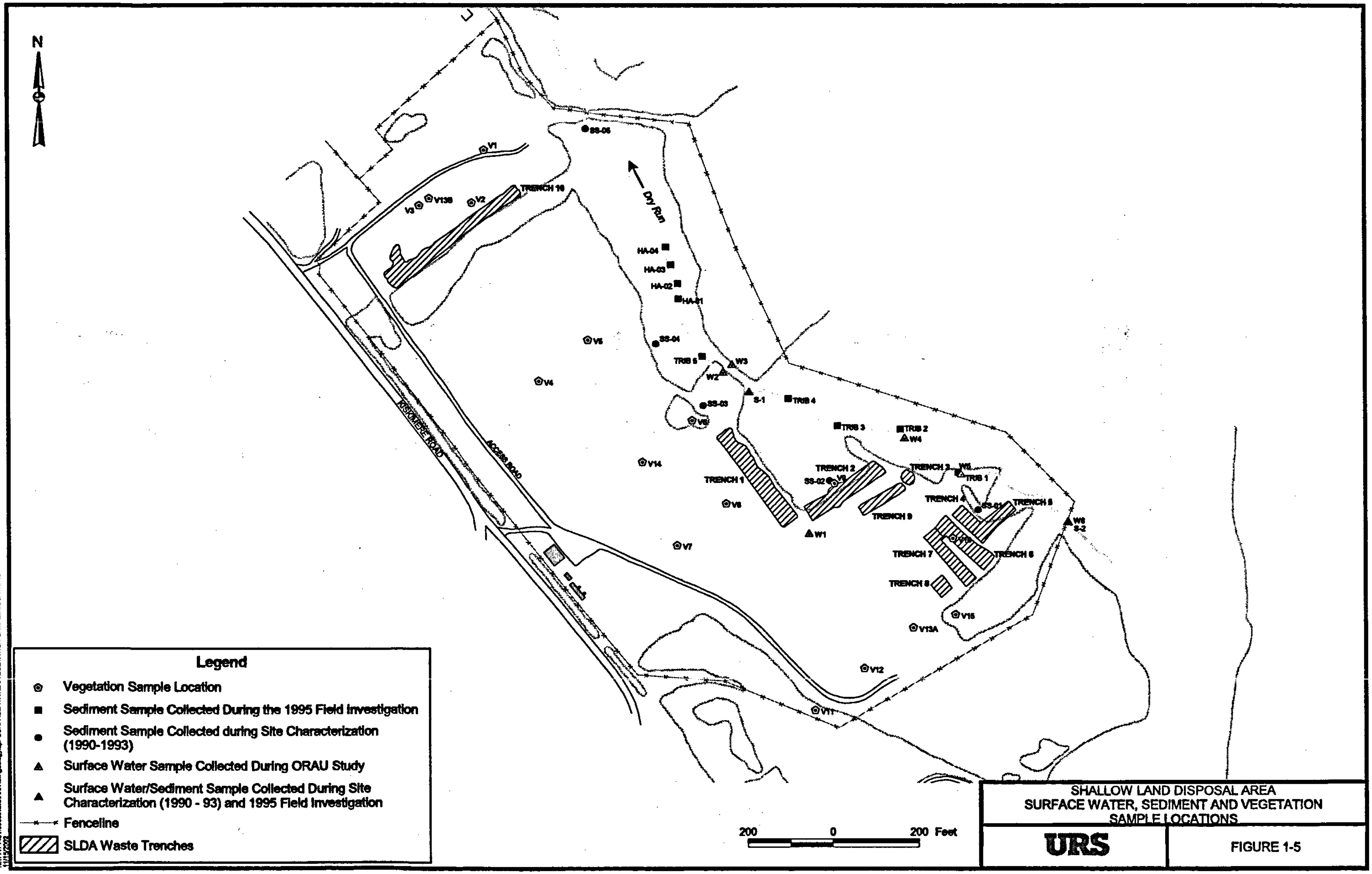
Five surface soil samples collected from the lower trench area contained U-235 ranging from 0.12 to 0.36 pCi/g. U-238 concentrations in these samples ranged from 1.9 to 26.5 pCi/g. Total uranium was detected in 63 samples collected from the vicinity of Trench 10 with a maximum concentration of 21.71 pCi/g.

Americium and plutonium were also detected in samples collected from the vicinity of Trench 10. A total of 115 samples contained americium (Am-241) above background with a maximum concentration of 61.59 pCi/g. Plutonium (Pu-241) was detected in each of the five samples analyzed at concentrations ranging from 24.7 to 63 pCi/g.

Isotopes of thorium, radium, cesium, and cobalt were also detected in surface soil samples, but the concentrations were at or near background. These included Th-232 (0.72 to 1.33 pCi/g), Ra-226 (0.61 to 1.02 pCi/g), Cs-137 (0.01 to 0.72 pCi/g), and Co-60 (0.01 to 0.47 pCi/g).

Six surface water samples were collected from locations within the SLDA site during the sampling completed in 1981. In addition, two surface water sample locations were routinely sampled during a quarterly monitoring program since 1991. Figure 1-5 illustrates the surface water sample locations. The range of constituent concentrations detected in the surface water samples is presented in Table 1-1. The range of gross alpha concentrations reported by B&W/ARCO was -0.48 to 13.71 pCi/L. The negative gross alpha concentration indicates that the actual concentration was very low.

Eighteen sediment samples were collected from locations within the SLDA site during the Site Characterization and the 1995 Field Investigation. In addition, quarterly sampling of seven sediment sampling locations established during the 1995 Field Investigation (Trib 0 through Trib 6) along Dry Run was completed since 1992. Figure 1-5 illustrates the sediment



SHALLOW LAND DISPOSAL AREA
SURFACE WATER, SEDIMENT AND VEGETATION
SAMPLE LOCATIONS

FIGURE 1-5

sampling locations (coordinates for the Trib 0 and Trib 6 locations were not provided). The range of radionuclide concentrations detected in the sediment samples is presented in Table 1-1.

A total of 16 vegetation samples were collected from on-site during the investigation completed in 1981 and the Site Characterization. Figure 1-5 illustrates the sample locations. The range of radionuclide concentrations detected in the vegetation samples is presented in Table 1-1.

Table 1-2 lists the maximum gross alpha, gross beta and individual radionuclides detected in samples collected from subsurface soils, groundwater, coal, leachate, and waste.

TABLE 1-1

RANGE OF RADIOLOGICAL PARAMETERS DETECTED IN SURFACE WATER, SEDIMENT, AND VEGETATION SAMPLES COLLECTED AT THE SLDA SITE

	Units	Parameter Concentration Ranges												
		U-235	U-238	Total Uranium	Th-232	Ra-228	Ra-226	Cs-137	Co-60	Am-241	Pu-239	Gross Alpha (pCi/l)	Gross Beta (pCi/l)	K-40
Surface Water	pCi/L	<10 - 20	<1000 - 2500	NA	NA	<40 - <50	<0.1 - 0.7	<10 - 50	<10	<0.014 - <0.037	<0.08 - <0.014	-0.48 - 13.71	0.40 - 8.20	NA
Sediment	pCi/g	NA	NA	1.11 - 45.13	1.29 - 1.98	NA	0.81 - 1.85	0.04 - 0.32	<0.04 - <0.13	0.1 - 0.25	NA	NA	NA	NA
Vegetation	pCi/g	0.05 - 0.24	1.2 - 18.2	6.2	NA	0.11 - 0.35	0.07 - 1.19	0.02 - 0.27	0.03 - 0.09	NA	NA	NA	NA	14.1 - 28.7

NA - Not Analyzed for this parameter.

TABLE 1-2 MAXIMUM GROSS ALPHA, GROSS BETA, TOTAL URANIUM AND INDIVIDUAL ISOTOPES CONCENTRATIONS DETECTED IN SUBSURFACE SOILS, GROUNDWATER, COAL, LEACHATE AND WASTE SAMPLES COLLECTED AT THE SLDA SITE										
Parameter	Subsurface Soils		Groundwater		Coal		Leachate		Waste	
	Conc. (pCi/g)	Sample Location	Conc. (pCi/l)	Sample Location	Conc. (pCi/g)	Sample Location	Conc. (pCi/L)	Sample Location	Conc. (pCi/g)	Sample Location
Gross Alpha	NA	--	137.39	MW-3	NA	--	7889.1	TWSP 1-6	NA	--
Gross Beta	NA	--	382.99	MW-4	NA	--	957.6	TWSP 1-6	NA	--
Total Uranium	626.19	02U08 (6-8 feet)	NA	--	7.18	MW-18 (92.7 feet)	29,500	TWSP 3-2	1106.96	01U06 (10 feet)
U-234	162	01U31 (6-8 feet)	NA	--	NA	--	NA	--	1368.34	01U06 (10-12 feet)
U-235	54.8	B-32, B-33, B-38, B-40 – B-44 (1 meter)[1]	30	B-1, B-2, B-3	NA	--	NA	--	47.53	01U06 (10-12 feet)
U-238	278	113	1800	B-1, B-2, B-3	NA	--	NA	--	29.60	01U06 (10-12 feet)
Th-232/ Ra-228	2.77	MW-13 (10-12 feet)	60	B-32, B-33, B-38, B-41, B-42	3.07	MW-18 (92.7 feet)	NA	--	NA	--
Ra-226	1.87	B10-B30 (5 meters)[1]	2.1	B-13, B-15, B-16, B-18, B-19, B-23-B-29	2.09	MW-18 (92.7 feet)	NA	--	NA	--
Cs-137	0.83	B10-B30 (1 meter)[1]	10	B-32, B-33, B-38, B-41, B-42	<0.07	MW-18 (92.7 feet)	85.3	TWSP-1-6	NA	--
Co-60	0.08	B31, B34-B37 (5 meters)	10	B-1, B-2, B-3	<0.07	MW-18 (92.7 feet)	89	TWSP-4-2	NA	--
Am-241	38.36	10L07 (4-6 feet)	0.081	B-17	<1.00	MW-18 (92.7 feet)	94.9	TWSP 1-7	3.21	10L18 (4 feet)
Pu-239/240	88.02	10L07 (4-6 feet)	0.003	B-34	NA	--	NA	--	NA	--
Pu-242	<0.24	10L07 (4-6 feet)	NA	--	NA	--	NA	--	NA	--

Notes: NA -- Not Analyzed for this parameter.
1 -- Reported concentration was the maximum of all samples collected from the borings indicated at that depth interval (1981 Investigation).

1.3 Site-Specific Gamma Walkover Survey Problems

There are no anticipated site-specific sampling or analysis problems associated with the majority of the gamma walkover survey, as 75% of the survey is within open and unobstructed areas. However, approximately 25% of the work may be performed in thickly vegetated areas or areas of steep elevation changes (high wall area, Dry Run). In these areas, a grid system will be established and data will be gathered at accessible grid locations.

Another problem could be excessive accumulations of snow at the site. If this occurs, then the survey may be delayed until the snow cover is small enough to allow the use of field instrumentation. If heavy ground freezing occurs (>46 centimeters), this may effect gamma readings. However, the relative site readings to that of background should remain the same.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section defines the overall project organization, identifies the project team, indicates each team member's responsibilities, and provides URS's approach to management of the project team.

The primary members of the project team are listed on the project organization chart (Figure 2-1). Additionally, this chart illustrates direct (primary) or indirect (secondary) lines of communication and authority. The following is a brief discussion of the project team members' responsibilities.

Project Principal (Vern Singh, PE) - Is the URS corporate officer who ensures that all required corporate resources are made available to the project team to complete the delivery order. He is the indirect (secondary) point of contact for the USACE for project communication and authority. The Delivery Order (D.O.) Manager, Quality Assurance (QA) Manager, and Health and Safety Officer will report directly to the Project Principal. The Project Principal will be responsible for:

- Providing corporate resources for completion of the delivery order
- Resolving any issues that cannot be resolved by the D.O. Manager

D.O. Manager (Thomas Fralick) - Is the primary point of contact for the USACE and all project team members. He is responsible for all assigned technical and administrative aspects of the project. The D.O. Manager will be responsible for the following:

- Directing and monitoring the planning, coordination, scheduling, cost, and quality of all tasks required by the project
- Coordinating staff and technical assignments for the project
- Ensuring that sufficient procedures and instructions exist for the adequate performance of project activities
- Maintaining communication with the USACE to resolve any questions that occur during the performance of this project
- Maintaining project files

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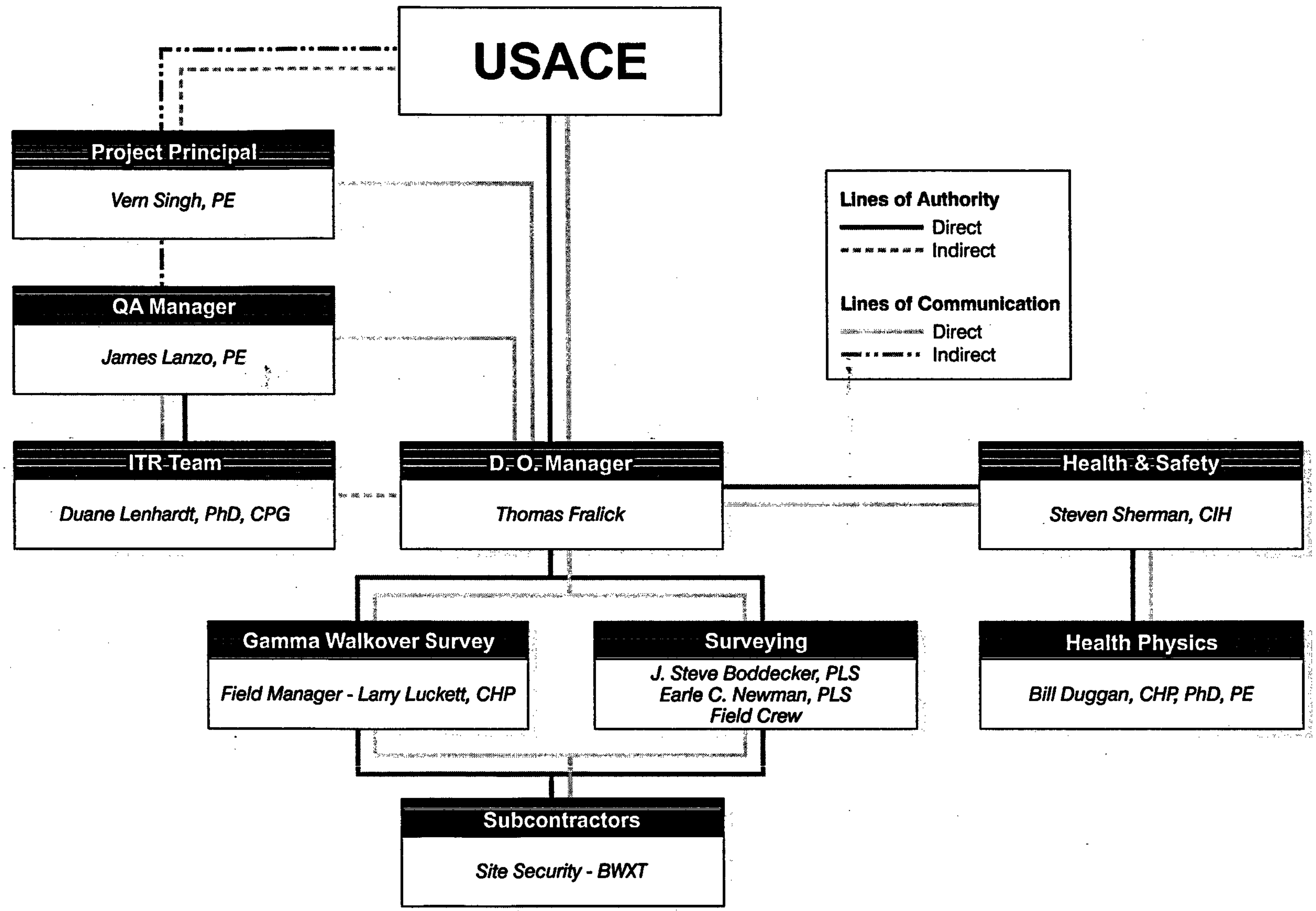

URS

GAMMA WALKOVER SURVEY
ORGANIZATION CHART

FIGURE 2-1

- Coordinating subcontractor activities and contracts
- Maintaining project QA and quality control (QC) records

Health and Safety Officer (Steven Sherman, CIH) - is responsible for the creation and implementation of the SSHP and all other issues on this project that concern health and safety. He will communicate directly with the D.O. Manager and technical staff on matters of health and safety. His authority comes directly from the Project Principal. The Health and Safety Officer or his designees are responsible for:

- Ensuring proper health and safety training for URS field personnel
- Providing medical surveillance for URS field personnel
- Ensuring that field personnel have adequate experience and training with personal protective equipment
- Providing guidance on health and safety data interpretation
- Determining required levels for worker protection
- Ensuring and auditing compliance with the SSHP

QA Manager (James Lanzo, PE) - is responsible for overall project quality assurance. He will ensure that project quality assurance meets the requirements of the SAP and URS Corporate requirements. His authority derives directly from the Project Principal and he communicates directly with the D.O. Manager and the Independent Technical Review (ITR) Team, on which he also serves as the team leader. The QA Officer or his designees are responsible for:

- Project Quality Assurance as defined by the scope of work and work plans
- Adherence to the URS Corporate Quality Assurance Manual
- Periodic audits of the project QA files and documentation

Independent Technical Review Team (ITRT) (Duane Lenhardt, PhD and representatives from the URS Salt Lake City office) - is responsible for senior independent review of all work products (work plans, technical memorandum, and all reports or documents that make recommendations or draw conclusions) submitted to the USACE under this delivery order. The ITRT derives its authority from and reports directly to the QA Manager. Through the team leader, they will communicate indirectly with the technical and support staff as necessary to ensure that proper quality assurance is being performed by the project team. The ITRT is responsible for the following:

- Senior technical review of all documents that are submitted to the USACE
- Ensure compliance with the scope of work, work plans and standards of the industry
- Ensure compliance with the project quality assurance requirements and URS corporate quality assurance requirements
- Ensure that all project team members know and meet the quality assurance requirements for the project
- Complete an ITR form for each document
- Ensure that all ITR comments are addressed

Health Physics Leader (William Duggan, PhD, PE, CHP) will lead the Health Physics activities under this Delivery Order. He is responsible for preparation and proper implementation of the gamma survey plans and procedures, and for preparation of the gamma survey report after completion of the field work.

Surveying Task Leader (J. Steve Boddecker, PLS) will oversee all day-to-day surveying activities including records research, field survey, computations, and report/map preparation. He is responsible for preparation and proper implementation of the land survey plans and procedures, and for preparation of the site survey map and site description after completion of the field work. If the gamma survey crew is not on-site, then Mr. Boddecker will coordinate with the BWXT representative on site security. Mr. Earle Newman will provide final review and checking.

Gamma Walkover Survey Field Manager (Larry Luckett, CHP) has overall responsibility for directing URS employees and our subcontractors on site. This includes the site surveying team if present at the same time. He will direct the BWXT representative in charge of site security.

Technical and Support Staff - are responsible for completing project tasks assigned to them by the D.O. Manager or his designee. They derive their authority from and communicate to the D.O. Manager or his designee.

The technical and support staffs are responsible for:

- Performing all technical or administrative tasks assigned to them by the D.O. manager
- Following all project work plans and the URS Corporate QA Manual
- Ensuring that all task are performed according to work plan requirements
- Ensuring the all quality control checks have been performed

Qualifications of most of the project team have previously been provided as part of the Engineering and Design Quality Control Plan. To ensure that only qualified individuals perform key tasks associated with this delivery order, personal qualifications are provided in Appendix B for the Health Physics and Land Survey Leaders, the Health Physics Site Supervisor, and the Health Physics Independent Technical Reviewer. If a project team member cannot complete his/her assignment, then a resume of the replacement team member will be forwarded to the USACE for approval.

3.0 SCOPE AND OBJECTIVES

The overall scope of this gamma walkover survey is to generate coverage maps showing variation of gamma radiation levels at the SLDA site. The gamma radiation data will be used in the development of planned RI work plans. Details of the gamma walkover survey are presented in Section 4.8.

The scope of the land survey is to establish limits of work and provide horizontal and vertical control for field activities. Also included in the scope of the land survey is confirming the location and elevation of the monitoring wells on site to confirm site conditions.

The project objective is to collect the necessary data, meeting the data quality objectives established for this project, in order to cleanup radioactive wastes at the SLDA site as directed by public law 107-117, Section 8143. The cleanup is to be consistent with the MOU between the USACE and the NRC for coordination of cleanup and decommissioning of FUSRAP sites with NRC licensed facilities (July 2001). The criteria in CERCLA and the National Contingency Plan (NCP) will be used for site evaluation and remedy.

4.0 FIELD ACTIVITIES

This section describes the rationale and procedures for all gamma walkover survey activities, as well as the methods that will be used to collect the data. Anticipated field activities consist of the gamma walkover survey and land surveying. Details regarding the gamma walkover survey and land surveying are presented in Sections 4.8 and 4.9, respectively. Note that certain types of field activities (e.g., groundwater sampling) are listed below as "Not Relevant" because they will not be performed during this survey. Field activities including sampling of soil, groundwater and other media are anticipated in subsequent phases of this project and will be addressed in the planned RI work plans.

4.1 Geophysics – Not Relevant

4.2 Underground Utility Clearance – Not Relevant

4.3 Soil Gas Survey – Not Relevant

4.4 Groundwater – Not Relevant

4.5 Subsurface Soil – Not Relevant

4.6 Surface Soil and Sediment – Not Relevant

4.7 Surface Water – Not Relevant

4.8 Gamma Walkover Survey

A scanning gamma walkover survey will be performed at the SLDA site to determine the presence of gross gamma radioactivity in soil. This survey will be performed using a Ludlum model 44-20, 3" by 3" sodium iodide (NaI) scintillation detector and a Field Instrument for the Detection of Low Energy Radiation (FIDLER), both coupled to a Ludlum Model 2221 count-rate meter (or equivalent). A Trimble Pathfinder PROXR global positioning system (GPS) unit will record the geographical position and match it to the count rate at that location. These data from both probes will be combined with the GPS data and electronically logged for subsequent download at the completion of the survey. A Ludlum Model 44-9 Pancake GM Detector coupled to a Ludlum Model 2221 count-rate meter (or equivalent) will be used to scan workers for radioactive contamination as part of the SSHP requirements.

The FIDLER is a thin NaI scintillation probe that is typically 12.7 cm (5 in.) in diameter and about 0.16 cm (0.063 in.) thick. The thin geometry of the crystal enables the detector to have a very high efficiency in detecting low energy photons (in the range of 30 to 100 keV), while allowing the high energy photons to pass through the crystal with very few interactions. As a result, the FIDLER is very good at detecting those radionuclides that emit low energy gamma rays. The typical FIDLER has a thin (0.03 cm [0.012 in.]) beryllium window, which means it is very fragile and can easily be damaged in the field by grass, twigs, or other surface protrusions. Because the detector is most efficient when held close to the ground (within about 30 cm [1 ft] of the surface), a thin protective covering will be used to protect the probe.

Background gamma walkover readings will be determined both in static (stationary) and walkover modes. Several measurements will be made so that statistical evaluation of background can be determined (mean, standard deviation, etc.). Selection of the reference location will be coordinated with the Pennsylvania Department of Environmental Protection (PADEP) and will be offsite but in close proximity to the site. After consultation with PADEP, URS recommends determining the background data at the Gilpin/Leechburg Community Park located on Pennsylvania State Route 66 approximately 4.8 km (3 miles) from the SLDA site. Additionally, the background count rate will be determined daily at a reference location known to be free of radioactive contamination. The results of this gamma walkover survey will be used during preparation of the RI work plans to select locations for biased soil samples. In the absence of positive gamma walkover survey results, other criteria will be selected for determining the location of biased samples.

The walkover survey will be accomplished by slowly walking straight-line sections of the site, carrying the 3" by 3" NaI detector and the FIDLER on a carriage similar to a baby stroller. Both detectors will be held approximately 30 cm (1 ft) above the ground surface with a linear scan rate of approximately 50 cm/sec (1.6 ft/sec). The field manager may modify this method, as needed, due to complications with terrain and the like. The spacing between the straight-line sections will be about 1 m (3.3 ft). The count rate will be automatically logged during the survey. At the completion of the survey, the count rate, matched to its physical coordinates (via GPS) will be downloaded into a computer and transmitted to a designated URS office for input into a geographical information system (GIS). A map will be generated that shows locations and instrument count rates.

In those areas where it is not possible to use the stroller-mounted unit, a grid of survey stakes will be established at a spacing of 9.1 m (30 ft). Gamma measurements will be taken at each station and recorded. The field operator will monitor the counter between grid points for any anomalous readings. If anomalous readings are observed, then a more detailed point survey will be performed to define the anomaly.

Prior to conducting this gamma walkover survey, it is useful to evaluate the sensitivity of the two detectors for the contaminants and conditions expected to be present at the site. This evaluation of the scan and static minimum detectable concentrations (MDCs) can be used to optimize the gamma walkover survey and maximize the amount of information generated by this effort. The MDCs for each detector are dependent on the radionuclides present at the site (and the associated gamma-emitting properties of these radionuclides), the manner in which the contamination occurs at the site (in terms of expected areal extent, depth, and possible cover), and procedures associated with conducting the survey (including the height of the detector above the ground surface and walking speed).

An approach for estimating scan MDCs for gamma walkover surveys using NaI detectors is given in Section 6.7.2 of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NRC, et al., 1997) and Section 6.8.2 of NUREG-1507 (NRC 1998). This methodology was used by Cabrera Services, Inc., to determine scan MDCs for processed uranium metal at the DuPont Chambers Works FUSRAP site. The approach used by Cabrera Services was followed here to provide consistency of approach for this FUSRAP site. Adjustments were made to account for site-specific differences between the DuPont Chambers Works site and the SLDA site, mainly in terms of the radioactive contaminants expected to be present and the likely pattern of soil contamination. The static MDC was evaluated in the same manner as the scan MDC; the only difference in the calculation is the amount of time that the detector is held above the contaminated area. Current plans are to perform static measurements using the same two detectors held about 30 cm (1 ft) above the ground surface for 1 minute.

The SLDA site consists of ten trenches that were used for the disposal of radioactive waste from 1961 through 1970, and the primary radioactive contaminants are uranium and thorium-232. The estimated uranium activity at the SLDA site is 6 curies and the estimated thorium-232 activity is 0.06 curies (as given in Section 7.2.3 of the Site Characterization Report [ARCO, B&W 1995]). The uranium-contaminated materials placed in the trenches are present in a wide range of enrichments, ranging from less than 0.2% uranium-235 (by weight) to more than 45% uranium-235. The uranium enrichment is noted as being somewhat higher than would be expected for low enriched uranium (ARCO, B&W 1995). Since more than 30 years has passed since disposal activities ceased, significant ingrowth of radium-228 has occurred, and this radionuclide is expected be present in secular equilibrium with thorium-232. In addition, small amounts of plutonium-239, plutonium-241, and americium-241 have been detected at the site in previous investigations, generally in the vicinity of Trench 10.

The wastes were buried in shallow trenches which occupy about 0.49 hectare (ha) (1.2 acres) of the 18-ha (44-acres) site, meaning that the trenches only occupy about 3% of the site. Most of the remainder of the site is vegetated with grasses and annuals, and wooded areas are present along the northeastern, southeastern, and southern portions of the site. In 1965, three of the trenches were excavated to investigate discrepancies in material accounts of disposed uranium. The materials removed from the trenches were placed on the ground and sorted. Some of the exhumed materials were placed back in the trenches and the remainder was shipped offsite for disposal. Two subsequent soil remediation projects were conducted in the 1980s to remove surface soils containing elevated levels of uranium. In addition to waste disposal activities (including the staging of waste materials on the ground surface prior to placement in the trenches), portions of the site were used for storage of radioactively contaminated equipment and material. Hence, there is a good possibility for relatively small areas of surficially contaminated soil at the site.

Based on previous investigations and a review of historical records, the radionuclides of potential concern at the site have tentatively been determined to be uranium isotopes (-234, -235, and -238), thorium-232 (with radium-228 present in secular equilibrium), two plutonium isotopes

(-239 and -241), and americium-241. Preliminary remediation goals (PRGs) have been developed for these radionuclides using the RESRAD computer code version 6.21; the unrestricted release criterion of 25 millirems (mrem)/year given in 10 CFR 20.1402 was used as the dose standard in developing these PRGs, which are shown in Table 4-1. Additional information on the procedures used to develop these PRGs is given in the RI Field Sampling Plan. These values are still considered preliminary and have not been approved for use at the site. However, they do provide a useful benchmark in designing the gamma walkover survey.

As noted above, the most prevalent radioactive contaminant is uranium in a variety of enrichments, and most of the radioactive contamination is in the ten trenches. However, since there may be small areas of soil contamination on or near the soil surface, a gamma walkover survey will be conducted with the goal of identifying these areas to support future site investigations and develop appropriate worker protection plans. One approach for determining scan and static MDCs would be to determine values for each of the seven radionuclides individually. This would be appropriate given the highly heterogeneous nature of radioactive contamination at the site (consistent with its use for waste disposal) and the fact that uranium is present in a wide range of enrichments. However, since uranium is by far the most prevalent radioactive contaminant at the site, it is more useful to evaluate scan and static MDCs for several enrichments of uranium for input into the design of the gamma walkover survey. Three enrichments were considered in this evaluation: depleted uranium (0.4% uranium-235), low enriched uranium (3% uranium-235), and 10% enriched uranium. In addition, scan and static MDCs were calculated for thorium-232 (in secular equilibrium with its decay products), plutonium-239, plutonium-241, and americium-241.

The relative activities of uranium-234, uranium-235, and uranium-238 for the three enrichment cases were obtained from a graph illustrating the activities of these three isotopes for various uranium-235 enrichments. For a concentration of 1 pCi/g of total uranium, the concentrations (in pCi/g) of these three isotopes (in the order given above) were determined to be: 0.38, 0.016 and 0.60 for depleted uranium; 0.75, 0.041 and 0.21 for low enriched uranium; and 0.88, 0.050, and 0.070 for 10% enriched uranium. These values are approximate, but are sufficient for use in this calculation. The effective PRGs for these three cases can be determined using the sum-of-ratios approach and are calculated to be (in pCi/g): 108 for depleted uranium; 94 for low enriched uranium; and 90 for 10% enriched uranium.

The scan and static MDCs were calculated for the two detectors for these seven cases based on the goal of detecting contaminated soil having an areal extent of about 1 m^2 (11 ft^2) to a depth of 15 cm (6 in.). This areal extent corresponds to the planned procedures for scanning the site, i.e., walking the site in straight-line sections separated by about 1 m, and is reasonable given the previous use of the site (including the one waste retrieval and two previous soil remediation projects). Even though the wastes disposed of in the trenches are highly heterogeneous, there have been a number of surface soil disturbance activities since disposal activities ceased. The area has been actively monitored and investigated for more than 30 years, and in two instances the surface soil was remediated (removed). These activities have likely resulted in the mixing of localized hot spots in the surface soil with nearby uncontaminated soil, increasing the size and reducing the radionuclide concentrations in such areas. As such, there is no reason to expect very localized areas of high radioactive contamination.

Analysis of previous surface soil sampling efforts has identified only 5 samples (out of a total of more than 700) that exceeded the preliminary PRGs given in Table 4-1, with the highest values being 278 pCi/g for uranium-238 and 236 pCi/g for uranium-235. For subsurface soil samples collected from 15 cm (0.5 ft) to 1.2 m (4 ft) below the ground surface, 25 samples (out of a total of more than 150) exceeded the PRGs, with the highest value being 131 pCi/g for total uranium. While very localized areas having radioactive concentrations significantly above the preliminary PRGs are not expected, such areas would likely be detected using the approach currently planned.

The results of the scan and static MDC evaluations are given in Tables 4-2 and 4-3, and the detailed calculations are provided in Appendix C. As can be seen in Table 4-2, the scan MDCs for the 3" by 3" NaI detector are about one-fourth to one-third of the PRGs for all radionuclides except for plutonium-239; the scan MDC for plutonium-239 is more than 80 times higher than the PRG, which is not surprising given the extremely low gamma yield for this radionuclide. The scan MDC for plutonium-241 is less than its PRG, largely as a result of the americium-241 ingrowth that has occurred since disposal activities ceased.

While the scan MDCs for the FIDLER are significantly lower than those for the 3" by 3" NaI detector, the plutonium-239 scan MDC for the FIDLER is still a factor of nine higher than the PRG. Only the static MDC for the FIDLER (which is based on a 1 minute count) is reasonably close to the plutonium-239 PRG. This points out the difficulty of identifying this radionuclide at the site during the gamma walkover survey. Historical information indicates that this radionuclide is likely present only in the vicinity of Trench 10, so it may be necessary to modify the walkover survey in this area, e.g., by walking slower here than in the rest of the site.

The scan and static MDCs were calculated using the approach described in MARSSIM and NUREG-1507, and include a number of approximations and assumptions as described in Appendix C. These MDCs were developed to support the design of the gamma walkover survey, and should be used consistent with the underlying assumptions associated in their development. The scan MDCs for the 3" by 3" NaI detector were compared to those given in Table 6.4 of NUREG-1507 for two NaI detectors having smaller crystals and the results are consistent, considering the difference in crystal size and increased size of the hot spot (and, hence, longer scan time) addressed for the SLDA site; both factors will lower the scan MDC. This is a good check as to the correctness of these calculations.

As noted previously, the most prevalent radioactive contaminant at the SLDA site is uranium. As can be seen by the information presented in Tables 4-2 and 4-3, these two detectors are able to detect uranium at a sufficiently low concentration, i.e., at levels below the PRGs. The FIDLER will provide additional information (beyond that which could be obtained by the 3" by 3" NaI detector), principally for americium-241 and the two plutonium isotopes.

Based on these considerations, it is concluded that the planned approach for conducting this survey is appropriate for this site and will provide useful information to guide future site investigations and support development of appropriate worker protection plans. The use of both detectors during the walkover survey should increase the amount of pertinent data generated during the survey without significantly increasing the cost of the activity.

Table 4-1

Tentative PRGs for the SLDA Site

Radionuclide	PRG (pCi/g)
Americium-241	27.7
Plutonium-239	32.6
Plutonium-241	892
Thorium-232	1.35
Uranium-234	96.4
Uranium-235	34.6
Uranium-238	123

Table 4-2

Scan MDCs and Tentative PRGs for the SLDA Site

Case	FIDLER	3" by 3" NaI	PRG (pCi/g)
Depleted Uranium (0.4%)	2.6	21	108
Low Enriched Uranium (3%)	4.2	24	94
10% Enriched Uranium	5.3	26	90
Thorium-232	0.20	0.56	1.35
Plutonium-239	300	2,800	32.6
Plutonium-241	21	280	892
Americium-241	0.57	7.6	27.7

Table 4-3

Static MDCs and Tentative PRGs for the SLDA Site

Case	FIDLER	3" by 3" NaI	PRG (pCi/g)
Depleted Uranium (0.4%)	0.81	6.3	108
Low Enriched Uranium (3%)	1.3	7.5	94
10% Enriched Uranium	1.6	8.0	90
Thorium-232	0.062	0.17	1.35
Plutonium-239	91	860	32.6
Plutonium-241	6.4	86	892
Americium-241	0.17	2.3	27.7

4.9 Site Land Survey

4.9.1 Control Surveys

Site project control will be established and/or verified using GPS and record Pennsylvania State Plane Coordinate Monuments established by the National Geodetic Survey (NGS) Branch of the National Oceanic and Atmospheric Administration (NOAA). GPS base stations, set at these record monuments and using static and/or real-time kinematics (RTK) survey methods, will be used to establish on-site horizontal and vertical control. All survey work associated with the control establishment will be completed as required by the USACE survey guidance document.

The UTM coordinates will be added to the locational information in the database.

No new mapping is proposed; URS will use existing mapping provided by USACE.

All established horizontal control will have a positional accuracy of ± 0.1 foot. All vertical control monuments established will have elevations accurate to the nearest 0.01 foot. Should GPS be unable to meet the required vertical accuracies, differential leveling will be used to obtain the necessary accuracies in elevations.

GPS survey techniques will be completed in accordance with methodology presented in the USACE document entitled, *NAVSTAR Global Positioning System Surveying* (EM 1110-1-1003). All GPS surveying will use differential techniques. Conventional survey techniques will be completed in accordance with methodology presented in the USACE document entitled, *Geodetic and Control Surveying* (EM 1110-1-1004).

4.9.2 Site Land Surveys

Using the established on-site control, URS will use a combination of conventional survey instruments (total stations, levels, etc.) and GPS to verify existing monitoring well locations and elevations. This information will be reported in Pennsylvania State Plane Coordinate Values and referenced to the North American Vertical Datum of 1988 (NAVD 88) for incorporation into existing base mapping.

A project site boundary survey will be completed to determine the limits of the land title of the subject parcel as well as those of adjacent land owners. Title records will be obtained from the County Clerk's files. Boundary evidence, visible evidence of easements, and structures and manmade items, will be located. Once the field work is completed, analysis of this information will be performed against the record title documents obtained from the office of the County Clerk and a boundary survey will be made in accordance to the standards established by the Professional Land Surveyors of the Commonwealth of Pennsylvania. Boundary corners will be established at corners where none exist. Table 5-1 contained in Chapter 5 of the USACE document, *Survey Markers and Monumentation* (EM 1110-1-1002), will be used to determine which of material shall be utilized. The boundary survey will be coordinated with the Real Estate Division of the local USACE office.

5.0 SAMPLE CHAIN-OF-CUSTODY/DOCUMENTATION

Not Relevant

6.0 SAMPLE PACKAGING AND SHIPPING

Not Relevant

7.0 INVESTIGATION-DERIVED WASTES

Personal protective equipment (PPE) such as tyvek, gloves, and boots will be removed prior to leaving the SLDA site. The PPE will be scanned for radioactivity with a Ludlum Model 44-9 Pancake GM Detector coupled to a Ludlum Model 3 survey meter (or equivalent) to evaluate the potential presence of elevated beta/gamma radioactivity. A Ludlum Model 43-5 scintillator probe will be used to survey for alpha contamination. The PPE will be disposed of as non-industrial or non-hazardous waste if radiation levels are below 1,000 disintegrations per minute (dpm)/100 cm^2 for beta/gamma, and below 1,000 dpm/100 cm^2 for alpha (uranium), corresponding to allowed removable contamination levels set forth in NRC Regulatory Guide 1.86. For field use, the count rate corresponding to that contamination level will be determined based on the actual instrument characteristics and efficiency. PPE meeting this criteria will be disposed of as municipal waste or trash. If the PPE exhibits radiation levels above those limits, it will be placed in a 55-gallon steel drum and staged in the trailer on-site for subsequent disposal with investigation-derived waste anticipated during the RI planned for 2003. Decontamination wash water will also be placed in a 55-gallon drum for disposal.

8.0 CONTRACTOR CHEMICAL QUALITY CONTROL

Not Relevant

9.0 DAILY QUALITY CONTROL REPORTS (DQCRs)

The Data Quality Control Report (DQCR) is completed on a daily basis to document quality control related information from the field. The Field Manager will complete the DQCR during site work, sign the DQCR and submit it to USACE on a weekly basis. If significant modifications to the QAPP and FSP are required, USACE will be contacted immediately. The DQCR form is included in Appendix D. The DQCR will contain, at a minimum, the following information:

- Work performed
- Equipment used
- Summary of Field survey measurements
- Health and Safety Activities and Action Levels
- Field instrument calibrations or calibration checks
- Departures from the QAPP and FSP
- Discussion of problems encountered and resolutions
- Discussion of field or surveying conditions that could impact data quality or usability
- Instructions from USACE or PADEP

10.0 CORRECTIVE ACTIONS

The Field Manager will be responsible for identifying field changes to the FSP. He/she will, in turn, notify the D.O. Manager who will notify the USACE within 48 hours of the field changes. Examples of corrective actions may include resurveying an area where the data was deemed unrepresentative.

11.0 PROJECT SCHEDULE

The project schedule for gamma walkover survey is shown in Figure 11-1. All field activities will be coordinated at least three weeks in advance with USACE.

GAMMA WALKOVER SURVEY
SLDA
DELIVERY ORDER 10

ID	Task Name	Duration	Start
1	Site Access Granted	0 days	4/14/03
2	**Gamma Walk Over Survey Field Work**	**26 days**	**4/14/03**
3	Mobilization	3 days	4/14/03
4	Land Survey Field Work	10 edays	4/15/03
5	Gamma Walk Over Survey Field Work	15 edays	4/30/03
6	Demobilization	2 days	5/16/03
7	**Data Reduction and Reporting**	**50 days**	**5/20/03**
8	URS Prepares Internal Draft Report	10 days	5/20/03
9	ITR	5 days	6/4/03
10	URS Issues Draft Report to USACE	0 days	6/10/03
11	USACE Review Report	15 days	6/11/03
12	URS Receives Comments on Report	0 days	7/1/03
13	URS Prepares Response to Comments and Change Pages	5 days	7/2/03
14	URS Submits Responses and change pages to USACE	0 days	7/8/03
15	USACE Reviews Responses and Change Pages	5 days	7/9/03
16	URS Prepares Final Report	5 days	7/16/03
17	URS Issues Final Report	0 days	7/22/03
18	USACE Accepts Final Report	5 days	7/23/03

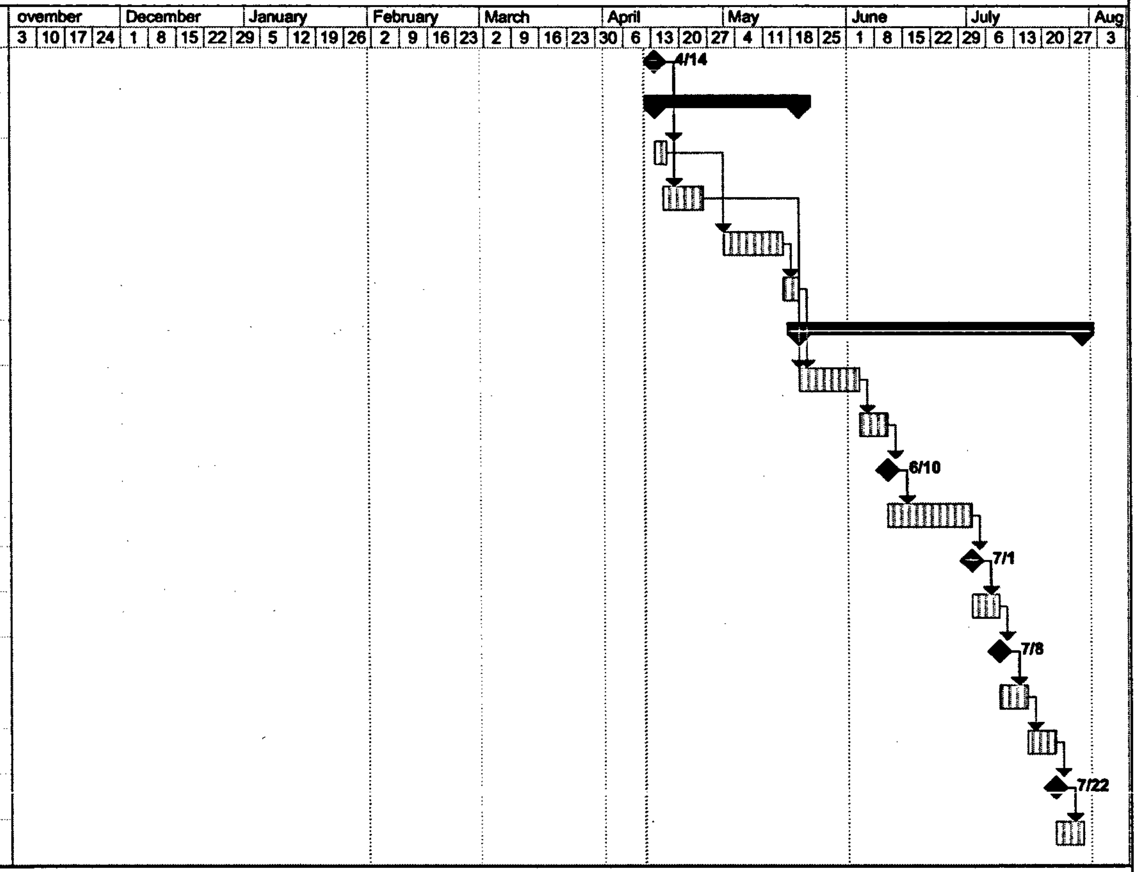

FIGURE 11-1

Note: Initiation of field work dependent on obtaining site access

Task | Progress | Summary | Split | Milestone

12.0 SAMPLING APPARATUS AND FIELD INSTRUMENTATION

The gamma walkover survey equipment is discussed in Section 4.8. The land surveying equipment will include the Topcon Total Station Model 700 and 701, Topcon Automatic Level Model ATF3, Trimble GPS Equipment Model 4400, Trimble GPS Pathfinder ProXP, and various rods and tapes. Appendix E contains the calibration and operational procedures for all field instrumentation that will be used during the investigation.

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APPENDIX A

BUFFALO DISTRICT U.S. ARMY CORPS OF ENGINEERS DELIVERY ORDER NO. 0010

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207-3199

REPLY TO
ATTENTION OF Contracting Division

11 September 2002

SUBJECT: Solicitation No. DACW49-02-R-0047, Contract No. DACW49-01-D-0001-0009, Modification 03 - Modification to the Parks Township Shallow Land Disposal Area, Data Review & Data Gap Analysis

URS
282 Delaware Avenue
Buffalo, NY 14202

Gentlemen:

You have been selected to submit a price proposal for a modification to the above referenced Solicitation for Data Review & Data Gap Analysis, Parks Township Shallow Land Disposal Area (SLDA).

You are requested to submit a price proposal for the performance of all work in accordance with the enclosed Scope of Work. Your price proposal should be in sufficient detail to permit an analysis of all labor hours involved in this work, including any additional expenses such as, but not limited to, supplies. Your proposal should be submitted in sufficient time so as to reach this office by 12:00 PM on 13 September 2002.

Award may be made on the basis of the initial proposal without discussion, or may be subject to further negotiations.

Sincerely,

Moira A. Restall

Moira A. Restall
Contract Specialist

FUSRAP

US Army Corps of Engineers

Scope of Work

Project Work Plans, Acquisition of Field Data and Technical Support for Shallow Land Disposal Area

Authorized under the
Formerly Utilized Sites Remedial Action Program

Shallow Land Disposal Area
Parks Township, Armstrong County, Pennsylvania

Prepared by:

U.S. Army Corps of Engineers
April 2002

TABLE OF CONTENTS

ACRONYMS

ABHP	American Board of Health Physics
Am	Americium
ANSI	American National Standard Institute
ARAR	Applicable or Relevant and Appropriate Requirement
BRA	Baseline Human and Screening Level Ecological Risk Assessments
BWXT	BWX Technologies
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CHP	Certified Health Physicist
CPM	Critical Path Method
CRP	Community Relations Plan
CSRS	Contractor Submittal Requirements Summary
DQO	Data Quality Objective
E&D QCP	Engineering & Design Quality Control Plan
EM	Engineer Manual
FS	Feasibility Study
FSP	Field Sampling Plan
FUSRAP	Formerly Utilized Sites Remedial Action Program
IDW	Investigative Derived Wastes
ISO	International Standards Organization
ITR	Independent Technical Review
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MOU	Memorandum of Understanding
NCP	National Contingency Plan
NRC	United States Nuclear Regulatory Commission
NTP	Notice to Proceed
PA	Preliminary Assessment
PDF	Adobe Acrobat Portable Document Format
Pu	Plutonium
QAPP	Quality Assurance Project Plan
QC	Quality Control
RI	Remedial Investigation
ROE	Right of Entry
RPP	Radiation Protection Plan
SAP	Sampling and Analysis Plan
SLDA	Parks Township Shallow Land Disposal Area
SOW	Scope of Work
SSHP	Site Safety and Health Plan
TPP	Technical Project Planning
U	Uranium
USACE	United States Army Corps of Engineers

1.0 INTRODUCTION

This Scope of Work (SOW) delineates requirements for project work plans, acquisition of field data, and technical support for the Parks Township Shallow Land Disposal Area (SLDA). All work is to be performed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The United States Army Corps of Engineers (USACE) completed a Preliminary Assessment (PA) as the first step in the CERCLA process. Limited Data Review and Data Gap Analysis has also been performed and all results from that analysis will be utilized in the completion of the tasks outlined in this SOW.

The Contractor shall provide all labor, material, equipment, and laboratory facilities necessary to perform the services described below. The Contractor shall furnish the required personnel, equipment, instruments, and transportation necessary to accomplish the required work and furnish to the Government data, reports, and all other material developed. During the execution of the work, the Contractor shall provide adequate professional supervision and Quality Control (QC) to assure the accuracy, quality, completeness and progress of the work.

1.1 Site Strategy and Objectives

Public Law 107-117, Section 8143 directs the USACE to clean up radioactive wastes at the SLDA consistent with the Memorandum of Understanding (MOU) between the United States Nuclear Regulatory Commission (NRC) and the USACE for Coordination on Cleanup and Decommissioning of the Formerly Utilized Sites Remedial Action Program (FUSRAP) sites with NRC-licensed facilities (July, 2001). The strategy for the SLDA is to address all radioactive waste at the site as directed by congress. The strategy will follow the process defined in CERCLA. The criteria in CERCLA and the National Contingency Plan (NCP) will be used for site evaluation and remedy.

Project-specific Data Quality Objectives (DQOs) will be developed. Based on these objectives, the Contractor shall prepare a Project Work Plan, Sampling and Analysis Plan (SAP), and Health, Safety, and Radiation Protection Plan delineating the methodologies, staffing and reporting protocols to be used during the Remedial Investigation (RI). These work plans must be submitted to and accepted by the USACE before implementation of the plans commences.

The goal during the execution of this SOW is to generate data of known quality for the intended usage on the first attempt. The data shall be of sufficient quality and quantity, with quantitation levels low enough to meet pertinent standards, Applicable or Relevant and Appropriate Requirements (ARARs), and remediation goals.

2.0 SITE DESCRIPTION

The SLDA consists of ten trenches spread over an approximately 44-acre area. The total trench surface-area is approximately 1.2 acres. The area is mowed three times per year and can be described as a grass-covered field. The site is fenced and posted to prevent public access. The trenches are separated into two general areas, one area containing trenches 1 through 9 and a second area containing trench 10. The land slopes downward from the southeast (trenches 1 through 9) toward the northwest (trench 10), resulting in a change in elevation of approximately 115 feet over a distance of approximately 1000 feet. Several SLDA site maps are presented in Appendix C.

Uranium-and thorium-contaminated wastes consisting of process wastes, equipment, scrap, and trash from the nearby Apollo nuclear fuel fabrication facility were disposed of in the SLDA between 1961 and 1970. The uranium (U) in the trenches is present at various levels of enrichment, from depleted to highly enriched. Americium (Am-241) and Plutonium (Pu-239/240/242), whose presence is attributed to the storage of equipment used in the Parks Facility, have been detected in soils in the trench 10 area. The Apollo Facility processed uranium and, to a lesser extent, thorium. Processing operations included the conversion of uranium hexafluoride (UF_6) to uranium dioxide (UO_2) by the ammonium diuranate process and subsequent metallurgical and ceramic processes to produce uranium products and fuel components. Typical products included U metal, UO_2, UC, UC_2, ThO_2, ThO_2-UO_2, and UC-ThC produced as sintered pellets, powder, and other particulate forms.

Waste types consisted of process wastes (slag, crucibles, spent solvent, unrecoverable sludges, organic liquids, debris, etc.), laboratory wastes (sample vials, reagent vials, etc.), old or broken equipment, building materials, protective clothing, general maintenance materials (paint, oil, pipe, used lubricants, solvents (trichloroethene, methylene chloride), etc.), and trash (shipping containers, paper, wipes, etc.). Some of the wastes were in cardboard and metal drums, some were bagged, and some, particularly pieces of equipment and building materials, were placed in trenches with no special packaging or containers.

Land use surrounding the SLDA site is mixed, consisting of medium-sized residential communities and individual rural residences, small farms with croplands and pastures, idle farmland, forestlands, and light industrial areas. The closest community is Kiskimere, which is adjacent to and to the south of the SLDA. Some residences within this community are located within a couple of hundred feet of the SLDA. These residences are not directly downgradient of the site with respect to groundwater and surface water flow. A restaurant and a small industrial complex are located north and within a mile of the site. Three natural gas pipelines traverse the area; two are owned by Apollo Natural Gas Company and one is owned by People's Natural Gas Company.

The former Parks Fuel Fabrication Facility, also owned by BWX Technologies (BWXT), joins the SLDA property to the north. This facility and the SLDA were included under the same NRC license until 1995, when the license was divided and each area became licensed individually and separately. The Parks Facility consisted of three buildings, all of which have been dismantled. Decommissioning of the Parks Facility is completed with the exception of routine monitoring activities.

3.0 DESCRIPTION OF TASKS

A cost estimate for Tasks 1, 2, 3.1.1, 4, 5 and 6 will be prepared separately from the remaining items in Task 3. A cost proposal for Task 3 will be prepared at a later date, as directed by the USACE.

3.1 Task 1: Quality Control and Independent Technical Review Plan

The Contractor shall prepare an Engineering & Design Quality Control Plan (E&D QCP) as defined in the base contract to cover development of all products described in this delivery order. An E&D QCP is the Contractor's management plan for execution of all aspects of the contract. It describes the way the Contractor will produce the deliverables and the steps that will be taken to control product quality, i.e., the Design, Engineering Drawings, and the Independent Technical Review (ITR) required under the contract for this project. A list of items that would normally be in the E&D QCP is included in Appendix A. *Please note that this plan applies to the overall project, and is not part of the document that will be prepared for quality control and quality assurance of sample acquisition and analysis.*

The E&D QCP shall specify and document the policies and procedures the Contractor will follow in performance of this SOW. It must include, at a minimum, the following:

- Personnel responsibilities and qualifications,
- Communications and reporting arrangements, and
- Project schedule.

The Contractor is required to specifically identify the individuals responsible for producing the Health, Safety, and Radiation Protection Plan and provide a detailed description of their qualifications (resume).

The Contractor's goal shall be to submit a complete and technically sound document, able to be implemented, sufficient for approval upon initial review by the USACE. To accomplish this, the Contractor is encouraged to contact the USACE Project Manager and USACE Project Engineer(s) during development of the submittal, and to discuss issues such as methodology, regulation interpretation, etc with relevant technical staff.

The Contractor shall perform an ITR of all documents identified in Appendix B as requiring an ITR review and attach an ITR Certification to new transmittals of documents before they are submitted to the USACE for review. ITRs do not need to be performed for resubmitted documents. The ITR will focus primarily on conformance to the approved design and appropriate technical criteria for function, reliability, and safety. Although the ITR is not for value assessment or value engineering, such comments may be a natural outcome of the review. Those comments will be considered suggestions, and will not require a formal response. Performance of the ITR should not be accomplished by the same personnel that produced the product and personnel performing the ITR must have different supervision than those individuals producing the product. This is to ensure that a truly 'independent' technical review is accomplished. If the Contractor elects to have the review done by another agency or firm, it shall identify that agency in the E&D QCP. Upon completion of the ITR, the Contractor shall submit to USACE a Certificate of Completion signed by the reviewer(s) (see Appendix A), along with responses to comments received. *Please note that labor hours associated with the ITR of documents should be estimated within the task associated with the document and not within this task.*

3.2 Task 2: Project Work Plans

The project work plans shall be comprised of: a Health, Safety and Radiation Protection Plan, a Field Sampling Plan and a Quality Assurance Project Plan. These plans shall include all proposed field activities except a gamma walkover survey, for which a separate set of plans shall be produced. The gamma walkover survey work plans shall contain all applicable sections of the project work plans related (only) to the execution of the survey.

A Technical Project Planning (TPP) meeting was held to further define project-specific DQOs. Detailed strategies shall be presented in the project work plans on how data will be collected to fill data gaps. Results of the Data Review and Data Gap Analysis, performed under a separate delivery order, shall be incorporated and made an integral part of the RI Work Plans. Key elements of the RI requiring additional data may include, but are not limited to: waste characterization, possibility of mine subsidence, nature and extent of contamination, conceptual model, and fate and transport of contamination. The project work plans must be accepted by the USACE prior to the commencement of any fieldwork.

3.2.1 Task 2.1 Health, Safety, and Radiation Protection Plan

The Contractor shall have in place a safety and health program that meets 29 CFR 1910.120 (b) requirements. The Contractor shall also prepare and submit a Site Safety and Health Plan (SSHP) that follows the exact outline of all elements (including radiation protection requirements) in Appendix B of ER 385-1-92 (USACE 1994). The Contractor is to submit an original SSHP document that is site specific and written only for this site. No "off-the-shelf" SSHP documents are acceptable. These plans must be reviewed by USACE personnel prior to performance of field activities, including mobilization. These plans shall conform to all appropriate USACE guidance, including but not limited to ER 385-1-92 Appendix B, and Engineer Manual (EM) 385-1-1 (USACE 1996c). USACE guidance for preparation of site-specific SSHPs will be provided to the Contractor upon request. The radiation protection elements shall be included as a separate document called the "Radiation Protection Plan" (RPP) and shall be included as an Appendix in the SSHP.

The Contractor will design an Activity Hazard Analysis for all field activities in accordance with the USACE Safety and Health Requirements Manual, EM 385-1-1 (USACE 1996c), Figure 1-1, page 4. This Activity Hazard Analysis shall be included in the SSHP.

The Contractor shall comply with all other appropriate and applicable regulations, which include but are not necessarily limited to: 29 CFR 1910.120, Hazardous Waste and Emergency Response; 10 CFR 20, Standards for Protection Against Radiation; and 49 CFR 172, Hazardous Materials. The Contractor shall also comply with any facility-specific health and safety procedures mandated by the site owner.

The Contractor shall utilize the services of a Health Physicist certified by the American Board of Health Physics (ABHP) with 2 years experience in radioactive waste handling and disposal operations. The Certified Health Physicist (CHP) shall be responsible for preparing a site radiation risk evaluation, and the development of a Radiation Protection Program for inclusion in the SSHP. The radiation protection program shall be developed, documented, and implemented in a manner that ensures the program is commensurate with the scope and extent of activities, and is sufficient to ensure compliance with the provisions of the applicable standards. The CHP is not required on site continuously during the project, but must be on site at least 25 percent of the total field operation time. The CHP must be available for consultation with site personnel and for emergencies.

3.2.2 Task 2.2 Field Sampling Plan and Quality Assurance Project Plan

The Contractor shall prepare a Field Sampling Plan (FSP) which specifies and provides for documentation of the data collection program. The Contractor is required to provide justification of why each data set is necessary. The FSP shall also include plans for mobilizing to the site, as well as plans for disposal of investigative derived wastes (IDW). The FSP shall be reviewed by the USACE before work commences. The Contractor shall use the USACE publication entitled "Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3" (USACE 2001) and Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) 2000 as guidance in preparing the FSP. The Contractor shall also provide to their Buffalo District approved laboratory a copy of the USACE analytical "SHELL" document, as listed in the references section of this SOW (USACE 1998d). The Contractor shall also use the "SHELL" document in developing the FSP and Quality Assurance Project Plan (QAPP). The Contractor shall coordinate with the USACE and the site owner to address any potential site constraints or other factors that may impact site characterization activities.

The Contractor shall also prepare a QAPP, which shall be reviewed by the USACE before work commences. Guidelines for QAPP preparation are also given in EM 200-1-3 (USACE 2001). Together the FSP and the QAPP constitute the SAP. *It must be noted that the QAPP described herein applies only to data acquisition and analysis and is not part of the E&D QCP described in Task 2. The QAPP and the E&D QCP are two separate documents with different names and purposes.*

3.3 Task 3: Acquisition of Field Data

In an effort to ensure the production of high quality chemical and radiological data that satisfy the project-specific DQOs, ER 1110-1-263 (USACE 1998a), including references (Appendix A), and MARSSIM 2000 will be utilized to complete this task. The Contractor shall be responsible for disposal of all IDW, which must be considered and costed in the Contractor's proposal. Once the work plans are reviewed, the Contractor shall implement the data acquisition plan for all necessary activities. Any installation of soil borings or monitoring wells shall comply with EM 1110-1-4000, Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites (USACE, 1998c).

The Contractor is required to comply with all provisions stated in the USACE Right of Entry (ROE) for SLDA while on their property. Further, the Contractor must be in accordance with all safety protocols, as directed by the BWXT site manager, and BWXT's Health, Safety, and Radiation Protection Plans.

The Contractor is required to pay a BWXT employee to provide site security during all site visits/work at the SLDA. The cost for this employee will be included in the Contractor's cost proposal for this task. This BWXT employee will not have authority to direct the Contractor's activities.

All laboratories that provide analytical services on environmental media for the purpose of demonstrating compliance with the state's laws must be registered with and accredited by the Pennsylvania Department of Environmental Protection. Therefore, the Contractor is required to employ a laboratory that meets this requirement.

The Contractor shall propose field activities for the following areas in the FSP for USACE acceptance.

3.3.1 Task 3.1 Soil

The Contractor shall propose the number and placement of soil borings, and the analytes of concern. This shall include surface and subsurface soil sampling. The combination of existing data and the data collected for this task should be adequate to delineate the nature and extent of contamination at the site, define fate and transport of materials, and meet other requirements as specified by the USACE. This work shall be performed in accordance with sections 3.3.4.7.8 Subsurface Soil and 3.3.4.7.9 Surface Soil and Sediment of EM-200-1-3 (USACE 2001).

3.3.1.1 Task 3.1.1 Gamma Walkover Survey

In order to aid the selection of soil sampling locations, a gamma walkover survey shall be performed at SLDA prior to the commencement of other fieldwork and sampling. The contractor shall propose the amount of survey coverage, in the separate gamma walkover survey work plans, as described in Task 2. Where possible, gamma activity data will be collected concurrently with global positioning data.

3.3.2 Task 3.2 Groundwater

The Contractor shall propose the number and placement of groundwater samples and additional monitoring wells, and the analytes of concern for each proposed sample. The combination of existing data and the data collected for this task should be adequate to delineate the nature and extent of contamination at the site, define fate and transport of materials, and meet other requirements as specified by the USACE. This work shall be performed in accordance with section 3.3.4.7.6 Groundwater of EM-200-1-3 (USACE 2001).

3.3.3 Task 3.3 Surface Water and Sediments

The Contractor shall propose the number and placement of samples and the analytes of concern. Here, too, the combination of existing data and the data collected for this task should be adequate to delineate the nature and extent of contamination at the site, define fate and transport of materials, and meet other requirements as specified by the USACE. The task shall be performed in accordance with sections 3.3.4.7.10 Surface Water and 3.3.4.7.9 Surface Soil and Sediment of EM-200-1-3 (USACE 2001).

3.3.4 Task 3.4 Trench Characterization

The Contractor shall propose activities needed to further define trench volume, contaminated soil volume, and/or trench contents. These activities should aid in the delineation of the nature and extent of contamination, and should be adequate to support development of remedial alternatives and cost estimates during the FS.

3.3.5 Task 3.5 Other Activities

If need is determined based on the results of the data review and data gap analysis and the TPP meeting, the Contractor shall propose any additional field activities in the FSP for USACE approval. Activities to evaluate the possibility of mine subsidence and mine safety issues may be included in this category.

3.4 Task 4: Community Relations Support

Although the USACE has principal responsibility for community relations activities, the Contractor shall assist the USACE as requested by providing information regarding site history, participating in public meetings, preparing written materials and displays, and providing other support as requested.

The Contractor shall also assist the Buffalo District USACE by interfacing with other agencies, Contractors, districts/divisions within the USACE, government officials, and organizations/individuals as requested. Assistance shall include but not be limited to providing information regarding site history, discussing data acquisition techniques and characterization results, attending meetings and forums, preparing written materials, presentations and displays, conducting interviews and providing other support as requested. For cost estimating purposes, the USACE assumes that a total of 250 labor hours are associated with this task. This includes management, professional, and non-professional labor categories.

3.5 Task 5: Technical Support Services

The Contractor shall provide the necessary labor to provide technical support services throughout the performance of this work order. These services may include engineering support, health physicist support, and other technical support as required. For estimating purposes, the USACE assumes that a total of 500 labor hours are associated with this task. This includes management, professional, and non-professional labor categories.

3.6 Task 6: Database Development

Limited conversion of historical data to electronic database format was awarded under a separate delivery order. The remaining historical data shall be imported or manually entered into electronic database format. Appropriate Quality Assurance/Quality Control (QA/QC) checks shall be applied to ensure accurate conversion.

4.0 SUBMITTALS, PRESENTATIONS AND COMMUNICATION

4.1 Submittals

All reports presenting data, analysis, and recommendations shall be prepared in the following standard format. All site drawings shall be of engineering quality with sufficient detail to show interrelations of major features on the site map (i.e., north arrows, keys, scales, etc.) When drawings are required, they shall be folded, if necessary, to 8-1/2" by 11". A decimal paragraphing system shall be used. The reports shall be submitted in three-ring hardcover binders. A report title page shall identify the report title, the Contractor, the USACE, Buffalo District, and the date. The Contractor identification shall not dominate the page. Submittals shall include incorporation of all previous review comments as well as the disposition of each comment. In addition to hard copies, all submittals shall also be provided electronically in Adobe Acrobat Portable Document Format (PDF). Also, all original files, including, but not limited to, documents, databases, and model output shall be provided to the USACE if requested. Documents should be screened for potential violation of the 1974 Privacy Act prior to submittal.

All geospatial data collected and generated under this SOW shall be submitted to the Buffalo District in Microsoft Access format. The Contractor shall create metadata for this project in accordance with the USACE document "Policies, Guidance, and Requirements for Geospatial Data and Systems, ER 1110-1-8156" (USACE 1996b).

Drawing files shall be compatible with Microstation 95SE, running on an Intel Windows 2000 Platform, without any translation by the Government.

The table below presents the approximate number of copies for each document version that will be required. Additional copies may be required, and shall be furnished by the Contractor to addressees as requested by the USACE. Some copies indicated in the table may be sent to alternate addresses as directed by the USACE. Following each submission, comments generated as a result of review by the USACE and other applicable parties shall be incorporated into the following or final draft. Also, reference Appendix B for additional guidance.

Addressee	Version/ Reviewers	Electronic Compact Disc – Read Only Memory (CD-ROM) (copies)	Paper (copies)	
U.S. Army Corps of Engineers Attn: SLDA Project Manager (Dilip Kothari) 1000 Liberty Ave. Pittsburgh, PA 15222-4186	CX/ITR	1	1	10
	State/Stakeholder	1	1	
	Final	1	8	
U.S. Army Corps of Engineers Attn: SLDA Project Engineer (Janna Hummel or David Frothingham) 1776 Niagara Street Buffalo, NY 14207-3199	CX/ITR	2	6	24
	State/Stakeholder	2	6	
	Final	3	12	

4.2 Communication

Good communication between the Contractor and the USACE is essential to deliver quality products and keep the project on schedule. Accordingly, the Contractor is encouraged to contact USACE personnel with questions, and required to advise the USACE about problems and delays as soon as they arise. In addition, weekly conference calls with USACE project personnel will be held to discuss project progress. Weekly hours estimates, summarized by task, shall be submitted to the USACE. Monthly meetings, involving additional SLDA team members shall be held as determined necessary by the USACE.

4.3 Field Reports

Daily Quality Control Reports shall be prepared both in the field and in the laboratory (should laboratory work be required). These reports shall be compiled weekly by the Contractor and made available to the USACE as requested.

The USACE project engineer shall be notified immediately of significant problems with sampling, well installation, instrument calibration and laboratory analysis. This notification is to be followed by a letter to the Contracting Officer within five working days of the discovery of the problem. Reports shall detail the solutions agreed upon with the project engineer and corrective actions taken. The Contractor shall also maintain a file of these reports, and submit them as an appendix to the final report.

4.4 Public Affairs

The Contractor shall provide a fact sheet prior to the commencement of any fieldwork, outlining the activities to be done at the site. Based on this fact sheet, the USACE will augment the site Community Relations Plan (CRP) to facilitate community relations between the community and the regulatory agencies.

The USACE has several goals in the implementation of the CRP. These goals include: keeping interested parties informed of on-site activities, detecting issues of concern to affected individuals and groups, responding to those concerns, and identifying opportunities for input by affected individuals and groups.

The USACE will conduct community relations activities designed to inform the public of the nature of the environmental problem, the threat the problem could pose, responses under consideration, and the progress being made addressing the problem. The Contractor may be required to attend and participate in public meetings as specified in the task list.

4.5 Preparation of Proposal

The Contractor shall prepare cost estimates based on work tasks as presented in this SOW, and list all assumptions on which the cost estimate was based. A cost estimate for Tasks 1, 2, 3.1.1, 4, 5 and 6 will be prepared separately from the remaining items in Task 3. A cost proposal for Task 3 will be prepared at a later date, as directed by the USACE.

5.0 PROJECT SCHEDULE

The following are target dates for activities described in this SOW.

Deliverable/Action	Date(s) (Calendar days after notice to proceed (NTP))
E&D QCP	14
Distribute Gamma Walkover Survey Plans to USACE	18
Distribute Revised Gamma Walkover Plans to Property Owner	46
Execute Gamma Walkover Survey	70-81

Deliverable/Action	Date(s) (Calendar days after notice to proceed (NTP))
Distribute Project Work Plans to ITR & USACE CX Teams	30
Distribute Revised Project Work Plans to State/Stakeholders for Review	113
Final Work Plans	210
Field Work	218-274

6.0 REFERENCES

References include, but are not limited to, the following:

10CFR20. Code of Federal Regulations, Title 10, Part 20, January 1999.

29CFR190.120. Code of Federal Regulations, Title 29, Part 190, Section 120, July 1999.

49CFR172. Code of Federal Regulations, Title 49, Part 172, October 1998.

U.S. Army (USA) 1991. Department of the Army Pamphlet (DA Pam) 40-578. *Health Risk Assessment Guidance for Installation Restoration Program and Formerly Used Defense Sites.*

USACE 2002. Preliminary Assessment, Shallow Land Disposal Area, Parks Township, Armstrong County, Pennsylvania, March 2002.

USACE 2001. Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3, U.S. Army Corps of Engineers, February 2001.

USACE 1999a. *Corps of Engineers Guide Specifications for Construction, Section 01351, Safety, Health, and Emergency Response (HTRW/UST),* U.S. Army Corps of Engineers, February 1999.

USACE 1999b. EM 200-1-4. *Risk Assessment Handbook, Volume I: Human Health Evaluation.* Final.

USACE 1998a. Chemical Data Quality Management for Hazardous, Toxic, Radioactive Waste Remedial Activities, ER 1110-1-263, U.S. Army Corps of Engineers, April 1998.

USACE 1998b. Technical Project Planning (TPP) Process, EM 200-1-2, U.S. Army Corps of Engineers, August 1998.

USACE 1998c. Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites, EM 1110-1-4000, U.S. Army Corps of Engineers, November 1998.

USACE 1998d. "SHELL" Interim Chemical Data Quality Mangement (CDQM) Policy for USACE Hazardous, Toxic, and Radioactive Waste (HTRW) Projects, U.S. Army Corps of Engineers, 1998.

USACE 1996a. Risk Assessment Handbook: Volume II - Environmental Evaluation, EM 200-1-4, U.S. Army Corps of Engineers, June 1996.

USACE 1996b. Policies, Guidance, and Requirements for Geospatial Data and Systems, ER 1110-1-8156, U.S. Army Corps of Engineers, August 1996.

USACE 1996c. Safety and Health Requirements Manual, EM 385-1-1, U.S. Army Corps of Engineers, September 1996.

USACE 1994. Safety and Occupational Health Document Requirements for Hazardous, Toxic and Radioactive Waste (HTRW) and Ordnance and Explosive Waste (OEW) Activities, ER 385-1-92, U.S. Army Corps of Engineers, March 1994.

MARSSIM 2000. Multi-Agency Radiation Survey and Site Investigation Manual, EPA 402-R-97-016, U.S. Environmental Protection Agency, December 2000.

USEPA 1999. A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents, EPA 540-R-98-031, U.S. Environmental Protection Agency, July 1999

USEPA 1998. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part D)*, U.S. Environmental Protection Agency, 1998.

USEPA 1997. "Checklist for Ecological Assessment/Sampling".

USEPA 1992a. OSWER Directive 9285.7-09A. Guidance for Data Usability in Risk Assessment (Part A). Final report. Office of Emergency and Remedial Response.

USEPA 1992b. Publication No. 9285.7-09B. PB92-963362. Guidance for Data Usability in Risk Assessment (Part B).

USEPA 1991a. Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B), U.S. Environmental Protection Agency, December 1991.

USEPA 1991b. Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part C), U.S. Environmental Protection Agency, December 1991.

USEPA 1990. National Oil and Hazardous Substances Pollution Contingency Plan. Final Rule. Office of Solid Waste and Emergency Response. 55 FR 8660.

USEPA 1989. Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part A), U.S. Environmental Protection Agency, December 1989.

USEPA 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, U.S. Environmental Protection Agency, October 1988.

APPENDIX A - KEY COMPONENTS OF AN ENGINEERING & DESIGN QUALITY CONTROL PLAN AND INDEPENDENT TECHNICAL REVIEW

The E&D QCP is the Contractor's management plan for execution of the contract. The E&D QCP describes the way in which the Contractor will produce the deliverables and the steps that will be taken to control quality. The following items are essential components of an E&D QCP, but should not be interpreted as excluding others.

1. Management Philosophy. Discuss the organization's technical management philosophy relative to its commitment to quality. If the firm has undergone a peer review of its organization, practices and procedures, a statement should be made describing it. Give the date, the name of the person who conducted the peer review, and a brief description of resulting changes.

2. Management Approach. Define the specific management methodology to be followed during the performance of the work, including such aspects as: documentation management and control, communications, design coordination procedures, checking, and managerial continuity and flexibility.

3. Management Structure. Delineate the organizational composition of the Contractor to clearly show the interrelationship of management and the design team components, including all consultants. Include an organization chart to identify by name the key design and review team members, and show their specific responsibilities related to the project.

4. Design Tools. Describe the design tools that will be used in execution of the contract, such as CADD, MCACES, computer application programs, etc.

5. Scheduling. Include a time-scale bar chart or Critical Path Method (CPM) design schedule showing the sequence of events involved in carrying out specific tasks within the specified period of service. Clearly show the design review and correction periods scheduled prior to submittals.

6. Cost Control. For cost reimbursement contracts, describe how project costs will be monitored and controlled.

7. Construction Cost Estimate Control. Discuss the organization's internal controls to minimize construction cost limitation overruns, and ensure the accuracy and integrity of the construction cost estimate. Indicate how construction cost information will be handled and communicated to the Government.

8. Communications. Discuss the methods by which clear and accurate communications are to be achieved within the organization, and outside the organization. Indicate the names of all parties authorized to request modifications to the work, and specifically how these modifications will be coordinated and documented.

COMPLETION OF INDEPENDENT TECHNICAL REVIEW

The Contractor has completed the (type of study, work plans, report or P&S) of (project name and location). Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the E&D QCP. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions; methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing USACE policy.

___/Signature/__________ Date:________

Design Team Leader

___/Signature/__________ Date:________

Design Team Members

___/Signature/__________ Date:________

Independent Technical Review Team Leader

___/Signature/__________ Date:________

Independent Technical Review Team Members

CERTIFICATION OF INDEPENDENT TECHNICAL REVIEW

Significant concerns and the explanation of the resolution are as follows:

Item	Technical Concerns	Possible Impact	Resolution

As noted above, all concerns resulting from independent technical review of the project have been considered.

(Signature)____________________ Date:______________

Principal w/ CONTRACTOR firm

APPENDIX B - CONTRACTOR SUBMITTAL PROCEDURES

CLAUSE 1 - SUBMITTAL REQUIREMENTS

The Contractor shall furnish copies of all submittals as directed by Section 4.1 of this SOW. This appendix contains additional guidance.

All submittals prepared for this Contract shall have a cover sheet indicating the following information in or near the title block:

- Project Name and Phase
- USACE Contract Number
- Date
- Submittal Title and Number

With each separate submittal, a copy of the attached Contractor Submittal Requirements Summary (CSRS) form shall be included and "Submittal Title" of item(s) being submitted shall be circled or highlighted. In addition, the Contractor shall include a letter of transmittal detailing the following:

- Contract number
- A description of contents per the CSRS Form
- Number and type of items (floppies, etc.)
- Note if the submittal is a resubmittal

Whenever possible, related items shall be submitted together to permit simultaneous review. When such submittal is not possible, submittals shall be in an appropriate sequence to ensure that necessary information is available for reviewing such item as it is received.

USACE reserves the right to request any submittal not included on the CSRS form or any new submittal requirement.

CLAUSE 2 - SUBMITTAL RECIPIENTS

Submittals of all documents as identified on the CSRS shall be made directly to the individuals noted below.

U.S. Army Corps of Engineers
Attn: SLDA Project Manager
(Dilip Kothari)
1000 Liberty Ave.
Pittsburgh, PA 15222-4186

U.S. Army Corps of Engineers
Attn: SLDA Project Engineer
(Janna Hummel or David Frothingham)
1776 Niagara St.
Buffalo, NY 14207-3199

CLAUSE 3 - TYPES OF SUBMITTALS

Documents

Each submittal shall be an unfolded, direct reading, first-generated copy the same size as the original. The minimum size of submittals shall be 8-1/4 inches by 11 inches. Each submittal shall be of a sufficient quality to produce clearly legible/readable third-generation copies using either diazo or electrostatic (Xerox-type) processes and clearly legible/readable microfilm and copies from the microfilm.

Submittals 11 inches by 17 inches or smaller shall be black-on-white, or color copies; bond paper is acceptable.

Submittals larger than 11 inches by 17 inches shall be dark line on translucent or transparent material suitable for diazo reproduction and shall be rolled and inserted into mailing tubes.

Drawing Requirements

All drawings and diagrams shall be prepared in accordance with the latest applicable American National Standard Institute (ANSI) Drafting Manual, ANSI-Y14.

Each drawing submitted shall have a separate drawing number. When a drawing is revised, revision numbers must be clearly legible and easily distinguishable from the drawing number and should be as close as possible to the title block. A short description of the nature of the revision must be included, and revised areas on the drawing shall be circled and identified with the revision number.

"Typical," "standard," or "off-the-shelf" drawings will be acceptable only if they have all non-applicable sections either removed or noted on each drawing.

Magnetic Storage Media

1. Data submitted on magnetic storage media shall be accompanied by a hardcopy list of the media contents and a letter of transmittal.

2. Electronic Digital Media shall be delivered on CD-ROM with International Standards Organization (ISO)-9660 format.

Samples

Submittal of sample materials, such as bentonite, geomembrane, or geotextile swatches, etc., shall be of the size and type as noted in the technical specifications.

CLAUSE 4 - SUBMITTAL STATUS AND RETURN BY USACE

A copy of documents submitted requiring review will be returned by USACE with status (code) marked in accordance with ENG FORM 4025.

Approval and/or acceptance of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval and/or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the QC requirements of this contract is responsible for the satisfactory performance of all work. Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the Contractor/supplier, and does not relieve the Contractor/supplier from full compliance with contractual obligations or release any "holds" placed on the contract.

Work shall not proceed until submittals requiring prior review (see CSRS) have been reviewed and approved and/or accepted by USACE. The Contractor shall provide a disposition of each comment, incorporate changes as required by comments on submittals, and resubmit corrected submittals for review. Submittals that have been given a code notation by USACE shall not be changed without notification to USACE. If changes are required, affected submittals shall be resubmitted to USACE for review.

CLAUSE 5 - Payment Requests and Invoices

Payment requests or invoices shall contain the following information as a minimum: Project Title, Contract Number, Delivery Order Number, Invoice Number (or indicate FINAL PAYMENT), date of invoice, dates covered for each invoice, total contract amount with all modifications and amounts listed individually, amounts retained, amount remaining in the contract to be completed, certification of the invoice by a responsible individual of the firm, and any other pertinent information that will assist in review and processing. Mail payments requests promptly to:

U.S. Army Engineer District, Buffalo
ATTN: CELRB-TD-DM (Mr. David Frothingham)

Contract No. DACW49-XX-X-XXXX
Delivery Order No. XXX
1776 Niagara Street
Buffalo, NY 14207

Contractor Submittal Requirements Summary

SUBMITTAL SCHEDULE
- s Prior to Shipment
- B Prior to Balance of Payment
- A Per S/C Schedule
- M Prior to Mobilization
- W Prior to Commencing Work
- Y Prior to Progress Payment
- — For Each Specific Task
- Z As Required

SUBMITTAL TYPE REQUIRED
- O Original
- P Print/Photocopy
- T Transparency
- M Microfilm
- PH Photograph
- E Electronic Format
- S Sample

CLASSIFICATION
- FIO For Information Only
- GA Government Approval

NOTICES

1. To each item submitted, attach a copy of this form and circle the title of the item being submitted.
2. Failure to submit required submittals as delineated on this form may result in withholding of payment in accordance with provisions of the contract.
3. The Contract Administrator is responsible for distributing submittals to the requesting Department (e.g., Construction). The Department is responsible for further distributions (e.g., Site Superintendent).

Item No./ Submittal Titles		SOW Paragraph	Classification	ITR Required	Submittal Codes (No.) and Type
1	R&D QCP	3.1	GA	No	E, O
2	Project Work Plans	3.2	GA	Yes	E, O
3	Gamma Walkover Survey Work Plans	3.2	GA	Yes	E, O

APPENDIX C - SLDA SITE MAPS

US Army Corps of Engineers

Contract	Date
URS A/E	05-Sep-2002

Shallow Land Disposal Area

Independent Government Estimate

URS Labor Costs				TOTALS		Task 1 E&D QCP		Task 2.1 Health, Safety and Radiation Protection Plan		Task 2.2 Field Sampling Plan and Quality Assurance Plan		Task 3.1.1 Gamma Walkover Survey		Task 4 Community Relations Support		Task 5 Technical Support Services		Task 6 Database Development	
URS Item No	Discipline	Rate	Hour	Hours	Raw Cost	Qnty	Cost	Qnty	Cost	Qnty	Cost	Qnty	Cost	Qnty	Cost	Qnty	Cost	Qnty	Cost
1a	Principal/Program Manager	$190.73	hr																
1b	Sr. Technical Reviewer/QA Officer	$125.71	hr																
2	Project Manager	$114.93	hr																
3	Senior Engineer	$ 99.86	hr																
4	Mid-Level Engineer	$ 89.72	hr																
5	Junior Engineer	$ 55.08	hr																
6	Technician	$ 50.29	hr																
7	Senior Scientist	$ 95.04	hr																
8	Mid-Level Scientist	$ 76.02	hr																
9	Junior Scientist	$ 46.39	hr																
10	Chemist	$ 54.59	hr																
11a	Field Geologist	$ 46.80	hr																
11b	Senior Geologist	$ 81.15	hr																
12	Certified Industrial Hygienist	$108.18	hr																
13	Industrial Hygienist	$ 64.97	hr																
14	Certified Health Physicist	$131.84	hr																
15	Health Physicist	$ 82.60	hr																
16	Radiation Control Technician	$ 57.55	hr																
17	Risk Assessor	$191.59	hr																
18	Ecological Risk Specialist	$ 84.86	hr																
19	Environmental Compliance Specialist	$ 90.84	hr																
20	Community Relations Specialist	$ 60.39	hr																
21	Contract Administrator	$ 85.85	hr																
22	Project Controls Analyst	$ 88.22	hr																
23	Cost Estimator	$ 88.72	hr																
24	CADD/Graphics	$ 53.57	hr																
25	GIS Technician	$ 42.73	hr																
26	Technical Writer	$ 56.41	hr																
27	Secretarial/Clerical	$ 34.87	hr																
28	3-Person Topo Crew	$188.45	hr																
29	Drill Rig Equipment Operator	$ -	hr																
30	Laborer	$ -	hr																
Raw Labor					$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -

	TOTALS	Task 1	Task 2.1	Task 2.2	Task 3.1.1	Task 4	Task 5	Task 6
URS Costs Before Profit	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Profit (on labor only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
URS Labor Costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Note: (Loaded labor rates include fringe benefits (30.61%), G&A (%.60%), and overhead (71.85%))

APPENDIX B

PROJECT TEAM QUALIFICATIONS

Project Principal

Mr. Vern Singh, PE has been selected to serve as Project Principal. He has over 33 years of professional engineering experience in environmental engineering, hazardous waste management, and geotechnical/civil engineering in the nuclear and power industry. He has managed numerous USACE, USAF, and radiological waste management projects in New York, Ohio, and other parts of the country. Mr. Singh's project experience extends to 24 states and he holds current professional registration in New York, New Jersey, Kansas, California, and Illinois. He has published numerous articles, chaired technical sessions, and taught graduate courses as an Adjunct Faculty Member at the State University of New York. He is a member of SAME, ADPA, ASCE, and SHSPE.

DO Manager

Mr. Thomas Fralick's (Geology) environmental experience spans a broad range of activities on HTRW projects. He has managed, performed, and/or provided technical review for a wide range of environmental projects including numerous Federal CERCLA and New York State remedial investigations/feasibility studies (RI/FSs). As a senior project manager, Mr. Fralick has extensive experience in design of traditional and emerging remedial technologies. These projects included the HTRW contract with the USACE Baltimore District and the Hunterstown Road Superfund, Fort Drum, and Nike BU 34/35 Missile Battery sites. Over the past 14 years, he has been instrumental in producing high quality documents on numerous URS contracts across the nation.

Health and Safety

Mr. Steven Sherman, CIH is regional Health and Safety Manager for URS. He is a board-certified industrial hygienist with extensive domestic and international experience providing safety and health consulting services to private industry and governmental clients. He began his career in the OSHA Consultation Program in Washington, DC. Mr. Sherman has trained over 2,000 employees under the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) rules and has reviewed over 500 site-specific safety plans. He serves on the Board of Directors of the Western New York Chapter of the American Industrial Hygiene Association.

Health Physics

Mr. William Duggan, CHP, Ph.D., PE (Health Physics) has experience working with radiological and mixed waste issues, including assessment and remediation of contaminated sites. His knowledge of USEPA, DOE, NRC, FUSRAP, and state regulations pertaining to the handling of such wastes has been used in the investigation, remediation, and closure of thorium, radium, and uranium sites in New York, Ohio, and eight other states. Dr. Duggan is also skilled in the assessment of technology implementability and hazard reduction assessments.

Quality Assurance Manager

Mr. James Lanzo, PE will administer the QA program and provide oversight of QA audits. A senior civil engineer with 29 years of involvement with environmental and engineering projects, Mr. Lanzo is well versed in QA/QC issues relevant to remedial investigations, feasibility studies, engineering design, and construction. For the past eight years he has managed remedial investigations, remedial design, and construction projects and has been the Buffalo Office QA manager.

ITR Team

Mr. Duane Lenhardt, Ph.D., CPG (Geology) is a certified professional geologist with over 23 years experience in a wide variety of environmental and civil engineering projects. He has designed and implemented numerous remedial investigations and monitoring programs at a variety of industrial, municipal, and hazardous waste sites. He has played a critical role on several projects requiring evaluation of technically challenging geologic subsurface conditions including the Monroeville and Southern Alleghenies Landfills in Pennsylvania and the Pennsylvania/Fountain Landfill in New York City. Mr. Lenhardt is currently serving as the discipline lead for the Buffalo office geology department.

Gamma Walkover Survey

Mr. Larry Luckett, CHP (Health Physics) has over 30 years experience in the assessment and management of radiological conditions in occupational, environmental, medical and emergency situations in the United States, the Western Pacific, Europe, and the former Soviet Union. He has managed the characterization and remediation of several government and CERCLA sites, including the preparation and implementation of work, quality assurance, and health and safety plans. Currently, he provides project management and radiological consultation for radioactive waste management engineering, environmental risk assessment, siting and licensing projects.

Surveying

Mr. Boddecker has 20 years of experience in the various aspects of land surveying on projects ranging from small residential subdivision lots to large-scale 10,000-acre wood lots. His expertise includes topographic mapping, construction stake-out and as-built surveys.

APPENDIX C

CALCULATION OF SCAN AND STATIC MDCs

CALCULATION OF SCAN AND STATIC MDCs

This appendix provides the results of the calculation of scan and static minimum detectable concentrations (MDCs) for the two sodium iodide (NaI) detectors scheduled for use in the gamma walkover survey at the SLDA site. These two detectors are the Field Instrument for the Detection of Low Energy Radiation (FIDLER) and a 3" by 3" Ludlum 44-20 NaI detector. An approach for calculating scan MDCs is given in Section 6.7.2 of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NRC, et al., 1997), and Section 6.8.2 of NUREG-1507 (NRC 1998). In addition to calculating scan MDCs, calculations of static MDCs (applicable when holding the detector above a contaminated area while standing still) were also performed. The calculation of static MDCs is conceptually the same as for the scan MDCs, but accounts for a different length of time above the contaminated area. The scan MDCs are calculated first using the approach provided in MARSSIM and NUREG-1507, and these results are then modified to calculate the static MDCs.

The first step in estimating the scan MDC is to calculate the gamma fluence rate necessary to yield a given exposure rate (1 μR/hr) as a function of gamma energy. The NaI detector response (in counts per minute [cpm]) can then be related to the fluence rate at specific energies, considering the detector's efficiency (probability of interaction) at each energy. From this relationship, the NaI detector response versus exposure rate for various gamma energies can be determined. Once the relationship between the detector response (in cpm) and exposure rate (in μR/hr) is known, the minimum detectable count rate (MDCR) can be related to the minimum detectable exposure rate (MDER). The MDER is used to determine the minimum detectable concentration, i.e., the scan MDC. The relationship between exposure rate and radionuclide soil concentration is determined by modeling a small area of elevated radioactivity using the computer code Microshield™. This approach is described in greater detail in MARSSIM and NUREG-1507.

This methodology was used by Cabrera Services, Inc. to determine the scan MDCs for processed uranium metal at the DuPont Chambers Works FUSRAP site. These evaluations by Cabrera Services were used as the basis of the calculations given here. Adjustments were made to account for site-specific differences between the DuPont Chambers Works site and the SLDA site, as described in Section 4.8.

Scan MDCs were calculated for seven cases (three for various enrichments of uranium, and for plutonium-239, plutonium-241, americium-241, and thorium-232) for the two detectors. The three uranium cases addressed were for depleted uranium (0.4% uranium-235), low enriched uranium (3% uranium-235), and 10% enriched uranium. The relative activity concentrations of uranium-234, uranium-235, and uranium-238 were obtained from a graph illustrating the activities of these three isotopes as a function of enrichment, and were estimated to be (in the same order given above): 0.38, 0.016, and 0.60 for depleted uranium; 0.75, 0.041, and 0.21 for low enriched uranium; and 0.88, 0.050, and 0.070 for 10% enriched uranium. These values are approximate, but sufficient for use in this calculation. The Microshield™ calculation used 40 years of radioactive decay and ingrowth to account for the time since disposal activities ceased.

C.1 FIDLER MDCs

The scan and static MDCs for the FIDLER were developed using the methodology described above. Factors addressed in this analysis include detector efficiency as a function of gamma energy, surveyor scan efficiency, natural soil background exposure rate in this area, scan rate, detector to source geometry, areal extent and depth of the hot spot being addressed, and energy and yield of the gamma emissions.

The computer code Microshield™ was used to model the presence of 1 pCi/g in soil for each of the seven cases described above with the assumption that the contamination was uniformly distributed to a depth of 15 cm (6 in.) and in a disk-shaped area of 1 m^2 (11 ft^2), or having a diameter of about 1.1 m (43 in.). The contaminated soil is assumed to be present at the surface and was used for both the scan and static MDC calculations. This areal extent and depth of contamination provides a reasonable approximation of the contamination conditions desired to be located by the gamma walkover survey of the site. A thin aluminum shield (having a thickness of 0.051 cm [0.020 in.]) is assumed to be present between the contaminated soil and crystal to simulate the cover of the detector, and the detector is assumed to be located 30 cm (1 ft) above the center of the disk. This model simulates the geometry of the gamma walkover survey and allows for the calculation of the exposure rate (in μR/hr) as a function of gamma energy for the seven cases.

The following sections provide tabulated results for this calculational methodology as applied to the FIDLER NaI detector and follows the approach utilized by Cabrera Services. The relative fluence rate to exposure rate in air (FRER) is first calculated using equation 6-15 in NUREG-1507 (on page 6-20). The FRER values calculated here are relative values and have no particular units associated with it. This equation is given as

$$FRER \sim 1 / (E\gamma)(\mu_{en}/\rho)_{air}$$

where,

$E\gamma$ = energy of the gamma photon, and

$(\mu_{en}/\rho)_{air}$ = the mass energy absorption coefficient for air.

These results are provided in tabular form in Table C.1 below.

Table C.1 Fluence Rate to Exposure Rate (FRER)

Energy (keV)	$(\mu_{en}/\rho)_{air}$, cm^2/g	FRER
15	1.29	0.05168
20	0.516	0.09690
30	0.147	0.22676
40	0.0640	0.39063
50	0.0384	0.52083
60	0.0292	0.57078
80	0.0236	0.52966
100	0.0231	0.43290
150	0.0251	0.26560
200	0.0268	0.18657
300	0.0288	0.11574
400	0.0296	0.08446
500	0.0297	0.06734
600	0.0296	0.05631
662	0.0294	0.05138
800	0.0289	0.04325
1,000	0.0280	0.03571
1,500	0.0255	0.02614
2,000	0.0234	0.02137
3,000	0.0211	0.01580

The probability, P, of a gamma ray interaction in the NaI scintillation crystal entering through the end of the crystal is given by equation 6-16 in NUREG-1507 (on page 6-20) as:

$$P = 1 - e^{-(\mu/\rho)(X)(\rho)}$$

where

(μ/ρ) = the mass attenuation coefficient for NaI,
X = thickness through the thin edge (end facing soil) of the FIDLER NaI crystal, 0.16 cm, and
ρ = density of NaI, 3.67 g/cm^3.

These results are provided in tabular form in Table C.2.

Table C.2 Probability of a Gamma Ray Interaction in the FIDLER Detector

Energy (keV)	(μ/ρ), cm^2/g	P
15	47.4	1.000
20	22.3	1.000
30	7.45	0.9874
40	19.3	1.000
50	10.7	0.9981
60	6.62	0.9795
80	3.12	0.8399
100	1.72	0.6358
150	0.625	0.3072
200	0.334	0.1781
300	0.167	0.0934
400	0.117	0.0664
500	0.0955	0.0545
600	0.0826	0.0473
662	0.0780	0.0448
800	0.0676	0.0389
1,000	0.0586	0.0338
1,500	0.0469	0.0272
2,000	0.0413	0.0240
3,000	0.0367	0.0213

The Relative Detector Response (RDR) by energy is determined by multiplying the relative fluence rate to exposure rate (FRER) by the probability (P) of an interaction as described on the bottom of page 6-20 of NUREG-1507 and is given by:

RDR = FRER (Table A.1) x P (Table A.2)

These results are provided in tabular form in Table C.3.

Table C.3 Relative Detector Response (RDR) for the FIDLER

Energy (keV)	FRER	P	RDR
15	0.05168	1.000	0.05168
20	0.09690	1.000	0.09690
30	0.22676	0.9874	0.22390
40	0.39063	1.000	0.39063
50	0.52083	0.9981	0.51984
60	0.57078	0.9795	0.55908
80	0.52966	0.8399	0.44486
100	0.43290	0.6358	0.27524
150	0.26560	0.3072	0.08159
200	0.18657	0.1781	0.03323
300	0.11574	0.0934	0.01081
400	0.08446	0.0664	0.005608
500	0.06734	0.0545	0.003670
600	0.05631	0.0473	0.002663
662	0.05138	0.0448	0.002302
800	0.04325	0.0389	0.001682
1,000	0.03571	0.0338	0.001207
1,500	0.02614	0.0272	0.0007110
2,000	0.02137	0.0240	0.0005129
3,000	0.01580	0.0213	0.0003365

Included in these three tables are values for FRER, P, and RDR at the cesium-137 gamma energy of 662 keV. Manufacturers typically provide an instrument response in terms of cpm and μR/hr for this energy gamma ray. This point allows for the determination of cpm per μR/hr and ultimately the minimum detection sensitivity level in terms of pCi/g.

Based on measured counts in a known field, it is estimated that a typical FIDLER NaI response is 1,287 cpm per μR/hr for a gamma energy of 662 keV. As shown in Table C.3, the RDR at an energy of 662 keV is 0.002302. The detector response (cpm) to another energy is based upon the ratio of the RDR at that energy to the RDR at 662 keV. That is

$$\text{cpm per } \mu\text{R/hr } (E_i) = (\text{cpm per } \mu\text{R/hr at 662 keV}) \times (\text{RDR at } E_i) / (\text{RDR at 662 keV})$$
$$= (1{,}287) \times (\text{RDR at } E_i) / (0.002302)$$
$$= 559{,}122 \times (\text{RDR at } E_i)$$

Table C.4 provides the cpm per μR/hr at various energies for the FIDLER.

Table C.4 Cpm per μR/hr for the FIDLER

Energy (keV)	RDR	cpm per μR/hr
15	0.05168	28,895
20	0.09690	54,179
30	0.22390	125,187
40	0.39063	218,410
50	0.51984	290,654
60	0.55908	312,594
80	0.44486	248,731
100	0.27524	153,893
150	0.08159	45,619
200	0.03323	18,580
300	0.01081	6,044
400	0.005608	3,136
500	0.003670	2,052
600	0.002663	1,489
662	0.002302	1,287
800	0.001682	940
1,000	0.001207	675
1,500	0.0007110	398
2,000	0.0005129	287
3,000	0.0003365	188

A typical background exposure rate from soil is about 5 μR/hr in an uncontaminated area in the eastern United States when not near granite outcroppings, which is appropriate for the SLDA site. Based on the measured background count rate to exposure rate ratio of 1,287 cpm per μR/hr, a background count rate of 6,435 cpm is calculated.

The count rate to exposure rate ratio for the gamma emissions associated with each of the seven cases is computed using the output of the Microshield™ runs and the count rate to exposure rate ratios from Table C.4. The results of these calculations are provided in Tables C.5 through C.11. The contribution of short-lived decay products (expected to be present with the parent radionuclides based on the 40 years of radioactive decay and ingrowth) is included in these calculations. The weighted cpm per μR/hr column is the product of the fractional exposure rate at that energy and the cpm per μR/hr results from Table C.4.

Table C.5 Count Rate to Exposure Rate for Depleted Uranium for the FIDLER

Energy (keV)	Exposure Rate, µR/hr (with buildup)	cpm/µR/hr	cpm/µR/hr (weighted)	Percent of detector response
15	8.150×10^{-5}	28,895	415	0.73
20	8.995×10^{-11}	54,179	0	0.0
30	8.830×10^{-6}	125,187	195	0.34
40	7.479×10^{-9}	218,410	0	0.0
50	4.285×10^{-6}	290,654	219	0.38
60	3.103×10^{-4}	312,594	17,074	29.92
80	5.945×10^{-5}	248,731	2,603	4.56
100	1.197×10^{-3}	153,893	32,426	56.81
150	1.514×10^{-4}	45,619	1,216	2.13
200	7.666×10^{-4}	18,580	2,507	4.39
300	8.742×10^{-6}	6,044	9	0.016
400	9.612×10^{-6}	3,136	5	0.0088
500	1.715×10^{-5}	2,052	6	0.011
600	8.293×10^{-5}	1,489	22	0.039
800	5.946×10^{-4}	940	98	0.17
1,000	2.310×10^{-3}	675	274	0.48
1,500	6.767×10^{-5}	398	5	0.0088
2,000	1.107×10^{-5}	287	1	0.0018
3,000	-	188	0	0.0
Total	5.681×10^{-3}		57,075	100

Table C.6 Count Rate to Exposure Rate for Low Enriched Uranium for the FIDLER

Energy (keV)	Exposure Rate, μR/hr (with buildup)	cpm/μR/hr	cpm/μR/hr (weighted)	Percent of detector response
15	7.669×10^{-5}	28,895	523	1.08
20	2.305×10^{-10}	54,179	0	0.0
30	2.263×10^{-5}	125,187	668	1.38
40	3.076×10^{-9}	218,410	0	0.0
50	8.459×10^{-6}	290,654	580	1.20
60	1.086×10^{-4}	312,594	8,008	16.55
80	1.113×10^{-4}	248,731	6,531	13.50
100	5.410×10^{-4}	153,893	19,641	40.59
150	3.516×10^{-4}	45,619	3,784	7.82
200	1.930×10^{-3}	18,580	8,459	17.48
300	4.183×10^{-6}	6,044	6	0.012
400	4.013×10^{-6}	3,136	3	0.0062
500	6.020×10^{-6}	2,052	3	0.0062
600	2.924×10^{-5}	1,489	10	0.021
800	2.083×10^{-4}	940	46	0.095
1,000	8.088×10^{-4}	675	129	0.27
1,500	2.387×10^{-5}	398	2	0.0041
2,000	4.195×10^{-6}	287	0	0.0
3,000	-	188	0	0.0
Total	4.239×10^{-3}		48,393	100

Table C.7 Count Rate to Exposure Rate for 10% Enriched Uranium for the FIDLER

Energy (keV)	Exposure Rate, μR/hr (with buildup)	cpm/μR/hr	cpm/μR/hr (weighted)	Percent of detector response
15	7.484×10^{-5}	28,895	581	1.33
20	2.811×10^{-10}	54,179	0	0.0
30	2.760×10^{-5}	125,187	928	2.13
40	1.496×10^{-9}	218,410	0	0.0
50	9.925×10^{-6}	290,654	775	1.78
60	3.622×10^{-5}	312,594	3,041	6.97
80	1.300×10^{-4}	248,731	8,685	19.90
100	3.058×10^{-4}	153,893	12,640	28.96
150	4.237×10^{-4}	45,619	5,192	11.90
200	2.349×10^{-3}	18,580	11,723	26.86
300	2.548×10^{-6}	6,044	4	0.0092
400	2.003×10^{-6}	3,136	2	0.0046
500	2.026×10^{-6}	2,052	1	0.0023
600	9.964×10^{-6}	1,489	4	0.0092
800	6.966×10^{-5}	940	18	0.041
1,000	2.698×10^{-4}	675	49	0.11
1,500	8.143×10^{-6}	398	1	0.0023
2,000	1.726×10^{-6}	287	0	0.0
3,000	-	188	0	0.0
Total	3.723×10^{-3}		43,644	100

Table C.8 Count Rate to Exposure Rate for Thorium-232 for the FIDLER

Energy (keV)	Exposure Rate, μR/hr (with buildup)	cpm/μR/hr	cpm/μR/hr (weighted)	Percent of detector response
15	3.866×10^{-4}	28,895	13	0.26
20	-	54,179	0	0.0
30	-	125,187	0	0.0
40	6.253×10^{-5}	218,410	16	0.33
50	-	290,654	0	0.0
60	9.080×10^{-5}	312,594	33	0.67
80	9.275×10^{-3}	248,731	2,681	54.55
100	2.178×10^{-3}	153,893	389	7.91
150	2.257×10^{-3}	45,619	120	2.44
200	4.084×10^{-2}	18,580	882	17.95
300	3.048×10^{-2}	6,044	214	4.35
400	3.703×10^{-3}	3,136	13	0.26
500	2.687×10^{-2}	2,052	64	1.30
600	7.274×10^{-2}	1,489	126	2.56
800	9.410×10^{-2}	940	103	2.10
1,000	2.095×10^{-1}	675	164	3.34
1,500	6.686×10^{-2}	398	31	0.63
2,000	1.883×10^{-3}	287	1	0.020
3,000	2.994×10^{-1}	188	65	1.32
Total	8.606×10^{-1}		4,915	100

Table C.9 Count Rate to Exposure Rate for Plutonium-239 for the FIDLER

Energy (keV)	Exposure Rate, μR/hr (with buildup)	cpm/μR/hr	cpm/μR/hr (weighted)	Percent of detector response
15	2.105×10^{-5}	28,895	17,009	21.18
20	1.046×10^{-16}	54,179	0	0.0
30	2.172×10^{-11}	125,187	0	0.0
40	2.275×10^{-16}	218,410	0	0.0
50	4.816×10^{-15}	290,654	0	0.0
60	2.472×10^{-12}	312,594	0	0.0
80	1.005×10^{-10}	248,731	1	0.0012
100	1.471×10^{-5}	153,893	63,304	78.82
150	3.321×10^{-10}	45,619	0	0.0
200	1.848×10^{-9}	18,580	1	0.0012
300	4.790×10^{-13}	6,044	0	0.0
400	2.174×10^{-13}	3,136	0	0.0
500	5.055×10^{-15}	2,052	0	0.0
600	1.784×10^{-17}	1,489	0	0.0
800	6.291×10^{-14}	940	0	0.0
1,000	-	675	0	0.0
1,500	-	398	0	0.0
2,000	-	287	0	0.0
3,000	-	188	0	0.0
Total	3.576×10^{-5}		80,315	100

Table C.10 Count Rate to Exposure Rate for Plutonium-241 for the FIDLER

Energy (keV)	Exposure Rate, μR/hr (with buildup)	cpm/μR/hr	cpm/μR/hr (weighted)	Percent of detector response
15	1.309×10^{-20}	28,895	0	0.0
20	-	54,179	0	0.0
30	2.575×10^{-6}	125,187	2,429	0.79
40	3.035×10^{-17}	218,410	0	0.0
50	3.128×10^{-12}	290,654	0	0.00
60	1.301×10^{-4}	312,594	306,469	99.21
80	8.106×10^{-10}	248,731	2	0.00065
100	3.174×10^{-9}	153,893	4	0.0013
150	2.174×10^{-10}	45,619	0	0.0
200	6.606×10^{-11}	18,580	0	0.0
300	1.379×10^{-8}	6,044	1	0.00032
400	1.294×10^{-9}	3,136	0	0.0
500	6.738×10^{-17}	2,052	0	0.0
600	6.819×10^{-18}	1,489	0	0.0
800	2.094×10^{-17}	940	0	0.0
1,000	2.724×10^{-17}	675	0	0.0
1,500	1.698×10^{-16}	398	0	0.0
2,000	-	287	0	0.0
3,000	-	188	0	0.0
Total	1.327×10^{-4}		308,905	100

Table C.11 Count Rate to Exposure Rate for Americium-241 for the FIDLER

Energy (keV)	Exposure Rate, μR/hr (with buildup)	cpm/μR/hr	cpm/μR/hr (weighted)	Percent of detector response
15	2.038×10^{-4}	28,895	1,163	0.39
20	-	54,179	0	0.0
30	9.434×10^{-5}	125,187	2,332	0.78
40	-	218,410	0	0.0
50	-	290,654	0	0.0
60	4.766×10^{-3}	312,594	294,199	98.83
80	-	248,731	0	0.0
100	-	153,893	0	0.0
150	-	45,619	0	0.0
200	-	18,580	0	0.0
300	-	6,044	0	0.0
400	-	3,136	0	0.0
500	-	2,052	0	0.0
600	-	1,489	0	0.0
800	-	940	0	0.0
1,000	-	675	0	0.0
1,500	-	398	0	0.0
2,000	-	287	0	0.0
3,000	-	188	0	0.0
Total	5.064×10^{-3}		297,694	100

C.1.1 Scan MDCs

The scan MDCs for these seven cases were calculated using the NUREG-1507 methodology as described on pages 6-21 through 6-25 of that document. Since the scan rate is projected to be 50 cm/sec and the size of the contaminated area has a diameter of just over 1 m, the detector will be above the contaminated area for about 2 seconds. The number of background counts during this interval (b) can be determined using the background count rate calculated previously (6,435 cpm) as follows:

$$b = 6{,}435 \text{ cpm} \times (1 \text{ min} / 60 \text{ sec}) \times 2 \text{ sec} = 215$$

The minimum detectable count rate (MDCR) is given by

$$MDCR = (d') \times (b)^{0.5} \times (60 / i)$$

where d' is from Table 6.1 of NUREG-1507, and i is the observation interval in seconds. A value of d' of 1.38 is used as it represents a 95% rate of correct detections and a false positive rate of 60%, b is 215, and i is 2 seconds. The MDCR is calculated as

$$MDCR = (1.38) \times (215)^{0.5} \times (60 / 2) = 607 \text{ cpm}$$

The MDCR for the surveyor is given as:

$$MDCR_{surveyor} = MDCR / (p)^{0.5}$$

where p is the surveyor efficiency and ranges from 0.75 to 0.5 as given in NUREG-1507. A value of 0.5 is used in this calculation, as this is a conservative value. Therefore:

$$MDCR_{surveyor} = 607 / (0.5)^{0.5} = 859 \text{ cpm}$$

The minimum detectable exposure rate (MDER) for the surveyor is obtained by dividing the $MDCR_{surveyor}$ by the weighted count rate to exposure rate for each of the seven cases given in Tables C.5 to C.11. For depleted uranium, this is:

$$MDER_{surveyor} = (859 \text{ cpm}) / (57{,}075 \text{ cpm}/\mu R/hr) = .01505 \ \mu R/hr$$

The scan MDC is then equal to the ratio of the minimum detectable exposure rate in the field to the exposure rate determined for the normalized (1 pCi/g) concentration of each case. For depleted uranium, this is:

$$\text{Scan MDC} = (1 \text{ pCi/g}) \times (MDER_{surveyor}) / (\text{Microshield}^{TM} \text{ exposure rate})$$

or

$$\text{Scan MDC} = (1 \text{ pCi/g}) \times (0.01505 \ \mu R/hr) / (0.005681 \ \mu R/hr) = 2.6 \text{ pCi/g}$$

This calculation was performed for each of the other six cases and the results are provided in Table C.12.

C.1.2 Static MDCs

The static MDCs for these seven cases are calculated in a similar manner, with the time above the contaminated area increased from 2 seconds to 1 minute. In addition, since the detector is held in place while this measurement is taking place, the surveyor efficiency is set at 1, and the value of d' is modified to reduce the false positive rate from 60% to 5%. This calculation is as follows.

The number of background counts during the counting interval of 1 minute (b) is calculated to be:

$$b = 6{,}435 \text{ cpm} \times 1 \text{ min} = 6{,}435$$

Following the same procedure as before, the minimum detectable count rate (MDCR) is given by:

$$MDCR = (d') \times (b)^{0.5} \times (60 / i)$$

where d' is 3.28, b is 6,435, and i is 60. This value of d' is taken from Table 6.1 of NUREG-1507, and it represents a 95% rate of correct detections and a false positive rate of 5%. The MDCR is calculated as:

$$MDCR = (3.28) \times (6{,}435)^{0.5} \times (60 / 60) = 263 \text{ cpm}$$

The MDCR for the surveyor is given as:

$$MDCR_{surveyor} = MDCR / (p)^{0.5}$$

Using a value of 1 for p (since the detector is stationary) gives:

$$MDCR_{surveyor} = 263 / (1)^{0.5} = 263 \text{ cpm}$$

The minimum detectable exposure rate (MDER) for the surveyor is obtained by dividing the $MDCR_{surveyor}$ by the weighted count rate to exposure rate for each of the seven cases given in Tables C.5 to C.11. For depleted uranium, this is

$$MDER_{surveyor} = (263 \text{ cpm}) / (57{,}075 \text{ cpm}/\mu R/hr) = 0.004608 \ \mu R/hr$$

The static MDC is then equal to the ratio of the minimum detectable exposure rate in the field to the exposure rate determined for the normalized (1 pCi/g) concentration of each case. For depleted uranium, this is

$$\text{Static MDC} = (1 \text{ pCi/g}) \times (MDER_{surveyor}) / (\text{Microshield}^{TM} \text{ exposure rate})$$

or

$$\text{Static MDC} = (1 \text{ pCi/g}) \times (0.004608 \ \mu R/hr) / (0.005681 \ \mu R/hr) = 0.81 \text{ pCi/g}$$

This calculation was performed for each of the other six cases and the results are provided in Table C.12.

Table C.12 Scan and Static MDCs for the FIDLER

Case	Scan MDC (pCi/g)	Static MDC (pCi/g)
Depleted Uranium	2.6	0.81
Low Enriched Uranium	4.2	1.3
10% Enriched Uranium	5.3	1.6
Thorium-232	0.20	0.062
Plutonium-239	300	91
Plutonium-241	21	6.4
Americium-241	0.57	0.17

C.2 3" by 3" NaI MDCs

The calculation of the scan and static MDCs was repeated for the 3" by 3" Ludlum 44-20 NaI detector. Since the calculation follows the same approach as that for the FIDLER, some of the narrative describing the various steps is not repeated here. In addition, the first step in this calculation, i.e., determining the relative fluence rate to exposure rate in air (FRER), is the same as that for the FIDLER (see the results given in Table C.1).

The calculation of the probability, P, of a gamma ray interaction in the NaI scintillation crystal is the same as for the FIDLER, except that the thickness of the crystal is 7.62 cm (3 in.). The results of this calculation are provided in tabular form in Table C.13.

Table C.13 Probability of a Gamma Ray Interaction in the 3" by 3" NaI Detector

Energy (keV)	(μ/ρ), cm²/g	P
15	47.4	1.000
20	22.3	1.000
30	7.45	1.000
40	19.3	1.000
50	10.7	1.000
60	6.62	1.000
80	3.12	1.000
100	1.72	1.000
150	0.625	1.000
200	0.334	0.9999
300	0.167	0.9906
400	0.117	0.9621
500	0.0955	0.9308
600	0.0826	0.9007
662	0.0780	0.8871
800	0.0676	0.8490
1,000	0.0586	0.8058
1,500	0.0469	0.7306
2,000	0.0413	0.6849
3,000	0.0367	0.6416

As before, the Relative Detector Response (RDR) is given as the product of the FRER from Table C.1 and the probability (P) of an interaction from Table C.13. These results are provided in Table C.14.

Table C.14 Relative Detector Response (RDR) for the 3" by 3" NaI Detector

Energy (keV)	FRER	P	RDR
15	0.05168	1.000	0.05168
20	0.09690	1.000	0.09690
30	0.22676	1.000	0.22676
40	0.39063	1.000	0.39063
50	0.52083	1.000	0.52083
60	0.57078	1.000	0.57078
80	0.52966	1.000	0.52966
100	0.43290	1.000	0.43290
150	0.26560	1.000	0.26560
200	0.18657	0.9999	0.18655
300	0.11574	0.9906	0.11465
400	0.08446	0.9621	0.08126
500	0.06734	0.9308	0.06268
600	0.05631	0.9007	0.05072
662	0.05138	0.8871	0.04558
800	0.04325	0.8490	0.03672
1,000	0.03571	0.8058	0.02878
1,500	0.02614	0.7306	0.01910
2,000	0.02137	0.6849	0.01464
3,000	0.01580	0.6416	0.01014

As in the analysis performed for the FIDLER, included in these three tables are values of FRER, P, and RDR at the cesium-137 gamma energy of 662 keV, since manufacturers typically provide an instrument response in terms of cpm and μR/hr at this gamma energy. This point allows for the determination of the cpm per μR/hr and ultimately the minimum detection sensitivity level in terms of pCi/g.

Based on the manufacturer's 3" by 3" NaI response for the Ludlum 44-20 detector, a value of 2,700 cpm per μR/hr can be used for this calculation. As shown in Table C.11, the RDR at an energy of 662 keV is 0.04558. The detector response (cpm) to another energy is based upon the ratio of the RDR at that energy to the RDR at 667 keV. That is:

$$\text{cpm per } \mu\text{R/hr } (E_i) = (\text{cpm per } \mu\text{R/hr at 662 keV}) \times (\text{RDR at } E_i) / (\text{RDR at 662 keV})$$
$$= (2{,}700) \times (\text{RDR at } E_i) / (0.04558)$$
$$= 59{,}237 \times (\text{RDR at } E_i)$$

Table C.15 provides the cpm per µR/hr at various energies for the 3" by 3" NaI detector.

Table C.15 Cpm per µR/hr for the 3" by 3" NaI Detector

Energy (keV)	RDR	cpm per µR/hr
15	0.05168	3,061
20	0.09690	5,740
30	0.22676	13,433
40	0.39063	23,140
50	0.52083	30,852
60	0.57078	33,811
80	0.52966	31,375
100	0.43290	25,644
150	0.26560	15,733
200	0.18655	11,051
300	0.11465	6,792
400	0.08126	4,814
500	0.06268	3,713
600	0.05072	3,005
662	0.04558	2,700
800	0.03672	2,175
1,000	0.02878	1,705
1,500	0.01910	1,131
2,000	0.01464	867
3,000	0.01014	601

As noted previously, a typical background exposure rate from soil is about 5 µR/hr in an uncontaminated area in the eastern United States when not near granite outcroppings, which is appropriate for the SLDA site. Based on the measured background count rate to exposure rate ratio of 2,700 cpm per µR/hr, a background count rate of 13,500 cpm is calculated.

As in the previous evaluation of the FIDLER, the count rate to exposure rate ratio for the gamma emissions associated with each of the seven cases is computed using the output of the

Microshield™ runs and the count rate to exposure rate ratios from Table C.15. The results of these calculations are provided in Tables C.16 through C.22. The contribution of short-lived decay products (expected to be present with the parent radionuclides based on the 40 years of radioactive decay and ingrowth) is included in these calculations. The weighted cpm per µR/hr column is the product of the fractional exposure rate at that energy and the cpm per µR/hr results from Table C.15.

Table C.16 Count Rate to Exposure Rate for Depleted Uranium for the 3" by 3" NaI Detector

Energy (keV)	Exposure Rate, µR/hr (with buildup)	cpm/µR/hr	cpm/µR/hr (weighted)	Percent of detector response
15	8.150×10^{-5}	3,061	44	0.42
20	8.995×10^{-11}	5,740	0	0.0
30	8.830×10^{-6}	13,433	21	0.20
40	7.479×10^{-9}	23,140	0	0.0
50	4.285×10^{-6}	30,852	23	0.22
60	3.103×10^{-4}	33,811	1,847	17.45
80	5.945×10^{-5}	31,375	328	3.10
100	1.197×10^{-3}	25,644	5,403	51.04
150	1.514×10^{-4}	15,733	419	3.96
200	7.666×10^{-4}	11,051	1,491	14.09
300	8.742×10^{-6}	6,792	10	0.094
400	9.612×10^{-6}	4,814	8	0.076
500	1.715×10^{-5}	3,713	11	0.10
600	8.293×10^{-5}	3,005	44	0.42
800	5.946×10^{-4}	2,175	228	2.15
1,000	2.310×10^{-3}	1,705	693	6.55
1,500	6.767×10^{-5}	1,131	13	0.12
2,000	1.107×10^{-5}	867	2	0.019
3,000	-	601	0	0.0
Total	5.681×10^{-3}		10,585	100

Table C.17 Count Rate to Exposure Rate for Low Enriched Uranium for the 3" by 3" NaI Detector

Energy (keV)	Exposure Rate, μR/hr (with buildup)	cpm/μR/hr	cpm/μR/hr (weighted)	Percent of detector response
15	7.669×10^{-5}	3,061	55	0.46
20	2.305×10^{-10}	5,740	0	0.0
30	2.263×10^{-5}	13,433	72	0.60
40	3.076×10^{-9}	23,140	0	0.0
50	8.459×10^{-6}	30,852	62	0.52
60	1.086×10^{-4}	33,811	866	7.24
80	1.113×10^{-4}	31,375	824	6.89
100	5.410×10^{-4}	25,644	3,273	27.35
150	3.516×10^{-4}	15,733	1,305	10.91
200	1.930×10^{-3}	11,051	5,031	42.05
300	4.183×10^{-6}	6,792	7	0.059
400	4.013×10^{-6}	4,814	5	0.042
500	6.020×10^{-6}	3,713	5	0.042
600	2.924×10^{-5}	3,005	21	0.18
800	2.083×10^{-4}	2,175	107	0.89
1,000	8.088×10^{-4}	1,705	325	2.72
1,500	2.387×10^{-5}	1,131	6	0.050
2,000	4.195×10^{-6}	867	1	0.0084
3,000	-	601	0	0.0
Total	4.239×10^{-3}		11,965	100

Table C.18 Count Rate to Exposure Rate for 10% Enriched Uranium for the 3" by 3" NaI Detector

Energy (keV)	Exposure Rate, μR/hr (with buildup)	cpm/μR/hr	cpm/μR/hr (weighted)	Percent of detector response
15	7.484×10^{-5}	3,061	62	0.49
20	2.811×10^{-10}	5,740	0	0.0
30	2.760×10^{-5}	13,433	100	0.79
40	1.496×10^{-9}	23,140	0	0.0
50	9.925×10^{-6}	30,852	82	0.64
60	3.622×10^{-5}	33,811	329	2.59
80	1.300×10^{-4}	31,375	1,096	8.61
100	3.058×10^{-4}	25,644	2,106	16.55
150	4.237×10^{-4}	15,733	1,791	14.08
200	2.349×10^{-3}	11,051	6,973	54.80
300	2.548×10^{-6}	6,792	5	0.039
400	2.003×10^{-6}	4,814	3	0.024
500	2.026×10^{-6}	3,713	2	0.016
600	9.964×10^{-6}	3,005	8	0.063
800	6.966×10^{-5}	2,175	41	0.32
1,000	2.698×10^{-4}	1,705	124	0.97
1,500	8.143×10^{-6}	1,131	2	0.016
2,000	1.726×10^{-6}	867	0	0.0
3,000	-	601	0	0.0
Total	3.723×10^{-3}		12,724	100

Table C.19 Count Rate to Exposure Rate for Thorium-232 for the 3" by 3" NaI Detector

Energy (keV)	Exposure Rate, µR/hr (with buildup)	cpm/µR/hr	cpm/µR/hr (weighted)	Percent of detector response
15	3.866×10^{-4}	3,061	1	0.039
20	-	5,740	0	0.0
30	-	13,433	0	0.0
40	6.253×10^{-5}	23,140	2	0.078
50	-	30,852	0	0.0
60	9.080×10^{-5}	33,811	4	0.16
80	9.275×10^{-3}	31,375	338	13.21
100	2.178×10^{-3}	25,644	65	2.54
150	2.257×10^{-3}	15,733	41	1.60
200	4.084×10^{-2}	11,051	524	20.48
300	3.048×10^{-2}	6,792	241	9.42
400	3.703×10^{-3}	4,814	21	0.82
500	2.687×10^{-2}	3,713	116	4.53
600	7.274×10^{-2}	3,005	254	9.93
800	9.410×10^{-2}	2,175	238	9.30
1,000	2.095×10^{-1}	1,705	415	16.22
1,500	6.686×10^{-2}	1,131	88	3.44
2,000	1.883×10^{-3}	867	2	0.078
3,000	2.994×10^{-1}	601	209	8.17
Total	8.606×10^{-1}		2,559	100

Table C.20 Count Rate to Exposure Rate for Plutonium-239 for the 3" by 3" NaI Detector

Energy (keV)	Exposure Rate, μR/hr (with buildup)	cpm/μR/hr	cpm/μR/hr (weighted)	Percent of detector response
15	2.105×10^{-5}	3,061	1,802	14.59
20	1.046×10^{-16}	5,740	0	0.0
30	2.172×10^{-11}	13,433	0	0.0
40	2.275×10^{-16}	23,140	0	0.0
50	4.816×10^{-15}	30,852	0	0.0
60	2.472×10^{-12}	33,811	0	0.0
80	1.005×10^{-10}	31,375	0	0.0
100	1.471×10^{-5}	25,644	10,549	85.40
150	3.321×10^{-10}	15,733	0	0.0
200	1.848×10^{-9}	11,051	1	0.0081
300	4.790×10^{-13}	6,792	0	0.0
400	2.174×10^{-13}	4,814	0	0.0
500	5.055×10^{-15}	3,713	0	0.0
600	1.784×10^{-17}	3,005	0	0.0
800	6.291×10^{-14}	2,175	0	0.0
1,000	-	1,705	0	0.0
1,500	-	1,131	0	0.0
2,000	-	867	0	0.0
3,000	-	601	0	0.0
Total	3.576×10^{-5}		12,352	100

Table C.21 Count Rate to Exposure Rate for Plutonium-241 for the 3" by 3" NaI Detector

Energy (keV)	Exposure Rate, µR/hr (with buildup)	cpm/µR/hr	cpm/µR/hr (weighted)	Percent of detector response
15	1.309×10^{-20}	3,061	0	0.0
20	-	5,740	0	0.0
30	2.575×10^{-6}	13,433	261	0.78
40	3.035×10^{-17}	23,140	0	0.0
50	3.128×10^{-12}	30,852	0	0.0
60	1.301×10^{-4}	33,811	33,149	99.21
80	8.106×10^{-10}	31,375	0	0.0
100	3.174×10^{-9}	25,644	1	0.0030
150	2.174×10^{-10}	15,733	0	0.0
200	6.606×10^{-11}	11,051	0	0.0
300	1.379×10^{-8}	6,792	1	0.0030
400	1.294×10^{-9}	4,814	0	0.0
500	6.738×10^{-17}	3,713	0	0.0
600	6.819×10^{-18}	3,005	0	0.0
800	2.094×10^{-17}	2,175	0	0.0
1,000	2.724×10^{-17}	1,705	0	0.0
1,500	1.698×10^{-16}	1,131	0	0.0
2,000	-	867	0	0.0
3,000	-	601	0	0.0
Total	1.327×10^{-4}		33,412	100

Table C.22 Count Rate to Exposure Rate for Americium-241 for the 3" by 3" NaI Detector

Energy (keV)	Exposure Rate, µR/hr (with buildup)	Cpm/µR/hr	cpm/µR/hr (weighted)	Percent of detector response
15	2.038×10^{-4}	3,061	123	0.38
20	-	5,740	0	0.0
30	9.434×10^{-5}	13,433	250	0.78
40	-	23,140	0	0.0
50	-	30,852	0	0.0
60	4.766×10^{-3}	33,811	31,821	98.84
80	-	31,375	0	0.0
100	-	25,644	0	0.0
150	-	15,733	0	0.0
200	-	11,051	0	0.0
300	-	6,792	0	0.0
400	-	4,814	0	0.0
500	-	3,713	0	0.0
600	-	3,005	0	0.0
800	-	2,175	0	0.0
1,000	-	1,705	0	0.0
1,500	-	1,131	0	0.0
2,000	-	867	0	0.0
3,000	-	601	0	0.0
Total	5.064×10^{-3}		32,194	100

C.2.1 Scan MDCs

As for the FIDLER evaluation, the scan MDCs for these seven cases were calculated using the NUREG-1507 methodology. Since the scan rate is projected to be 50 cm/sec and the size of the contaminated area has a diameter of just over 1 m, the detector will be above the contaminated area for about 2 seconds. The number of background counts during this interval (b) can be determined using the background count rate calculated previously (13,500 cpm) as follows:

$$b = 13{,}500 \text{ cpm} \times (1 \text{ min}/60 \text{ sec}) \times 2 \text{ sec} = 450$$

The minimum detectable count rate (MDCR) is given by:

$$MDCR = (d') \times (b)^{0.5} \times (60 / i)$$

where d' is taken from Table 6.1 of NUREG-1507 and i is the observation interval in seconds. A value of d' of 1.38 is used as it represents a 95% rate of correct detections and a false positive rate of 60%, b is 450, and i is 2. The MDCR is calculated as:

$$MDCR = (1.38) \times (450)^{0.5} \times (60 / 2) = 878 \text{ cpm}$$

The MDCR for the surveyor is given as:

$$MDCR_{surveyor} = MDCR / (p)^{0.5}$$

where p is the surveyor efficiency and ranges from 0.75 to 0.5. A value of 0.5 is used in this calculation, as this is a conservative value. This gives:

$$MDCR_{surveyor} = 878 / (0.5)^{0.5} = 1{,}242 \text{ cpm}$$

The minimum detectable exposure rate (MDER) for the surveyor is obtained by dividing the $MDCR_{surveyor}$ by the weighted count rate to exposure rate for each of the seven cases given in Tables C.16 to C.22. For depleted uranium, this is:

$$MDER_{surveyor} = (1{,}242 \text{ cpm}) / (10{,}585 \text{ cpm}/\mu R/hr) = 0.1173\ \mu R/hr$$

The scan MDC is then equal to the ratio of the minimum detectable exposure rate in the field to the exposure rate determined for the normalized (1 pCi/g) concentration of each case. For depleted uranium, this is:

$$\text{Scan MDC} = (1 \text{ pCi/g}) \times (MDER_{surveyor}) / (\text{Microshield}^{TM} \text{ exposure rate})$$

or

$$\text{Scan MDC} = (1\ \rho Ci/g) \times (0.1173\ \mu R/hr) / (0.005681\ \mu R/hr) = 21 \text{ pCi/g}$$

This calculation was performed for each of the other six cases and the results are provided in Table C.23.

C.2.2 Static MDCs

The static MDCs for these seven cases are calculated in a similar manner as that for scan MDCs, with the time above the contaminated area increased from 2 seconds to 1 minute, the surveyor efficiency set at 1, and the value of d' modified to reduce the false positive rate from 60% to 5%. The number of background counts during the counting interval of 1 minute (b) is calculated to be:

$$b = 13{,}500 \text{ cpm} \times 1 \text{ min} = 13{,}500$$

Following the same procedure as before, the minimum detectable count rate (MDCR) is given by:

$$MDCR = (d') \times (b)^{0.5} \times (60 / i)$$

where d' is taken to be 3.28, b is 13,500, and i is 60. This value of d' is from Table 6.1 of NUREG-1507, and it represents a 95% rate of correct detections and a false positive rate of 5%. The MDCR is calculated as:

$$MDCR = (3.28) \times (13{,}500)^{0.5} \times (60 / 60) = 381 \text{ cpm}$$

The MDCR for the surveyor is given as:

$$MDCR_{surveyor} = MDCR / (p)^{0.5}$$

Using a value of 1 for p (since the detector is stationary) gives:

$$MDCR_{surveyor} = 381 / (1)^{0.5} = 381 \text{ cpm}$$

The minimum detectable exposure rate (MDER) for the surveyor is obtained by dividing the $MDCR_{surveyor}$ by the weighted count rate to exposure rate for each of the seven cases given in Tables C.16 to C.22. For depleted uranium, this is:

$$MDER_{surveyor} = (381 \text{ cpm}) / (10{,}585 \text{ cpm } \mu R/hr) = 0.03599 \ \mu R/hr$$

The static MDC is then equal to the ratio of the minimum detectable exposure rate in the field to the exposure rate determined for the normalized (1 pCi/g) concentration of each case. For depleted uranium, this is:

$$\text{Static MDC} = (1 \text{ pCi/g}) \times (MDER_{surveyor}) / (\text{Microshield}^{TM} \text{ exposure rate})$$

or

$$\text{Static MDC} = (1 \text{ pCi/g}) \times (0.03599 \ \mu R/hr) / (0.005681 \ \mu R/hr) = 6.3 \text{ pCi/g}$$

This calculation was performed for each of the other six cases and the results are provided in Table C.23.

Table C.23 Scan and Static MDCs for the 3" by 3" NaI Detector

Case	Scan MDC (pCi/g)	Static MDC (pCi/g)
Depleted Uranium	21	6.3
Low Enriched Uranium	24	7.5
10% Enriched Uranium	26	8.0
Thorium-232	0.56	0.17
Plutonium-239	2,800	860
Plutonium-241	280	86
Americium-241	7.6	2.3

References

NRC 1998, *Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, NUREG-1507, prepared by E.W. Abelquist, W.S. Brown, G.E. Powers, and A.M. Huffert, Division of Regulatory Applications, Office of Nuclear Regulatory Research, Washington, D.C. June.

NRC, et al., 1997, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, EPA 402-R-97-016, prepared by U.S. Department of Defense, U.S. Department of Energy, U.S. Environmental Protection Agency, and U.S. Nuclear Regulatory Commission, Washington, D.C. December.

APPENDIX D

FIELD DOCUMENTATION FORMS

URS

Parks Township SLDA Gamma Survey

GAMMA SURVEY DATA

	Grid Location	Reading (cpm)	Instr code	Bkg cpm	Date	Surveyed By (initials)	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Manager Approval

PROJECT____________________
PROJECT No.____________________
URS JOB No.____________________
BY____________________

URS
282 Delaware Avenue
Buffalo, New York 14202
(716) 856-5636

PHOTO LOG

PHOTO & ROLL No.	DATE TAKEN	DIRECTION FACING	DESCRIPTION

URSF-016/1 OF 1/GPL

URS

282 Delaware Avenue
Buffalo, New York 14202
(716)856-5636

DATE ____________

DAY	S	M	T	W	TH	F	S

WEATHER	Bright Sun	Clear	Overcast	Rain	Snow
TEMP	To 32	32-50	50-70	70-85	85 up
WIND	Still	Moder	High	Report No.	
HUMIDITY	Dry	Moder	Humid		

PROJECT MANAGER ____________

PROJECT ____________

JOB No. ____________

CONTRACT No. ____________

SUB-CONTRACTORS ON SITE:

EQUIPMENT ON SITE:

WORK PERFORMED (INCLUDING SAMPLING):

SHEET ______ OF ______

DAILY QUALITY CONTROL REPORT

URSF-003/1 OF 2/DQCREP

PROJECT ____________________ REPORT No. __________

JOB No. ____________________ DATE __________

QUALITY CONTROL ACTIVITIES (INCLUDING FIELD CALIBRATIONS):

HEALTH AND SAFETY LEVELS AND ACTIVITIES:

PROBLEMS ENCOUNTERED/CORRECTION ACTION TAKEN:

SPECIAL NOTES:

TOMORROW'S EXPECTATIONS:

BY __________ TITLE __________

URSF-003/2 OF 2/DQCREP

APPENDIX E

FIELD INSTRUMENTATION EQUIPMENT, CALIBRATION, AND OPERATIONAL PROCEDURES

The information included in Appendix E describes the instruments that are expected to be used for the field survey. While different, but equivalent, instruments may ultimately be used for the actual field survey, the operation of such instruments would be the same or similar to the operation of the instruments described below.

E-1.0 LUDLUM MODEL 2221 PORTABLE SCALER/RATEMETER / MODEL 44-10 2x2 NaI RADIATION DETECTOR / MODEL 44-20 3x3 NaI RADIATION DETECTOR/FIELD INSTRUMENT FOR DETECTING LOW ENERGY RADIATION (FIDLER)

Instrument Description

The Ludlum Model 2221 Portable Scaler Ratemeter is a self-contained counting instrument designed for operation with scintillation, proportional or G-M detectors. Power is derived from 4 "D" cell batteries. The unit contains a pre-amplifier, linear amplifier, electronic timer, detector high voltage power supply and detector overload detection circuitry.

A single channel analyzer is also featured in this unit for use in gamma spectrum analysis. The analyzer may be switched on or off, allowing gross or window counting.

The unit has a combination four decade linear and log ratemeter and a six digit liquid crystal display (LCD) readout for the scaler and digital ratemeter. Potentiometers are supplied for threshold, window and high-voltage controls.

The Ludlum Model 44-10 Gamma Scintillator is a 2" X 2" NaI scintillator coupled to a 2" diameter magnetically shielded photmultiplier. This unit is attached to the model 2221 via a series "C" connector. The Ludlum Model 44-20 Gamma Scintillator is similar to the 44-10, but is a 3" X 3" NaI scintillator.

The FIDLER (Field Instrument for Detecting Low Energy Radiation) is a NaI detector specifically designed for detecting radiation in the 10 to 100 keV range (approximately). The NaI crystal is about 12.7 cm in diameter and 0.16 cm thick. The thin geometry allows the crystal to detect low energy gamma rays with reasonable efficiency while most of the higher energy gamma rays pass through the crystal undetected. The thin (0.03 cm) beryllium window of the FIDLER probe means that it must be handled in the field with greater care than the other scintillation probes to prevent damage from grass, twigs, or other surface protrusions. In other respects, the FIDLER probe is similar to the other scintillation probes, including its calibration and operating procedures, which are described below.

E-1.1 Calibration Procedure

The ratemeter and scintillator will be calibrated by the instrument supplier according to the manufacturer's specifications. All relevant calibration parameters will be supplied with the instrument so that they can be verified during daily operational checks.

E-1.1.1 Pre-Operational Tests

1. Press the following "TEST" buttons. Compare the values to those supplied by the vendor to ensure that the instrument settings are within specifications:

- "BATTERY" test button (minimum voltage is 4.4 volts);
- "HIGH VOLTAGE" test button;
- "THRESHOLD" test button; and
- "WINDOW" test button.

E-1.1.2 Daily Response Checks

For each instrument, a daily response check will be performed. This check will involve using an appropriate radiation source (type and energy of emission) in a repeatable geometry to take a measurement. The results will be recorded on a separate table for each instrument and will be plotted to observe trends and out of range (± 26) readings.

E-1.2 Startup and Use Procedure

1. Switch "POWER" ON/OFF toggle to the ON position.
2. Switch "RESPONSE" toggle to F (fast).

3. Press "ZERO" button (this zeros the display).
4. Switch "DIGITAL CONTROL" toggle to "DIGITAL RATEMETER" mode for scanning walkover. ("SCALER" mode may be used for static timed counts when areas of elevated activity are encountered).
5. Select the appropriate "RATEMETER" range.
6. Switch "WINDOW" toggle to the OUT position.
7. Switch "LAMP" toggle to appropriate position. (Do not use the lamp unnecessarily as it causes voltage drain).
8. Select the appropriate "AUDIO DIVIDE" setting.

E-1.3 <u>Shutdown Procedure</u>

1. Toggle "POWER" switch to the OFF position.
2. Toggle "LAMP" switch to the OFF position.
3. Avoid storing the instrument in extreme temperatures (high or low) as it will take additional time prior to subsequent use to get the instrument within the proper operating temperature range.

E-2.0 LUDLUM MODEL 3 SURVEY METER / MODEL 43-5 SCINTILLATOR PROBE/ MODEL 44-9 G-M DETECTOR

The Ludlum Model 3 is a portable radiation survey instrument with four linear ranges used in combination with exposure rate or counts per minute meter dials. The instrument features a regulated high-voltage power supply, speaker with audio ON-OFF capability, fast-slow meter response, meter reset button and a six-position switch for selecting battery check or scale multiples of X0.1, X1, X10 and X100. Each range multiplier has its own calibration potentiometer. The unit body and meter housing are made of cast aluminum.

Any Ludlum Geiger-Mueller probe (e.g., model 44-9) will operate on this unit as well as many scintillation type detectors (e.g., model 43-5). The instrument may be adjusted for operation with both a G-M and scintillator detectors that operate from 400-1500 volts. The unit is operated with two "D" cell batteries.

E-2.1 Calibration Procedure

The instrument and detectors will be calibrated by the instrument supplier according to the manufacturer's specifications. All relevant calibration parameters will be supplied with the instrument so that they can be verified during daily operational checks.

E-2.1.1 Pre-Operational Tests

1. Battery Check: Move the range switch to the "BAT" position. The meter should deflect to the battery check portion of the meter scale. If the meter does not respond, recheck that the batteries have been installed properly, or replace the batteries.
2. Source Check: Turn the instrument range switch to the X100 position. Expose the detector to a check source. The speaker should click with the AUDIO ON–OFF switch in the ON position. Move the range switch through the lower scales until a meter reading is indicated. The toggle switch labeled F-S should have a fast response in "F" and a slow response in "S". Depress the RESET button. The meter should zero.

E-2.1.2 Daily Response Checks

For each instrument, a daily response check will be performed. This check will involve using an appropriate radiation source (type and energy of emission) in a repeatable geometry to take a measurement. The results will be recorded on a separate table for each instrument and will be plotted to observe trends and out of range (± 26) readings.

E-2.2 Startup and Use Procedure

1. Select and connect the appropriate probe. Inspect the probe and connecting cable for physical damage.
2. Switch the range dial to the appropriate multiplier (if you are unsure of the approximate range setting for the material to be surveyed, start with the X100 scale and switch downward, while scanning, until a meter reading is obtained).
3. Select the appropriate "RESPONSE" (fast or slow, depending on use and probe).
4. Press "ZERO" button as necessary to zero the meter between readings.

E-2.3 Shutdown Procedure

1. Switch "POWER" dial to the OFF position.
2. Avoid storing the instrument in extreme temperatures (high or low) as it will take additional time prior to subsequent use to get the instrument within the proper operating temperature range.

E3.0 LAND SURVEYING EQUIPMENT CALIBRATION

E-3.1 Total Stations Topcon Model 700 & 701

E-3.1.1 Calibration Procedure:

Calibration for this equipment is performed on a National Oceanic and Atmospheric Administration (NOAA) calibration baseline established by the National Geodetic Survey (NGS). These baselines have published data that can be obtained from the NOAA website and are placed around the country. Calibration of this equipment takes place twice a year with additional checks if equipment experiences some fault.

E-3.1.2 Method:

- Instrument optical plumit is checked and adjusted as necessary per manufactures prescribed methods.
- Level bubbles are checked and adjusted as necessary per manufactures prescribed methods.
- Instrument is set up on one of the monuments of the calibration baseline and proper atmospheric and prism constants are entered into the instrument.
- Distances are measured to the other baseline monuments to fixed prisms mounted on adjusted tribrachs and tripods.
- Distances are recorded for each station and compared against record distances.
- The instrument is then set on one of the intermediate monuments and the procedure is carried out again.

The results are checked against the known values and analyzed to reflect if instrument is operating within the manufactures stated specifications. If the instrument fails this test, the procedure is re-run to eliminate blunders. If the instrument still fails this calibration test, it is sent to the manufacture for repairs.

E-3.2 Automatic Levels

E-3.2.1 Calibration Procedure:

- This instrument is calibrated and adjusted by using the manufactures stated procedures by a standard peg-test. This is accomplished by accurately measuring the difference in elevation between two points approximately 61 meters (200 feet) apart with the level set in the middle of both objects.
- Secondly, the difference is then measured with the level set approximately 3.0 meters (10 feet) away from one of the points.
- The two resulting differences in elevation are compared and if no difference is found the instrument is in calibration. If results indicate an out of calibration situation the level is adjusted in its current location per the manufactures specifications.
- Once any adjustment has been made, the procedure is re-run and results recorded.

E-3.3 GPS Equipment

E-3.3.1 Calibration Procedure:

- The basic calibration test for this is repeatability of results compared against NGS established points. This is accomplished within an area that multiple know coordinate points exist that have been established by NGS. The instruments can be used to measure the location of known points from other known points and the results compared with the record information. The results are then compared with the manufactures specifications for compliance. If the results indicate some error, the test will be rerun and if error still exists it is sent to the manufacturer for repair and calibration.

FINAL

GAMMA WALKOVER SURVEY
SAMPLING AND ANALYSIS PLAN

PART II –QUALITY ASSURANCE PROJECT PLAN

SHALLOW LAND DISPOSAL AREA (SLDA) SITE
PARKS TOWNSHIP, ARMSTRONG COUNTY, PENNSYLVANIA

USACE CONTRACT NO. DACW49-01-D-0001
DELIVERY ORDER NO. 0010

Prepared for:

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207-3199

Prepared by:

URS CORPORATION
282 DELAWARE AVENUE
BUFFALO, NEW YORK 14202

APRIL 21, 2003

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

FIGURES

APPENDIX

ACRONYMS

DCGL	Derived Concentration Guideline Level
D.O.	Delivery Order
DQO	Data Quality Objective
DQCR	Data Quality Control Report
FSP	Field Sampling Plan
FUSRAP	Formerly Utilized Sites Remedial Action Program
GIS	Geographic Imaging System
GPS	Global Positioning System
MDC	Minimum Detectable Concentration
MDL	Method Detection Limit
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NRC	Nuclear Regulatory Commission
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QCSR	Quality Control Summary Report
RI	Remedial Investigation
SLDA	Shallow Land Disposal Area
SSHP	Site Safety and Health Plan
USACE	United States Army Corps of Engineers
URS	URS Corporation

1.0 PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPP) describes the policy, organization, functional activities, and quality assurance and quality control (QA/QC) for the gamma walkover survey planned for the Shallow Land Disposal Area (SLDA) site in Parks Township, Armstrong County, Pennsylvania. The purpose of this survey is to generate coverage maps showing variation of gamma levels at the site and to aid in the performance of a remedial investigation and selection of additional sampling locations if needed. The survey's purpose is discussed in more detail in Section 1.0 of the Field Sampling Plan (FSP).

This QAPP, the FSP, and the Site Safety and Health Plan (SSHP) are the work plans that URS Corporation (URS) has prepared to fulfill the requirements of the USACE Delivery Order No. 0010 for the SLDA site. These plans will govern the work at the site.

A summary of the site description, history, and existing site data is presented in Section 1.0 of the FSP.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The URS organizational structure for this project, presented in Figure 2-1, identifies the names of key project personnel. The Delivery Order (D.O.) Manager, Mr. Thomas Fralick, is responsible for all assigned technical and administrative aspects of the project. Mr. Fralick is the primary point of contact between the USACE and URS. The D.O. Manager's role is discussed in detail in the FSP. The Project Principal, Mr. Vern Singh, is the indirect (secondary) point of contact for project communication and authority. The Project Principal's role is also discussed in detail in the FSP.

The Field Manager, Mr. Larry Luckett, CHP is responsible for coordinating the activities of all personnel involved with implementing the project in the field and will verify that all field work is carried out in accordance with the approved project FSP. The QA Manager, Mr. James Lanzo, is responsible for verifying and documenting that Delivery Order quality assurance has been performed for this project, and ensuring that quality assurance meets the requirements of the FSP and URS corporate requirements. The QA Manager's role is discussed in detail in the FSP. Qualifications of all key personnel associated with this project are presented in the FSP.

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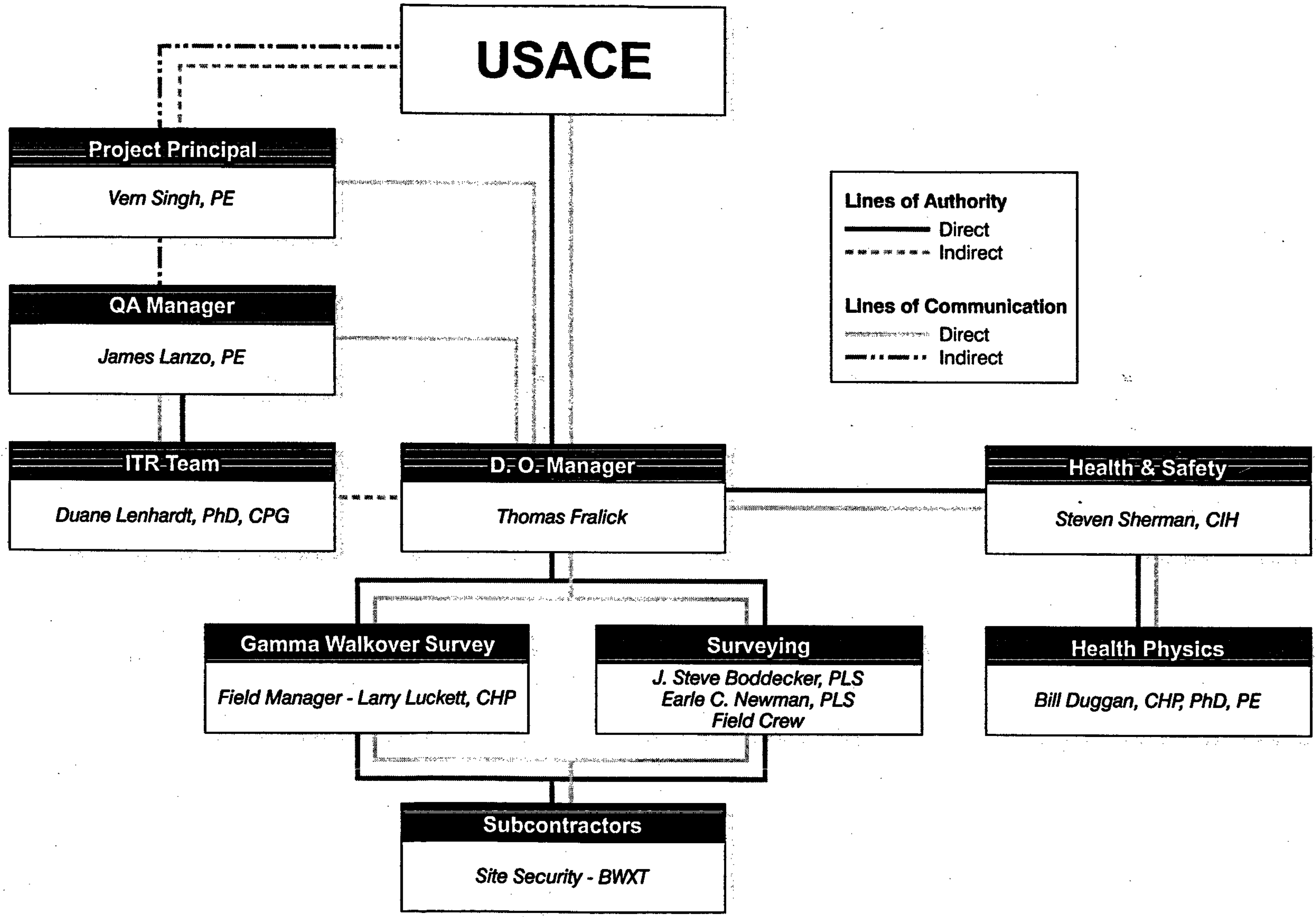

URS

GAMMA WALKOVER SURVEY
ORGANIZATION CHART

FIGURE 2-1

3.0 DATA QUALITY OBJECTIVES

3.1 General

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of data required to support the gamma walkover survey at the SLDA site, considering the intended use of the data. The purpose of the gamma walkover survey is to develop a radiological baseline of the site and to aid in the selection of biased soil sample locations. Therefore, the data collected must be of sufficient quantity and quality to reliably define site radiological conditions on a preliminary basis.

Radiological measurements will be recorded by the URS field crew during the gamma walkover survey. The gamma activity data will be collected concurrently with locational data using a Global Positioning System (GPS) unit. The gamma walkover survey measurements will be collected and managed through use of approved procedures. In particular, the survey will be performed using instruments in current calibration and appropriate for detection of the anticipated external radiation energy. Instrument accuracy will be sufficient to measure external gamma radiation at a fraction of typical background levels.

In order to locate the gamma reading spacially, a land survey will be performed to establish the limits of the work area and horizontal and vertical control of the site.

3.2 Data Quality Objectives

The following DQOs have been developed for the gamma walkover survey at the SLDA site :

1. Acquire sufficient land survey information such as land title records, deeds, and filed maps at the local municipality and from Nuclear Regulatory Commission (NRC) license SNM-2001 to identify the limits of the SLDA site prior to the gamma walkover survey. The site limits will be identified using stakes, flagging, etc.

2. Measure background gamma radiation levels that are representative of the SLDA vicinity. Identification of areas of elevated gamma radiation within the SLDA site will be based on gamma radiation levels exceeding the average background concentration by an amount determined through calculation of the Minimum Detectable Count Rate.

3. Measure external gamma radiation levels approximately one foot above the ground surface within the SLDA site. Gamma radiation levels will be measured over the entire site to the extent possible. Areas where gamma radiation levels were not measured due to topography or other adverse conditions will be clearly identified in the final report.

4. Develop a baseline characterization of external gamma radiation levels across the SLDA site. This characterization will identify areas of surface soil concentrations that are elevated relative to the following preliminary investigation levels:

Isotope	**Preliminary Investigation Level (pCi/g)**
Am-241	27.7
Pu-238	36.3
Pu-239	32.6
Pu-240	32.6
Pu-242	32.8
Rc-226	0.3
Unat	123 (of U-238)
U-234	96.4
Th-230	1.0

These levels have been established based on a preliminary site model and risk assessment, and correspond to the site preliminary Derived Concentration Guideline Levels (DCGLs).

The gamma survey will be able to detect areas of elevated concentrations that are $1m^2$ or greater in size.

5. Gamma survey data will be obtained using instruments calibrated according to manufacturer's procedures. Each radiation detector will be checked at least daily, with an expected instrument response within two standard deviations of the running average for that instrument.

6. The actual Minimum Detector Limit achieved in the gamma survey (scan MDC) will be determined based on the field and background measurements. Measurements above the scan MDC will be noted as elevated for the purpose of planning the sampling program for the SLDA RI.

In order to achieve these project DQOs, two kinds of data will be generated during the gamma survey:

- *Survey data at specific locations* will be obtained via a gamma walkover survey, using a FIDLER instrument and 3" x 3" sodium iodide detector coupled with a GPS receiver to measure external surface gamma radiation levels indexed to specific location data. These screening data will be used to identify potential radiologically impacted areas at the site, and to provide a basis for one of the criteria used in the selection of biased soil sample locations.

- Gamma radiation levels will also be measured in areas where acceptable GPS signals are not available due to interference. This data will be used to identify areas of elevated gamma radiation and the specific locations will be identified using standard land surveying techniques.

4.0 PROCEDURES FOR DETERMINING GAMMA SURVEY LOCATIONS

The location of measurements obtained during the gamma walkover survey will be obtained by GPS or by standard land survey methods. The horizontal (Northing and Easting) locations will be identified and tied to the North America Datum of 1983 (NAD83). The GPS system will be used in accessible areas where an acceptable signal can be obtained. A baseline, control points, and/or a grid will be established and tied to the above- referenced horizontal and vertical controls by standard land survey methods (e.g., total station, level, etc.) in accessible areas where an acceptable GPS signal cannot be obtained. The gamma radiation measurements in these areas will be located using the baseline, control points, and/or a grid.

The accuracy of the locations will be as follows:

- Gamma walkover survey locations using GPS to one meter (horizontal plane coordinate) accuracy.

- Gamma walkover survey locations using standard land survey methods will have a target accuracy of one meter (horizontal plane coordinate), where possible. Every effort will be made to meet the one-meter accuracy target in these areas; however, it may be necessary to modify this accuracy level due to difficult access and the presence of vegetation and steep terrain. Any modification will be documented and relative accuracy assessed.

5.0 DATA REPORTING

It is expected that most of the data gathered during the gamma walkover survey will be recorded electronically, using the field instruments coupled with GPS. However, in areas where use of the GPS unit is not feasible due to inaccessible topography or other conditions, data will be recorded manually on the Gamma Survey Data form presented in Appendix A. The data collected manually in the field will be subsequently entered into the database to allow map generation using a Geographic Imaging System (GIS).

The radiation level and other relevant data measured at each location will be recorded on the form immediately as the data is generated. Interim reports will be sent to the USACE from the field as the data is generated. Upon completion of the field investigation, a gamma walkover report will be prepared which will summarize the findings and results of the gamma walkover survey.

6.0 QUALITY CONTROL REPORT TO MANAGEMENT

Data Quality Control Reports (DQCRs), as shown in Appendix A, will be submitted to the USACE during the course of the field work. The DQCR is completed on a daily basis to document quality control related information from the field. The Field Manager will complete the DQCR during site work, sign the DQCR and submit it to USACE on a weekly basis.

A Quality Control Summary Report, which addresses quality control practices employed and summarizes the DQCRs, will be submitted to the USACE upon project completion. Additional deliverable items are discussed in detail as follows:

- Permission to depart from approved plans will be obtained from the USACE Contracting Officer in writing. The USACE will be notified within 48 hours of any such occurrence. Any departure from the approved QAPP and the corrective action taken to resolve any problems will be identified.

- A Gamma Walkover Survey Report will be prepared which will summarize the findings and results of the gamma walkover survey. The data will be used as a radiological baseline for the start of RI activities by the USACE under FUSRAP. Any quality control issues or deviations from the FSP will be discussed in the Gamma Walkover Survey Report

7.0 CALIBRATION PROCEDURES AND FREQUENCY

In order to obtain a high level of precision and accuracy during the gamma walkover survey, the gamma surveying equipment and the land surveying equipment must be properly calibrated. The following describes the equipment calibration procedures and frequency of calibration.

The gamma survey equipment will be calibrated by the instrument supplier according to the manufacturer's specifications. A daily check to confirm the instrument is responding will be completed by placing an appropriate radiation source (based on type and energy of emission) nearby and noting an expected response. Responses will be recorded and charted for each instrument; if the results indicate that the instrument is out of control, it will be removed from service.

The land survey equipment (e.g., total stations) are run on a daily basis to a calibrated baseline (published by the National Geodetic Survey Association) to ensure equipment precision and accuracy. In addition, equipment is calibrated during regular service by qualified vendor technicians to manufacturer's specifications.

Calibration and operation procedures are discussed in more detail in the FSP.

7.1 Analytical Support Areas

Not relevant.

7.2 Laboratory Instruments

Not relevant.

8.0 INTERNAL QUALITY CONTROL CHECKS

Since the gamma walkover survey does not include laboratory analyses, this section is not relevant. Field instrument calibration is addressed in Section 7.0.

8.1 Batch QC

Not relevant.

8.2 Matrix-Specific QC

Not relevant.

8.3 Additional QC

Not relevant.

9.0 CALCULATION OF DATA QUALITY INDICATORS

9.1 Precision

Not relevant.

9.2 Accuracy

Not relevant.

9.3 Completeness

Not relevant.

9.4 Method Detection Limits (MDLs) and Minimum Detectable Concentrations (MDCs)

Detection sensitivity calculations are supplied in the FSP.

10.0 CORRECTIVE ACTIONS

The gamma walkover survey will not require any laboratory services or outside analyses of samples. Corrective action related to instrument calibration is discussed in Section 7.0. Areas of insufficient gamma walkover survey coverage will be determined by approximate daily data reduction. The field crew will collect additional gamma survey data to address areas with insufficient coverage prior to de-mobilization from the site.

10.1 Incoming Samples

Not relevant.

10.2 Sample Holding Times

Not relevant.

10.3 Instrument Calibration

No sample analyses will be performed. All measurements will be taken in the field. Therefore, instrument calibration applies only to the field instruments as discussed in Section 7.0.

10.4 Reporting Limits

Not relevant.

10.5 Method QC

Not relevant.

10.6 Calculation Errors

Not relevant.

11.0 DATA REDUCTION, REVIEW, VALIDATION, AND REPORTING

Laboratory analyses will not be conducted; therefore, discussion of data reduction is not relevant to this project. Data files will be downloaded approximately on a daily basis from the GPS data logger and transmitted to a designated URS office. The designated and qualified office staff will transmit the data into the GIS and the data will be mapped. On a weekly basis, URS will forward to USACE the ASCII data files downloaded from the field instruments, preliminary coverage maps, and any applicable backup data. Maps of locational data will be transmitted to the field crew approximately once a day. The data will then be validated using standard QC procedures. These QC procedures will consist of spot checking five data points for each data transfer. The spot check will consist of comparing the locational and gamma radiation measurement data forwarded from the field with the data presented in the draft GIS coverage maps. Upon completion of field activities, data will be presented in the Gamma Walkover Survey Report. Data will be considered preliminary until validated and presented in the final report.

Land survey data will be reduced, reviewed, validated and reported by a Licensed Pennsylvania Land Surveyor using methods and standards acceptable to the professional standard of the State of Pennsylvania.

12.0 PREVENTATIVE MAINTENANCE

Not relevant.

13.0 PERFORMANCE AND SYSTEM AUDITS

Daily response checks and maintenance of survey equipment will be completed as described in detail in the FSP. In addition, a daily performance audit will be conducted to document deviations from the procedures specified in the FSP and QAPP.

Since sampling and analysis of site media is not included in this scope of work, performance and external audits typically completed by the laboratory and performance audits associated with the required gamma walkover survey are not merited.

13.1 Performance and External Audits

A daily performance audit will be conducted by the Gamma Walkover Survey Field Manager to document various aspects of the actual survey procedures. At minimum, the survey scan speed and distance from the detector to the ground will be recorded.

13.2 Systems/Internal Audits

Not relevant

14.0 QC REPORTS TO MANAGEMENT

Daily Quality Control Reports (DQCRs), as shown in Appendix A, will be submitted to USACE during the course of project. The Quality Control Summary Report (QCSR) which addresses quality control practices employed and summarizes the DQCRs will be submitted to the USACE at the end of the project. Other deliverable items are discussed in detail below.

14.1 Departure from Approved Plan

The USACE will be notified within 48 hours of identifying conditions requiring deviation from the approved plan. Verbal approval to deviate from the plans will be provided by the USACE Project Manager prior to proceeding. Written approval to deviate from the approved plans will be also provided by the USACE Contracting Officer. Any departure from the approved QAPP and the corrective action taken to resolve any problems will be identified. Also included will be any verbal/written instructions from USACE personnel for sampling or reanalysis.

14.2 Report

A gamma walkover survey report will be prepared which will summarize the findings and results of the gamma walkover survey. The data will be used to develop planned remedial investigation (RI) work plans. The gamma walkover survey report will discuss any QC issues that arose during completion of the survey activities.

A land survey map will be produced showing the limits of work and locational information of the grid system and monitoring wells.

APPENDIX A

STANDARD FORMS TO BE USED

INSTRUCTIONS ON WHEN AND HOW TO COMPLETE GAMMA SURVEY DATA FORM

It is expected that most of the data gathered during the gamma walkover survey will be recorded electronically, using the field instruments coupled with the GPS. Paper documentation in the field will not be necessary for this data gathering system. However, if the GPS is not operating, data readings and locations will be recorded by hand in the field on the Gamma Survey Data form. In addition to the gamma walkover survey reading, the form allows the identification of the instrument being used, the survey location, the person gathering the data, the date, and notes describing unusual conditions, if appropriate.

URS

Parks Township SLDA Gamma Survey
GAMMA SURVEY DATA

Page ________

	Grid Location	Reading (cpm)	Instr code	Bkg cpm	Date	Surveyed By (initials)	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

____
Manager Approval

URS

282 Delaware Avenue
Buffalo, New York 14202
(716)856-5636

DATE ______________________

DAY	S	M	T	W	TH	F	S

WEATHER	Bright Sun	Clear	Overcast	Rain	Snow
TEMP	To 32	32-50	50-70	70-85	85 up
WIND	Still	Moder	High	Report No.	
HUMIDITY	Dry	Moder	Humid		

PROJECT MANAGER ______________________

PROJECT ______________________

JOB No. ______________________

CONTRACT No. ______________________

SUB-CONTRACTORS ON SITE:
EQUIPMENT ON SITE:
WORK PERFORMED (INCLUDING SAMPLING):

SHEET ______ OF ______

DAILY QUALITY CONTROL REPORT

URSF-003/1 OF 2/DQCREP

PROJECT ____________________ REPORT No. ____________

JOB No. ____________________ DATE ____________

QUALITY CONTROL ACTIVITIES (INCLUDING FIELD CALIBRATIONS):

HEALTH AND SAFETY LEVELS AND ACTIVITIES:

PROBLEMS ENCOUNTERED/CORRECTION ACTION TAKEN:

SPECIAL NOTES:

TOMORROW'S EXPECTATIONS:

BY ____________________ TITLE ____________________