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SL-11116

POST-REMEDIAL ACTION REPORT

FOR THE REMEDIAL ACTIONS CONDUCTED IN ST. LOUIS, MISSOURI

DURING CALENDAR YEAR 1995

NOVEMBER 1996

Prepared for

United States Department of Energy

Oak Ridge Operations Office

Under Contract No. DE-AC05-91OR21949

By

Bechtel National, Inc.
Oak Ridge, Tennessee

Bechtel Job No. 14501

148716

Bechtel

Oak Ridge Corporate Center
151 Lafayette Drive
P. O. Box 350
Oak Ridge, Tennessee 37831-0350

Telephone: (423) 220-2000

Job No. 14501, FUSRAP Project
DOE Contract No. DE-AC05-91OR21949
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DEC 0 5 1996

U.S. Department of Energy
Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, TN 37831-8723

Attention: David G. Adler, Site Manager
Former Sites Restoration Division

Subject: St. Louis Site CY 1995 Remedial Actions - Publication of PRAR

Dear Mr. Adler:

Enclosed is a copy of the subject document, which is being published following your approval of November 25 (CCN 148511).

This document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that the information submitted was properly gathered and evaluated. To the best of my knowledge and belief, they are true, accurate, and complete.

If you have any questions, please call me at 241-2192.

Sincerely,

, P.E.

K. A. Albin
Project Manager - FUSRAP

BAF:onl:LR_1884.DOC

Enclosure: Published St. Louis VP PRAR

cc: S. K. Oldham, w/2

Concurrence: R. F. Sanchez @RES D. J. Hughel DJH B. A. Fogelman

ACTION REQ'D ☐ YES ☐ NO DUE DATE _____

RESPONSE TO CHRON NO _____

☐FFA ☐Permit ☐Milestone ☐OcR ☐CCN ☐CAR ☐Mid-Yr ☐Yr-End ☐Periodic Rpt

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TABLES

ACRONYMS

AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
BNI	Bechtel National, Inc.
DCG	derived concentration guide
DOE	U.S. Department of Energy
FUSRAP	Formerly Utilized Sites Remedial Action Program
IVC	independent verification contractor
MED	Manhattan Engineer District
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
PIC	pressurized ionization chamber
PPE	personal protective equipment
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
TN	Thermo NUtech
VP	vicinity property

UNITS OF MEASURE

cm	centimeter
cpm	counts per minute
dpm	disintegrations per minute
ft	foot
g	gram
h	hour
in.	inch
L	liter
m	meter
µCi	microcurie
µR	microroentgen
ml	milliliter
mrad	millirad
mrem	millirem
pCi	picocurie
yd	yard
yr	year

1.0 INTRODUCTION

1.1 BACKGROUND

This report documents the interim remedial actions conducted in St. Louis during calendar year 1995. The interim remedial actions were performed at the St. Louis Downtown Site (SLDS) Plant 10 and two Latty Avenue vicinity properties (VPs) as part of the U.S. Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP was established to identify and clean up or otherwise control sites where residual radioactive contamination (exceeding current DOE guidelines) remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy. The remedial actions were conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act.

The objectives of FUSRAP, as they apply to the St. Louis site, are to

- identify and evaluate sites used to support former U.S. Army, Corps of Engineers, Manhattan Engineer District (MED), and U.S. Atomic Energy Commission (AEC) nuclear development activities;
- remove or otherwise control contamination on sites identified as contaminated above current DOE guidelines;
- achieve and maintain compliance with applicable criteria for the protection of human health and the environment;
- maintain compliance with applicable or relevant and appropriate requirements; and
- certify the site, to the extent practicable, for use without radiological restrictions after remediation.

FUSRAP was established in 1974, and remedial actions began at FUSRAP sites in 1981. Administered by the Former Sites Restoration Division of DOE's Office of Environmental Management, FUSRAP currently includes 46 sites in 14 states. The primary legislation authorizing FUSRAP is the Atomic Energy Act of 1954.

Bechtel National, Inc. (BNI) is the project management contractor for FUSRAP. Health physics and laboratory functions were provided by Thermo NUtech [(TN) formerly Thermo Analytical], the radiological support subcontractor. Oak Ridge Institute for Science and Education (ORISE), the FUSRAP independent verification contractor (IVC) for the St. Louis sites, performed independent verification

surveys and will issue interim reports of post-remedial verification survey results. ORISE will provide final reports for each property after the final post-remedial action report is issued.

1.2 HISTORY AND SITE DESCRIPTION

1.2.1 SLDS Plant 10

The 18-ha (45-acre) SLDS is a chemical plant located in a highly industrialized area on the eastern border of the city of St. Louis, Missouri, 90 m (300 ft) west of the Mississippi River (Figure 1-1). The plant is currently owned and operated by Mallinckrodt Group, Inc. Contamination at SLDS resulted from industrial-scale processes to recover uranium from high-grade African ore from 1942 to 1957, when Mallinckrodt Chemical Works conducted uranium processing and recovery operations for research, development, and production programs under contract to MED/AEC. During close-out of operations in 1957, government-owned buildings were either dismantled or transferred to Mallinckrodt. Other buildings constructed for or owned by AEC were purchased by Mallinckrodt in 1961.

Plant 10 (historically Plant 4) at SLDS was used in pilot-scale work to develop a continuous furnace green salt (UF_4) process (Figure 1-2). Its facilities were later modified to be used as a metallurgical pilot plant for developmental work with uranium metal. Following process closure in 1956, AEC decontaminated the plant to comply with the standards in effect at that time, returning it to Mallinckrodt for use without radiological restrictions in 1962.

Radiological and chemical characterization and surveys conducted at SLDS from 1987 through 1990 included walkover gamma scans, sampling and analysis of groundwater and soil for radioactive and chemical constituents, downhole gamma logging, and radiological surveys of building surfaces. Plant 10 building surveys indicated that no residual contamination exceeding DOE guidelines existed on any building surfaces (BNI 1990a). Additional boundary delineation and waste classification activities were performed for Plant 10 before remediation began. The primary soil contaminant found at SLDS Plant 10 was uranium-238.

1.2.2 Vicinity Properties 3L and 6L

The St. Louis Airport Site (SLAPS) is located north of the Lambert-St. Louis International Airport in St. Louis County, Missouri, approximately 24 km (15 mi) northwest of downtown St. Louis (Figure 1-1). The two vicinity properties remediated during 1995 are located approximately 0.8 km (0.5 mi) northeast of SLAPS within the city of Hazelwood (Figure 1-3). VP 3L is located at 9060 Latty Avenue. The property is currently owned by SLT Development Corporation, and the tenant at the time of the remedial activities was Quaker State, Incorporated. VP 6L is just southwest of VP 3L at 8979 Seeger Industrial Drive. The property is currently owned and operated by Rykoff-Sexton, Incorporated.

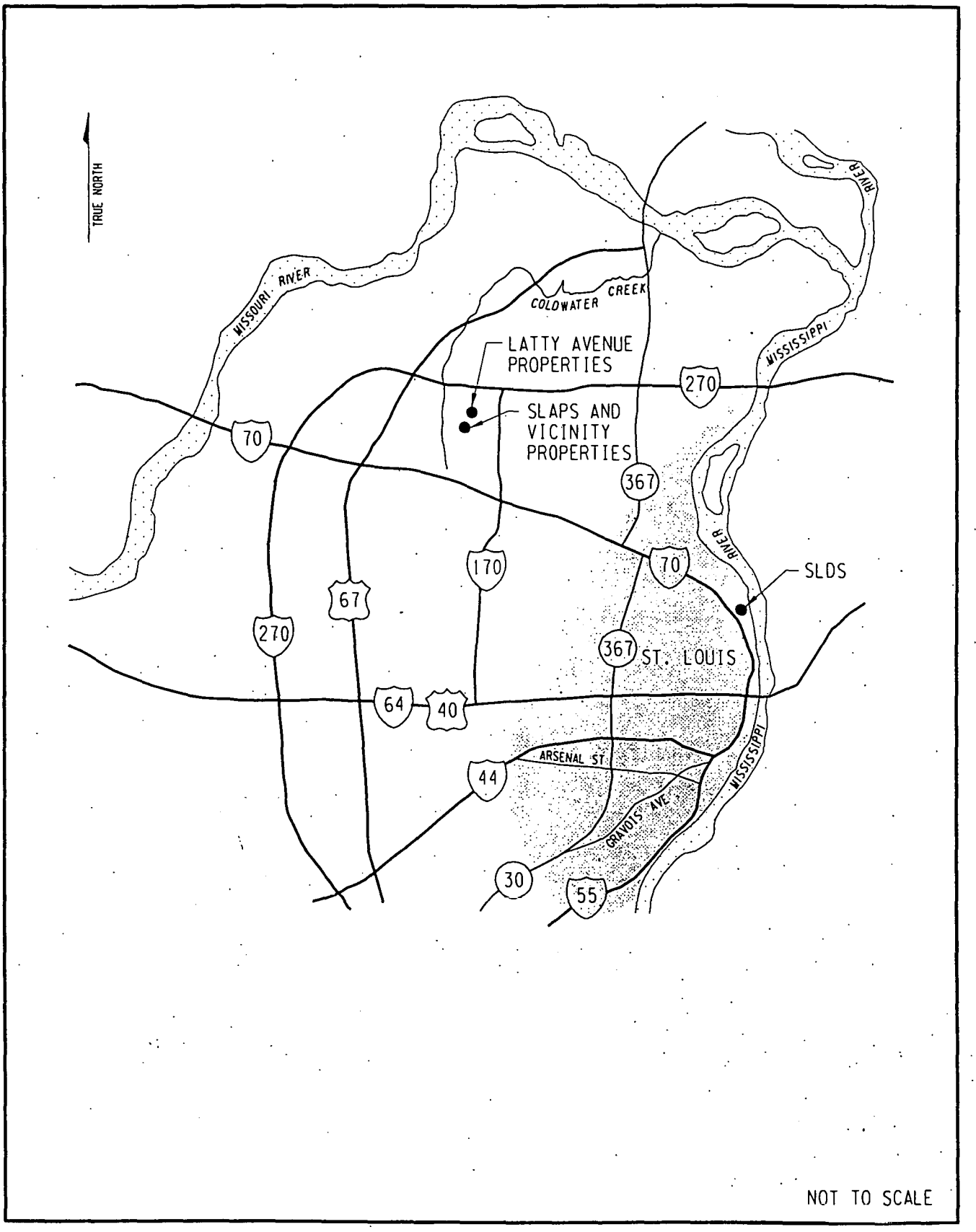

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Figure 1-1
Locations of FUSRAP Properties in the St. Louis, Missouri, Area

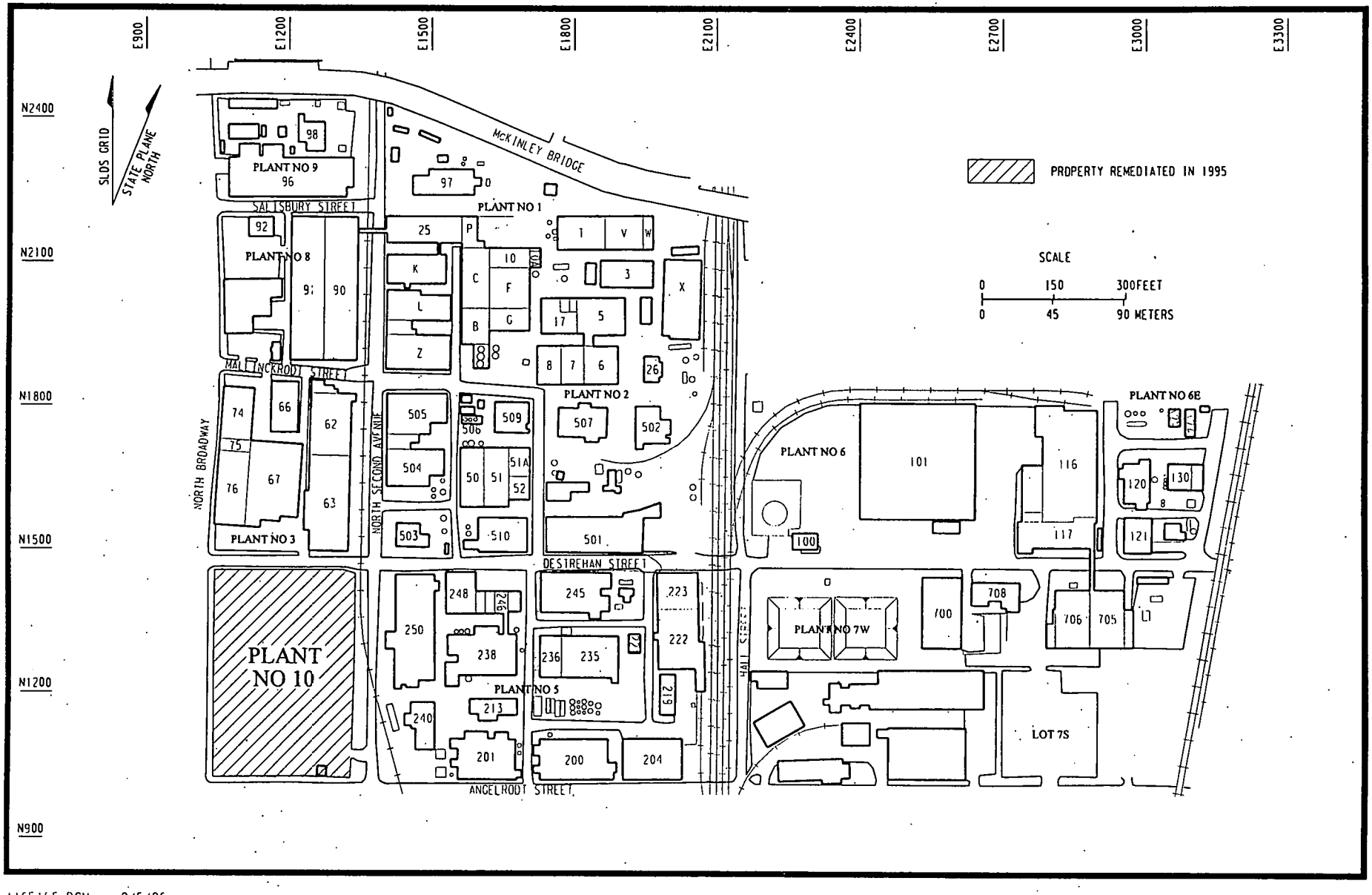

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Figure 1-2
Location of SLDS Plant 10

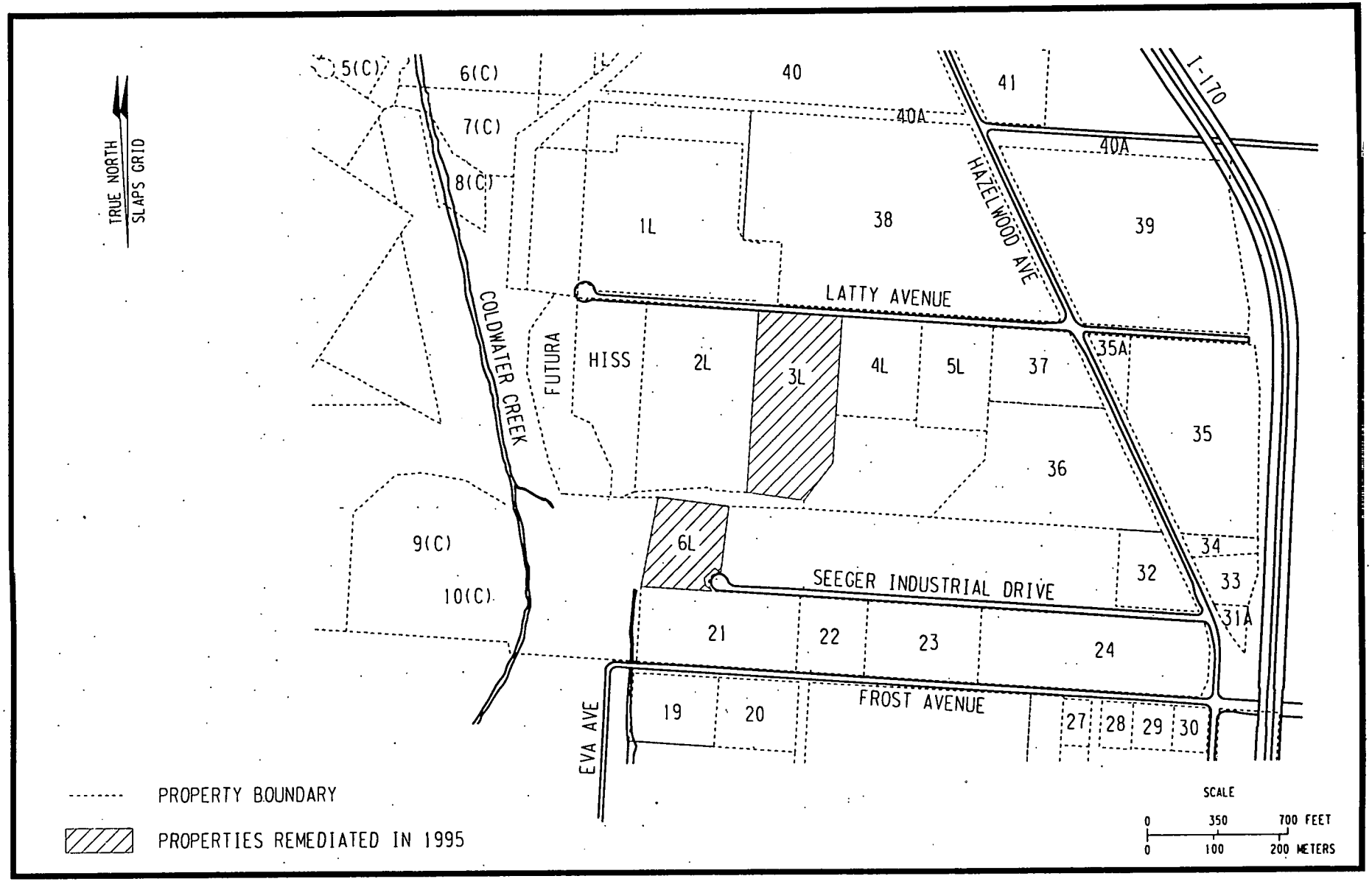

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Figure 1-3
Locations of Vicinity Properties 3L and 6L

SLAPS was acquired by MED in 1946 and operated until 1966 to store uranium-processing wastes from the Mallinckrodt Chemical Company in downtown St. Louis. These processing wastes, which consisted of pitchblende raffinate residues, radium-bearing residues, and barium sulfate cake, were generated between 1942 and the late 1950s. The waste materials were purchased by Continental Mining and Milling Company of Chicago in 1966 and subsequently transported to 9200 Latty Avenue for storage under an AEC license. During transit, some of these materials spilled from trucks onto the roadway, right-of-ways, and properties bordering the haul roads. The haul roads used for transport included McDonnell Boulevard, Hazelwood Avenue, Pershall Road, Eva Avenue, Frost Avenue, and Latty Avenue. Redistribution of the contaminated materials has occurred, probably as a result of flooding, surface runoff, and road and utility line installation and maintenance activities.

The Latty Avenue site was assigned to DOE by Congress in 1984. During a radiological survey of haul roads in 1985, Oak Ridge National Laboratory (ORNL) identified areas with elevated gamma exposure rates and concentrations of thorium-230 in soil (BNI 1987). Thorium-230 was the primary contaminant, with lesser amounts of radium-226 and uranium-238. As a result, the properties along the haul roads were designated in 1986 for remedial action under FUSRAP.

Site characterization activities were performed from 1986 to 1989 to delineate contamination boundaries as documented in the St. Louis site characterization report (BNI 1990b). Additional boundary delineation and waste classification activities were performed for VPs 3L and 6L before remediation began.

2.0 REMEDIAL ACTION GUIDELINES

The source of contamination of the designated properties was the processing and transportation of uranium and residues. Standards and criteria governing the release of properties for future use are included in DOE Order 5400.5, "Radiation Protection of the Public and Environment." The applicable DOE standards and guidelines for the Latty Avenue vicinity properties and SLDS Plant 10 are listed in Table 2-1.

The basic limit for the annual radiation dose (excluding radon) received by an individual member of the general public is 100 mrem/yr above background. In implementing this limit, DOE applies as-low-as-reasonably achievable (ALARA) principles to set site-specific guidelines.

One method used to verify compliance with DOE remedial action guidelines is the measurement of radionuclide concentrations in soil samples. For radium and thorium, these concentration guidelines are listed in DOE Order 5400.5 at levels above naturally occurring background concentrations. For uranium, soil cleanup goals are derived from exposure models based on appropriate land use scenarios and pathways. The guideline for uranium concentrations in soil at the St. Louis site is 50 pCi/g of uranium-238, calculated to ensure that the dose to members of the public does not exceed the basic dose limit of 100 mrem/yr above background (Fiore 1990).

Another method used to confirm that remedial action has been successful is a comparison of post-remedial exposure rates with the average background external gamma radiation exposure rates for the St. Louis area. The background external gamma radiation exposure rate for the St. Louis area is 10 μR/h (BNI 1990b).

Table 2-1

Summary of DOE Guidelines for Residual Radioactive Contamination

Basic Dose Limits

The basic limit for the annual radiation dose (excluding radon) received by an individual member of the general public is 100 mrem/yr above background. In implementing this limit, DOE applies the ALARA principle to set site-specific guidelines.

External Gamma Radiation Limit

The average external gamma radiation exposure rate inside a building or habitable structure on a site that has no radiological restrictions on its use must not exceed the background level by more than 20 μR/h.

Soil Guidelines (above background)

Radium-226 Thorium-230 Thorium-232	5 pCi/g, averaged over the first 15 cm of soil below the surface; and 15 pCi/g when averaged over any 15-cm-thick soil layer below the surface (DOE 5400.5)
Uranium-238	50 pCi/g, any depth, site-specific guideline for St. Louis, Missouri (Fiore 1990)

3.0 REMEDIAL ACTION

Before remedial action began, additional characterization was performed on the sites to more accurately define the boundaries of radioactive contamination, supplement existing characterization information, and obtain the information necessary to classify the waste expected to be generated during remediation.

Excavation to the appropriate depths was performed using earth-moving equipment; areas with limited access and areas around utility lines were excavated by hand. All soil, gravel, rocks, asphalt, concrete, and organic materials within the contaminated areas were excavated. All contaminated areas were excavated to a depth of 15 cm (6 in.) or greater. Erosion and sediment controls were placed around excavated areas.

After excavation to design depths, external gamma radiation exposure rate measurements were taken with a pressurized ionization chamber (PIC), and soil samples were collected in the excavations to determine compliance with applicable guidelines. In addition to the surveys and sampling by TN/BNI, independent verification was performed by ORISE. Verification activities included review of post-remedial action data as well as independent gamma surface scans, exposure rate measurements, and the collection of verification soil samples. After independent verification was complete, the excavation was backfilled with clean material and the area restored to a condition agreeable to DOE and the property owner.

3.1 REMEDIAL ACTIVITIES AT VICINITY PROPERTIES 3L AND 6L

At VP 3L, the property owner had excavated soil from portions of the property to remove soil contaminated with oil. Some of the excavated soil was radioactively contaminated and had been stockpiled onsite. The stockpiled soil was sampled and analyzed and was determined not to require management as a hazardous waste subject to the regulations of the Resource Conservation and Recovery Act. Remedial activities on VPs 3L and 6L included the excavation of radioactively contaminated soil on the properties. After remedial and verification activities, the excavated areas were restored to a condition agreed upon by DOE and the property owner. Approximately 3,520 m^3 (4,610 yd^3) of soil, including the radioactively contaminated soils stockpiled onsite by the property owner and the material resulting from DOE's remedial action, were shipped to a licensed disposal facility (Table A-1 of Appendix A).

3.2 REMEDIAL ACTIVITIES AT SLDS PLANT 10

All areas of contamination were limited to below-grade soil and concrete slabs. The site owner demolished existing above-grade structures in Plant 10 before the start of remedial action. Remedial activities included demolition and removal of concrete floor slabs and excavation of soil exceeding the site-specific criteria. The excavated areas were restored to a condition agreed upon by DOE and the

property owner. Approximately 10,600 m^3 (13,900 yd^3) of radioactively contaminated waste resulting from remedial action was shipped to a licensed disposal facility (Table A-2 of Appendix A). Approximately 1,100 m^3 (1,500 yd^3) of concrete slab material was processed through a rock crusher. Analysis of the crushed material showed that the average concentration of uranium-238 was 3 pCi/g, well below the site-specific uranium guideline. Upon agreement with the property owner and the Missouri Department of Natural Resources, the crushed material was used to backfill the excavated areas of Plant 10.

3.3 CONTAMINATION CONTROL DURING REMEDIAL ACTION

During remedial action, engineering and administrative controls were used to protect remediation workers and members of the public from potential exposure to radiation in excess of applicable standards. Additionally, personal protective equipment (PPE) was used for protection of remediation workers. When conditions warranted, additional protective clothing and equipment, such as hoods and respirators, were used. These controls are outlined in the site-specific health and safety plan.

Under the direction of a health physics technician, workers exiting controlled areas were subjected to a radiological survey (frisk) at the access control point with a hand-held radiation detection instrument to minimize the spread of contamination to clean areas. A frisk is a search for radioactive material that may have been transferred onto the clothing or skin of individuals inside the work area. Contaminated PPE was shipped to a licensed disposal facility. All equipment was surveyed and decontaminated as necessary before it was removed from the controlled area.

The primary potential exposure pathways for members of the general public were inhalation and ingestion of radioactively contaminated airborne dust particles generated during the remedial action. The potential for dust migration was minimized by curtailing activities during windy conditions and maintaining adequate moisture with a fine mist of water during excavation and loading of excavated materials.

High-volume air samplers were used for air particulate sampling adjacent to areas being excavated to verify that no member of the public was exposed to radioactivity above the current standards and criteria. These guidelines were established to protect members of the general public and the environment against undue risks from radiation. The limits expressed in DOE Order 5400.5 are derived concentration guides (DCGs), which represent the concentration of a particular radionuclide that would yield an inhalation dose of 100 mrem/yr, the DOE primary dose limit, to an individual continuously exposed at that concentration for an entire year. The filters were collected daily and counted after sufficient time was allowed for radon progeny decay. Concentrations of radionuclides measured by area air samplers for VPs 3L and 6L ranged from $< 9.5 \times 10^{-15}$ to 1.9×10^{-14} µCi/ml (0.000019 pCi/L), well below the DCG of 4.0×10^{-14} µCi/ml (0.00004 pCi/L) for thorium-230. Concentrations of uranium-238 measured by area air samplers for SLDS

Plant 10 ranged from $< 3.4 \times 10^{-15}$ to $< 1.4 \times 10^{-13}$ μCi/ml (0.00014 pCi/L), well below the DCG of 2.0×10^{-12} μCi/ml (0.002 pCi/L) for uranium-238. The "<" (less than) symbol indicates that the measurement was less than the minimum detectable activity (MDA).

4.0 POST-REMEDIAL ACTION MEASUREMENTS

During the radiological characterization conducted in 1990 (BNI 1990b), radiological surveys and soil analyses were performed at three remote background locations (Figure 4-1) in the St. Louis area. These locations were selected because they are in the general vicinity of the site but are not influenced by former MED/AEC activities. Background measurements and soil samples provide a reference with which results obtained before, during, and after the remedial action may be compared (Table 4-1 and Appendix B).

The areas of remediation are shown in Figures 4-2, 4-3, and 4-4. To confirm that no radioactivity exceeding DOE guidelines remained in the remediated areas, surveys were performed as remedial actions were being completed, and soil samples were collected and analyzed. The soil samples from each area were collected at a frequency of 25 equally spaced plugs per 100-m^2 surface area with a depth of 15 cm (6 in.) and a diameter of 2.5 cm (1 in.). The 25 plug soil samples were composited and analyzed to ensure that the residual contamination was below current DOE guidelines. The soil samples for Plant 10 were analyzed for uranium-238 by gamma spectroscopy. The soil samples for VPs 3L and 6L were analyzed for thorium-230 and thorium-232 by alpha spectroscopy and for uranium-238 and radium-226 by alpha and gamma spectroscopy. Residual hot spots above the average soil guidelines identified by the IVC were subsequently bounded and determined to be below hot spot criteria.

External gamma radiation exposure rates were measured with a PIC at 1 m (3 ft) above the surface. Readings at this elevation provide an estimate of the potential exposure from gamma radiation to persons standing on the ground. These measurements were collected to ensure that the exposure rate from all pathways was below the guideline of 20 μR/h above background.

Methods for survey techniques are described in the post-remedial action survey plans, which are included in Appendix C. The radiological support subcontractor also provided the laboratory functions for analyzing the collected samples. The IVC performed independent verification surveys of the remediated areas using similar survey techniques. The IVC survey data and conclusions will be issued in a separate report by ORISE.

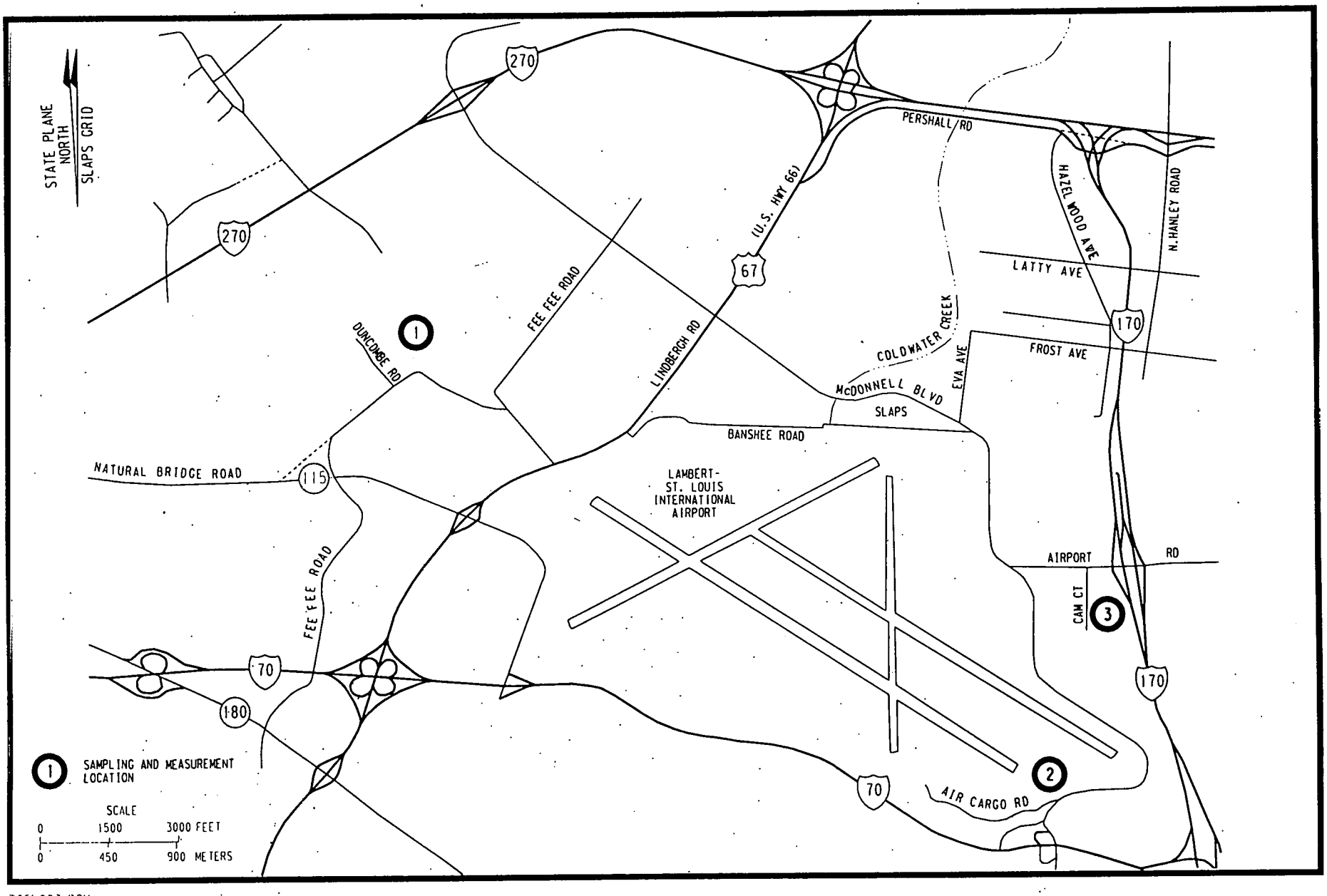

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Figure 4-1
Background Sampling Locations

Table 4-1
Summary of Post-Remedial Action Sample and Survey Results

Property	Number of Samples	Uranium-238 Concentration (pCi/g)[a,b]	Thorium-230 Concentration (pCi/g)[a,b]	Thorium-232 Concentration (pCi/g)[a,b]	Radium-226 Concentration (pCi/g)[a,b]	External Gamma Exposure Rate (μR/h)[a]
3L	91	0.8 - 7.4	1.2 - 9.0	0.34 - 1.6	0.65 - 4.5	8.8 - 9.4
6L	18	1.1 - 2.2	1.8 - 7.3	0.53 - 2.1	0.81 - 1.8	10.0 - 10.5
Plant 10	99	<2.0 - 33.5[c]	--[d]	--[d]	--[d]	7.1 - 11.1
Average Background[e]	3	1.1	1.3	1.0	0.9	10
DOE Guideline[f]	NA	50	15	15	15	<20[g]

[a]Results include background levels for the St. Louis area.
[b]Subsurface soil.
[c]< indicates that the result was less than the minimum detectable activity (MDA).
[d]Not a contaminant of concern.
[e](BNI 1990a)
[f]Above background.
[g]Less than 20 μR/h above background in habitable structures.

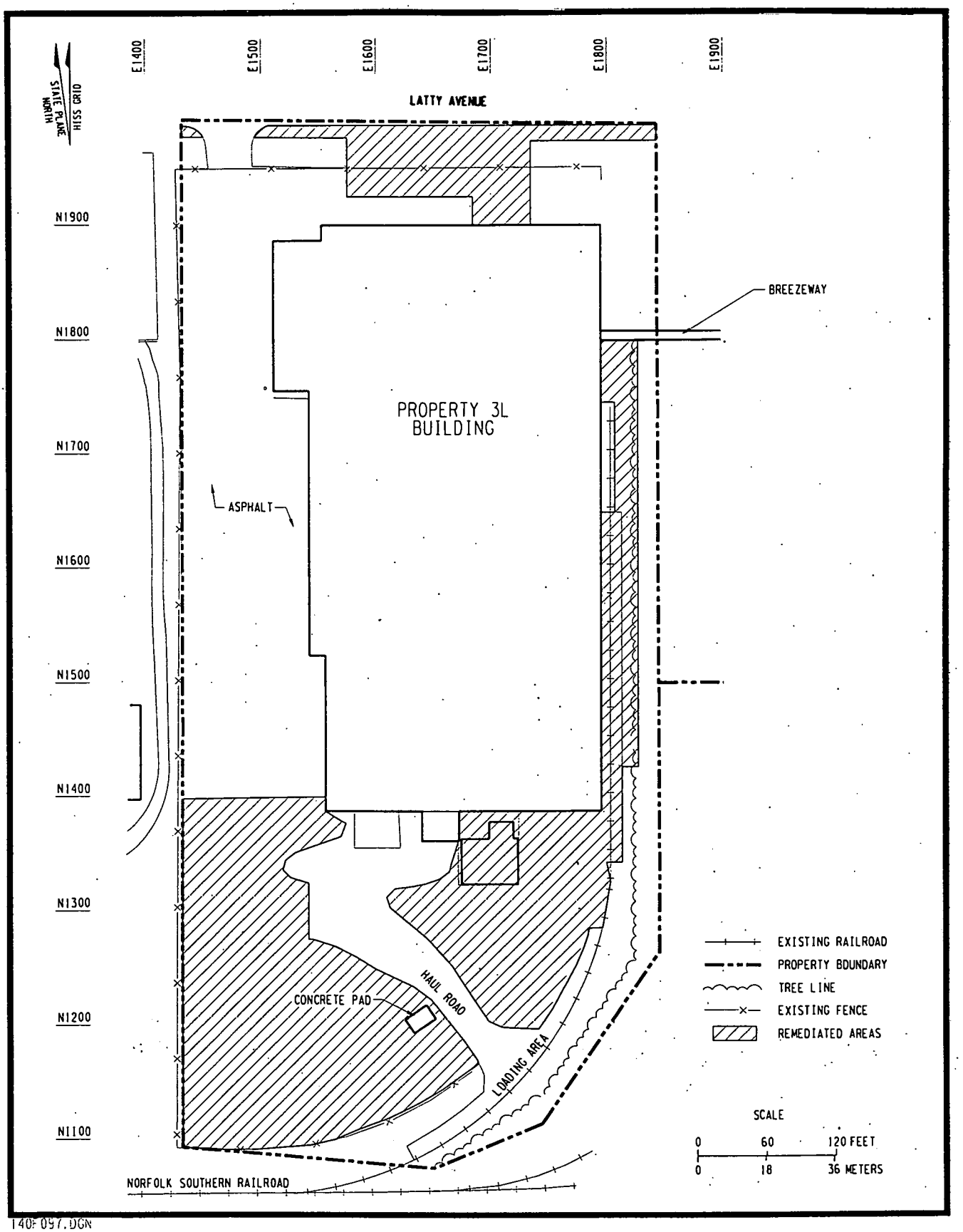

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Figure 4-2
Areas of Remediation at Vicinity Property 3L

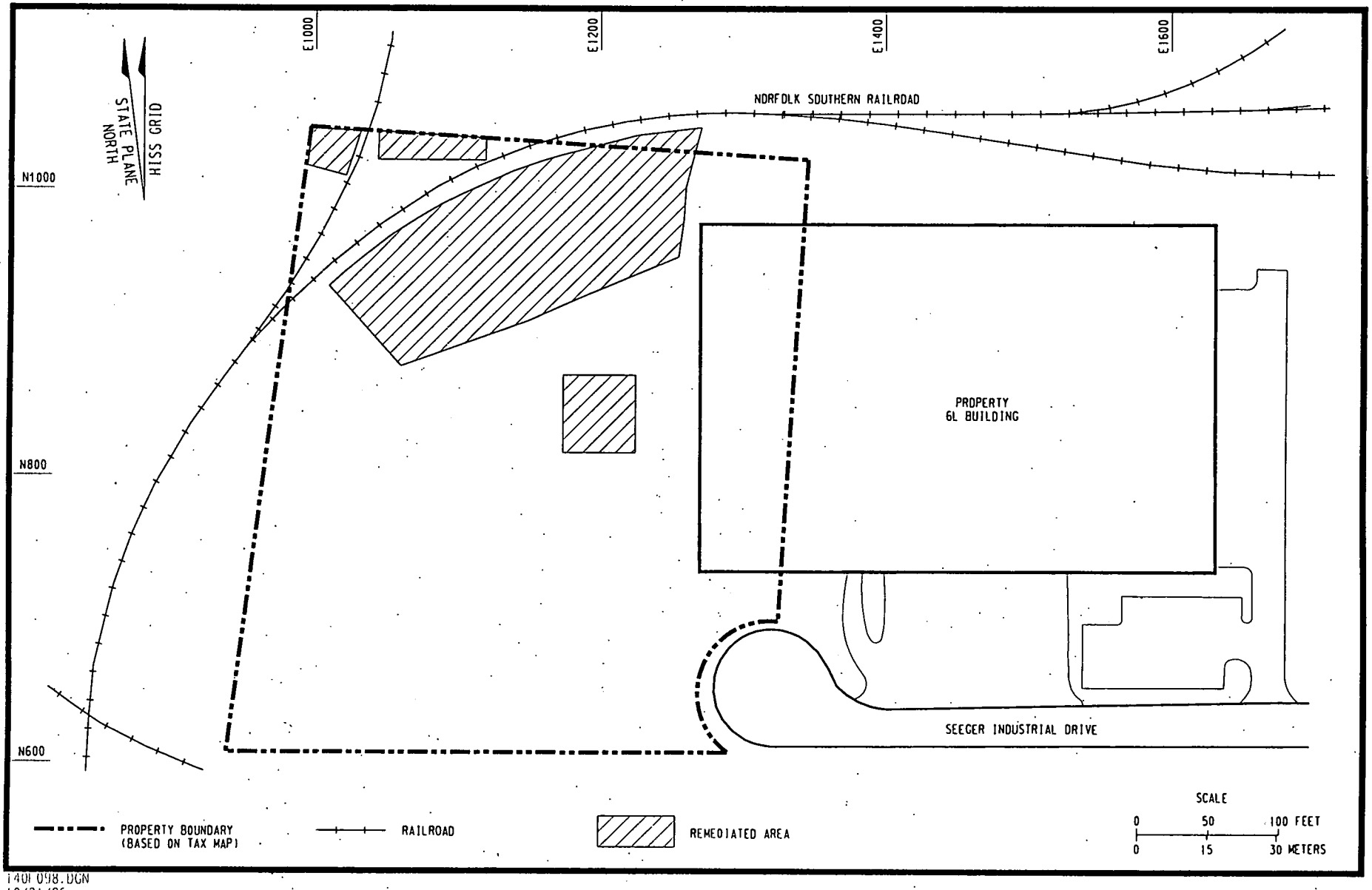

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Figure 4-3
Areas of Remediation at
Vicinity Property 6L

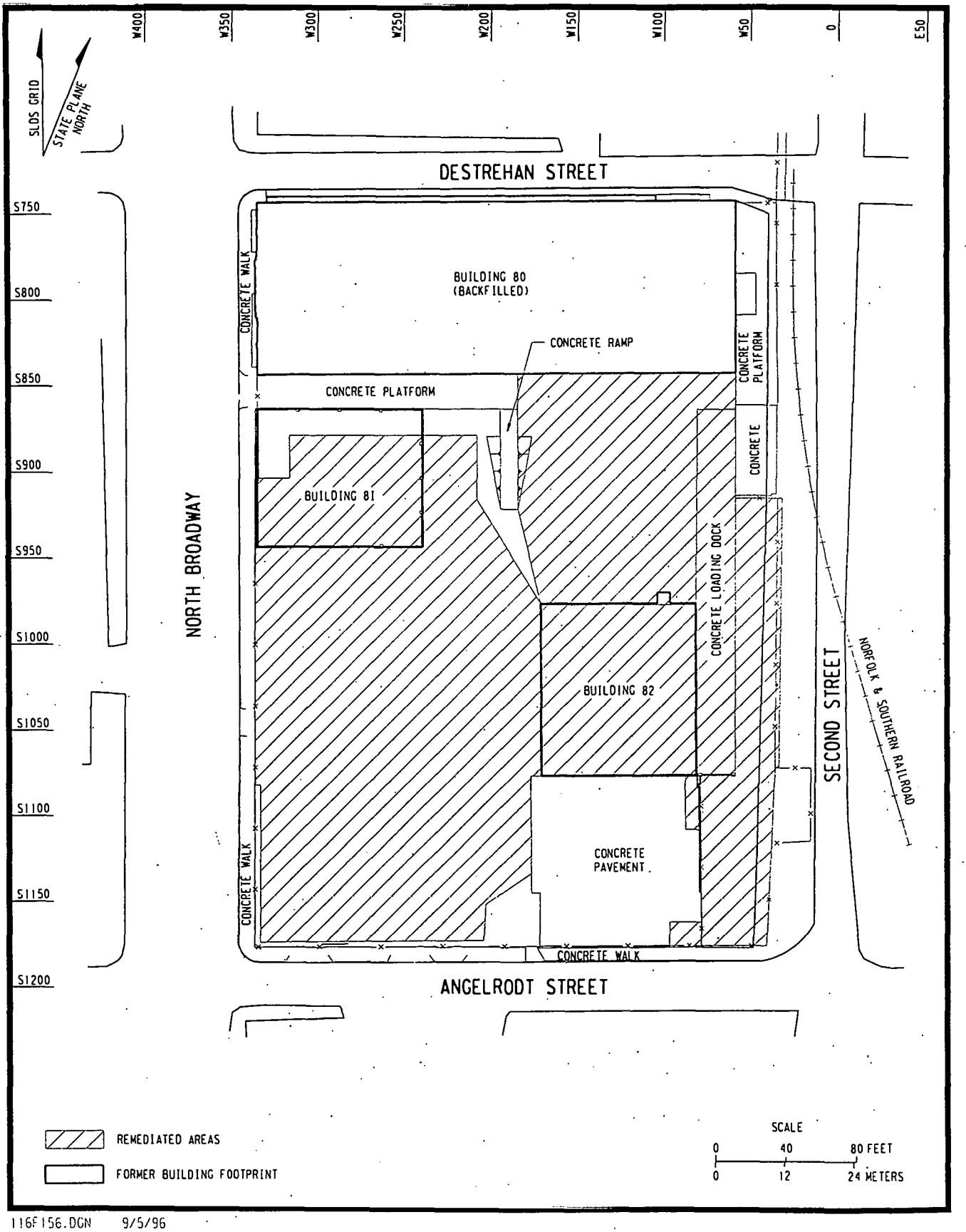


Figure 4-4
Areas of Remediation at SLDS Plant 10

5.0 POST-REMEDIAL ACTION STATUS

The post-remedial action survey data indicate that Latty Avenue VPs 3L and 6L and SLDS Plant 10 are now in compliance with applicable cleanup guidelines for residual radioactive contamination. After review of post-remedial action measurements, survey procedures, and quality assurance data, the IVC confirmed that the properties were decontaminated to the radiological guidelines established for the sites.

After verification activities were completed, the IVC notified DOE-Headquarters, Division of Facility and Site Decommissioning, and DOE-Oak Ridge Operations Office, Former Sites Restoration Division, of its findings and recommendations. DOE reviewed the data to determine whether the remedial action was successful. Based on this review, radiological conditions at the site were determined to be in compliance with DOE decontamination criteria and standards to protect health, safety, and the environment, and DOE certified the site as suitable for appropriate future use without radiological restrictions.

Waste volumes from remedial action and their final disposition are listed in Appendix A.

REFERENCES

Bechtel National, Inc. (BNI), 1987. *Radiological and Limited Chemical Characterization Report for the St. Louis Airport Site*, DOE/OR/21949-163 (August).

BNI, 1990a. *Radiological, Chemical, and Hydrogeological Characterization Report for the St. Louis Downtown Site in St. Louis, Missouri*, DOE/OR/20722-258 (September).

BNI, 1990b. *Radiological Characterization Report for FUSRAP Properties in the St. Louis, Missouri Area*, DOE/OR/20722-203 (August).

Fiore, J. J., to L. K. Price, 1990. "Uranium Cleanup Guidelines for St. Louis, Missouri, FUSRAP Sites," BNI CCN 072982 (November 6).

GLOSSARY

Alpha-emitting - See **Radiation**

Ambient Background Radiation - Ambient background radiation refers to naturally occurring radiation emitted from either cosmic (e.g., from the sun) or terrestrial (i.e., from the earth) sources. Exposure to this type of radiation is unavoidable, and its level varies greatly depending on geographic location. For example, New Jersey typically receives 100 millirem per year (mrem/yr), Colorado receives about 115 mrem/yr, and some areas in South America receive up to 7,000 mrem/yr. Naturally occurring terrestrial radionuclides include uranium, radium, potassium, and thorium (see **Radionuclide**). The dose levels do not include the concentrations of naturally occurring radon inside buildings.

Beta-gamma-emitting - See **Radiation**

Centimeter - A centimeter (cm) is a metric unit of measurement for length; 1 inch is equal to 2.54 cm; 1 foot is equal to approximately 30 cm.

Contamination - The term "contamination" is used generally to mean a concentration of one or more radioactive materials that exceeds naturally occurring levels. Contamination may or may not exceed the DOE cleanup guidelines.

Disintegrations per minute - Disintegrations per minute (dpm) is the measurement indicating the amount of radiation being released from a substance per minute.

Dose - As used in this report, dose is actually dose equivalent and is used to relate absorbed dose (mrad) to an effect on the body. Dose is measured in mrem. For comparison, a dose of 500,000 mrem to the whole body within a short time causes death in 50 percent of the people who receive it; a dose of 5,000,000 mrem may be delivered to a cancerous tumor during radiation treatment. Normal background radiation at or near sea level results in an annual dose of about 100 mrem. DOE radiation protection standards limit the dose that may be received by members of the general public to 100 mrem/yr above background levels; living in a brick house typically results in a dose of about 75 mrem/yr above the background level.

Exposure Rate - Exposure rate is the rate at which radiation imparts energy to the air. Exposure is typically measured in microroentgens (μR), and exposure rate is typically expressed as μR/h. The dose to the whole body can be approximated by multiplying the exposure rate by the number of hours of exposure. For example, if an individual were exposed to gamma radiation at a rate of 20 μR/h for 168 h/week (continuous exposure) for 52 weeks/yr, the whole-body dose would be approximately 175 mrem/yr.

Gamma Radiation - See **Radiation**

Meter - A meter (m) is a metric unit of length; 1 m is equal to approximately 39 inches.

Microroentgen - A microroentgen (μR) is a unit used to measure radiation exposure. For further information, see **Exposure Rate**.

Millirem - The millirem (mrem) is the unit used to measure radiation dose to man. The DOE dose limit is 100 mrem above background radiation levels within any one-year period for members of the general public. Naturally occurring radioactive substances in the ground result in a yearly exposure of about 100 mrem to each member of the population. To date, no difference can be detected between the health of population groups exposed to 100 mrem/yr above background and the health of groups who are not exposed.

Natural Background Radiation - Natural background radiation refers to radiation emitted from the naturally occurring radionuclides found in manmade materials. The concentrations of the radionuclide, and thus the radiation, will vary widely because of variation in the composition of the materials.

Radiation - There are three primary types of radiation: alpha, beta, and gamma. Alpha radiation travels less than an inch in air before it stops, and it cannot penetrate the outer layers of human skin. Beta radiation can penetrate the outer layers of skin but cannot reach the internal organs. Gamma radiation, the most penetrating type, can usually reach the internal organs.

Radionuclide - Radioactive elements are also referred to as radionuclides. For example, uranium-235 is a radionuclide, uranium-238 is another, thorium-232 is another, and so on.

Remedial Action - Remedial action is a general term used to mean cleanup of contamination that exceeds DOE guidelines. It refers to any action required so that a property may be certified as being in compliance with guidelines and may therefore be released for future use. Remedial action also includes restoring remediated properties to their original conditions as far as practicable.

Uranium - Uranium is a naturally occurring radioactive element. The principal use of refined uranium is for the production of fuel for nuclear reactors. Uranium in its natural form is not suitable for use as a fuel source.

APPENDIX A

REMEDIAL ACTION/WASTE MANAGEMENT SUMMARIES

TABLE A-1

REMEDIAL ACTION/WASTE MANAGEMENT SUMMARY FOR VPS 3L AND 6L

WBS 140

REMEDIATION AUTHORITY

SITE Latty Avenue VPs 3L, 6L

X NEPA/CERCLA
SUPERFUND
RCRA

OWNERS H.A. Bardol, J.A. Couch

SITE ADDRESS 9060 Latty Avenue, 8979 Seeger Industrial Drive

CITY, STATE Hazelwood, Missouri

ACTION	DATE	RESPONSIBLE ENTITY	DOCUMENT
DESIGNATION	1990	DOE	Designation Letter
CHARACTERIZATION	1987	ORNL	Characterization Report
CHARACTERIZATION	1990	BNI	Characterization Report
FINAL RA	1994 and 1995	BNI	Post-Remedial Action Report

TOTAL VOLUME 4,610 yd^3
To Remain In Situ 0 Documentation Used: N/A
Volume Reduction 0
Net Disposal 4,610 yd^3

TYPE OF WASTE FOR NET DISPOSAL:

REGULATORY		VOLUME	DISPOSAL SITE
	LLRW		
X	11(E)2	4,610 yd^3	Envirocare of Utah
	MIXED		
	CHEMICAL		
PHYSICAL			
	BUILDING RUBBLE		
	SOIL		
	LIQUID		
	OTHER		

TREATMENT TECHNOLOGIES APPLIED AT THE SITE: N/A

TABLE A-2

REMEDIAL ACTION/WASTE MANAGEMENT SUMMARY FOR SLDS PLANT 10

WBS 116

SITE SLDS Plant 10

OWNERS Mallinckrodt Group, Inc.

SITE ADDRESS North Broadway and Angelrodt Street

CITY, STATE St. Louis, Missouri

REMEDIATION AUTHORITY

X NEPA/CERCLA
SUPERFUND
RCRA

ACTION	DATE	RESPONSIBLE ENTITY	DOCUMENT
DESIGNATION	1990	DOE	Designation Letter
CHARACTERIZATION	1987	ORNL	Characterization Report
CHARACTERIZATION	1990	BNI	Characterization Report
FINAL RA	1996	BNI	Post-Remedial Action Report

TOTAL VOLUME 15,400 yd^3
To Remain In Situ _____
Volume Reduction 1,500 yd^3
Net Disposal 13,900 yd^3

Documentation Used: N/A

TYPE OF WASTE FOR NET DISPOSAL:

REGULATORY		VOLUME	DISPOSAL SITE
	LLRW	_____	_____
X	11(E)2	13,900 yd^3	Envirocare of Utah
	MIXED _____	_____	_____
	CHEMICAL _____	_____	_____
PHYSICAL			
	BUILDING RUBBLE	_____	_____
	SOIL	_____	_____
	LIQUID	_____	_____
	OTHER _____	_____	_____

TREATMENT TECHNOLOGIES APPLIED AT THE SITE: Rock crusher used to crush concrete slab. This material was ultimately used as backfill on-site.

APPENDIX B

POST-REMEDIAL ACTION SOIL SAMPLES

Table B-1
Vicinity Property 3L Post-Remedial Action Soil Samples

Grid	Grid Center[a]		Uranium-238[b] (pCi/g)	Radium-226[b] (pCi/g)	Thorium-230[b] (pCi/g)	Thorium-232[b] (pCi/g)
	Northing (m)	Easting (m)				
1	145	115	3.4	1.1	1.6	0.8
2	125	115	3.7	0.8	1.5	1.0
3	85	105	7.4	1.2	4.6	1.1
4	85	85	4.1	1.1	3.6	1.0
5	85	65	3.0	1.1	1.5	1.1
6	85	45	5.1	1.1	1.2	1.2
7	75	95	3.4	1.2	1.5	1.4
8	75	75	3.5	0.9	3.3	0.8
9	75	55	4.5	1.1	1.9	1.3
10	65	105	3.4	0.8	2.3	1.4
11	65	85	2.1	1.0	2.0	0.9
12	65	65	2.2	1.1	1.9	1.3
13	55	95	2.2	1.1	2.3	1.5
14	55	75	3.5	1.2	9.0	1.2
15	55	55	2.3	1.0	1.8	0.9
16	45	85	2.0	1.2	1.8	0.9
17	45	65	3.3	0.9	3.9	1.1
18	45	45	2.1	0.9	2.2	1.2
19	35	95	2.1	0.9	2.6	1.4
20	35	75	3.2	1.0	1.8	1.2
21	35	55	2.5	0.9	2.4	1.1
22	15	60	2.7	0.8	7.4	1.1
23	5	45	3.3	0.9	3.9	1.1
24	5	5	1.4	1.3	3.0	0.8
25	5	15	1.0	1.1	1.9	1.1
26	5	25	1.4	1.0	2.5	1.2
27	5	35	1.2	1.2	2.1	0.9
28	15	5	1.6	1.4	4.5	1.2
29	15	15	1.8	1.8	1.9	1.0
30	15	25	1.5	1.9	1.7	0.9
31	15	35	1.6	1.0	2.1	0.9
32	25	5	2.1	2.4	8.8	1.1
33	25	15	1.6	1.1	3.5	1.4
34	25	25	1.4	1.4	2.2	1.0
35	25	35	1.8	1.5	1.7	1.1
36	35	5	1.9	1.0	7.5	1.0
37	35	15	1.9	1.1	3.4	0.8
38	35	25	1.4	1.2	3.3	1.2
39	35	35	1.9	1.1	2.0	0.5
40	35	45	1.5	1.6	3.2	0.7
41	45	5	2.1	1.6	7.8	0.5
42	45	15	1.8	1.4	3.4	0.7
43	45	25	1.9	1.3	2.9	0.6
44	45	35	1.6	1.2	3.6	1.2
45	45	45	1.6	1.1	3.1	0.8
46	55	5	2.0	1.1	6.5	0.5
47	55	15	2.1	1.8	2.2	0.5

Table B-1
(continued)

Grid	Grid Center[a]		Uranium-238[b] (pCi/g)	Radium-226[b] (pCi/g)	Thorium-230[b] (pCi/g)	Thorium-232[b] (pCi/g)
	Northing (m)	Easting (m)				
48	55	25	3.2	0.8	3.5	1.1
49	55	35	1.9	0.7	1.6	0.5
50	55	45	2.7	1.2	1.8	0.6
51	65	5	1.3	1.2	3.6	0.6
52	65	15	2.6	1.3	2.1	0.5
53	65	25	1.7	1.6	2.7	0.8
54	65	35	1.3	1.3	2.2	0.6
55	65	45	2.0	1.3	2.2	0.3
56	2.5	112.5	1.6	1.7	3.2	1.2
57	2.5	98.5	1.2	0.8	2.2	1.1
58	0	87.5	1.6	0.9	6.9	0.9
59	-10	87.5	1.3	1.1	1.7	0.7
60	-17.5	84.5	1.4	1.4	1.4	1.0
61	2.5	77.5	1.1	1.2	6.0	0.9
62	-2.5	77.5	1.3	1.1	2.5	1.0
63	2.5	67.5	1.3	1.0	2.6	0.9
64	-2.5	67.5	0.8	1.0	2.0	0.7
65	2.5	57.5	1.5	0.7	4.2	1.0
66	-2.5	57.5	1.9	1.2	1.8	0.8
67	2.5	47.5	1.6	0.8	3.0	0.7
68	-2.5	47.5	1.1	1.2	1.8	0.8
69	2.5	37.5	1.1	1.0	4.3	1.2
70	2.5	27.5	1.4	1.1	4.8	1.5
71	15	95	1.6	1.1	1.7	1.2
72	210	115	1.4	0.9	2.5	1.6
73	190	115	1.5	1.3	2.0	1.0
74	170	115	0.8	1.0	2.3	1.0
75	150	115	0.9	1.3	1.6	1.2
76	130	115	0.8	1.3	1.2	1.0
77	110	115	1.2	1.2	1.8	0.8
78	5	45	1.4	1.7	3.9	0.5
79	15	45	1.3	1.3	3.6	0.9
80	25	45	1.2	2.2	3.4	1.0
81	40	50	1.7	1.1	6.5	1.3
82	5	55	1.1	1.7	6.6	0.7
83	15	55	1.8	0.8	3.6	0.4
84	25	55	1.6	0.7	1.9	0.5
85	5	65	1.0	4.5	4.0	0.8
86	15	65	1.1	0.8	1.9	0.5
87	25	65	1.1	1.0	1.8	0.6
88	10	75	1.4	0.9	1.8	0.5
89	5	85	1.1	1.3	2.1	0.9
90	20	85	1.2	1.0	1.7	0.5
Background	--	--	1.1	0.9	1.3	1.0
Guideline[c]	--	--	50	15	15	15

[a]Property coordinates are shown in Figure B-1.
[b]Includes background levels for the St. Louis area.
[c]Above background.

Table B-2
Vicinity Property 6L Post-Remedial Action Soil Samples

Grid	Grid Center[a]		Uranium-238[b] (pCi/g)	Radium-226[b] (pCi/g)	Thorium-230[b] (pCi/g)	Thorium-232[b] (pCi/g)
	Northing (m)	Easting (m)				
1	259	380	1.4	1.1	1.8	1.1
2	289	310	1.6	0.8	3.5	1.3
3	289	320	1.1	1.3	3.3	1.5
4	289	330	2.2	1.8	3.1	1.0
5	289	340	1.2	1.7	3.6	1.3
6	289	350	1.2	1.6	3.7	1.0
7	299	310	1.6	1.5	3.8	1.2
8	309	315	1.2	0.8	3.1	1.2
9	309	335	1.3	1.1	3.4	0.9
10	309	345	1.1	1.5	4.2	1.0
11	299	320	1.3	0.8	3.8	1.3
12	299	330	1.2	1.1	3.4	1.0
13	299	335	1.3	1.4	5.8	1.6
14	299	345	1.3	1.5	4.9	1.3
15	304	366	1.5	1.3	7.3	2.1
16	311	280	1.6	1.3	3.6	0.5
17	310	335	1.5	1.1	2.8	1.2
18	310	320	1.1	1.1	3.4	1.4
Background	--	--	1.1	0.9	1.3	1.0
Guideline[c]	--	--	50	15	15	15

[a]Property coordinates are shown in Figure B-2.
[b]Includes background values for the St. Louis area.
[c]Above background.

Table B-3
SLDS Plant 10 Post-Remedial Action Soil Samples

Grid	Grid Center[a]		Uranium-238[b,c] (pCi/g)
	Northing (m)	Easting (m)	
1	35	80.9	33.5
2	45	80.9	33.5
3	45	65	15.2
4	45	55	7.7
5	55	55	8.0
6	55	75	13.6
7	55	80.9	15.1
8	65	75	10.3
9	65	80.9	15.1
10	75	75	12.7
11	75	80.9	15.1
12	85	71.5	12.1
13	62	65	9.1
14	45	75	19.6
15	35	75	11.3
16	25	80.4	33.5
17	15	80.4	33.5
18	5	80.4	33.5
19	25	75	15.1
20	15	75	7.7
21	5	75	11.2
22	55	65	14.4
23	35	55	<4.6
24	35	65	<4.4
25	25	65	12.0
26	15	69	10.6
27	5	65	10.6
28	55	45	11.4
29	45	45	16.8
30	35	45	14.8
31	62	55	6.6
32	62	45	6.6
33	55	35	<4.1
34	45	35	8.4
35	35	35	17.2
36	25	34	8.8
37	35	25	18.5
38	25	25	8.0
39	45	25	23.4

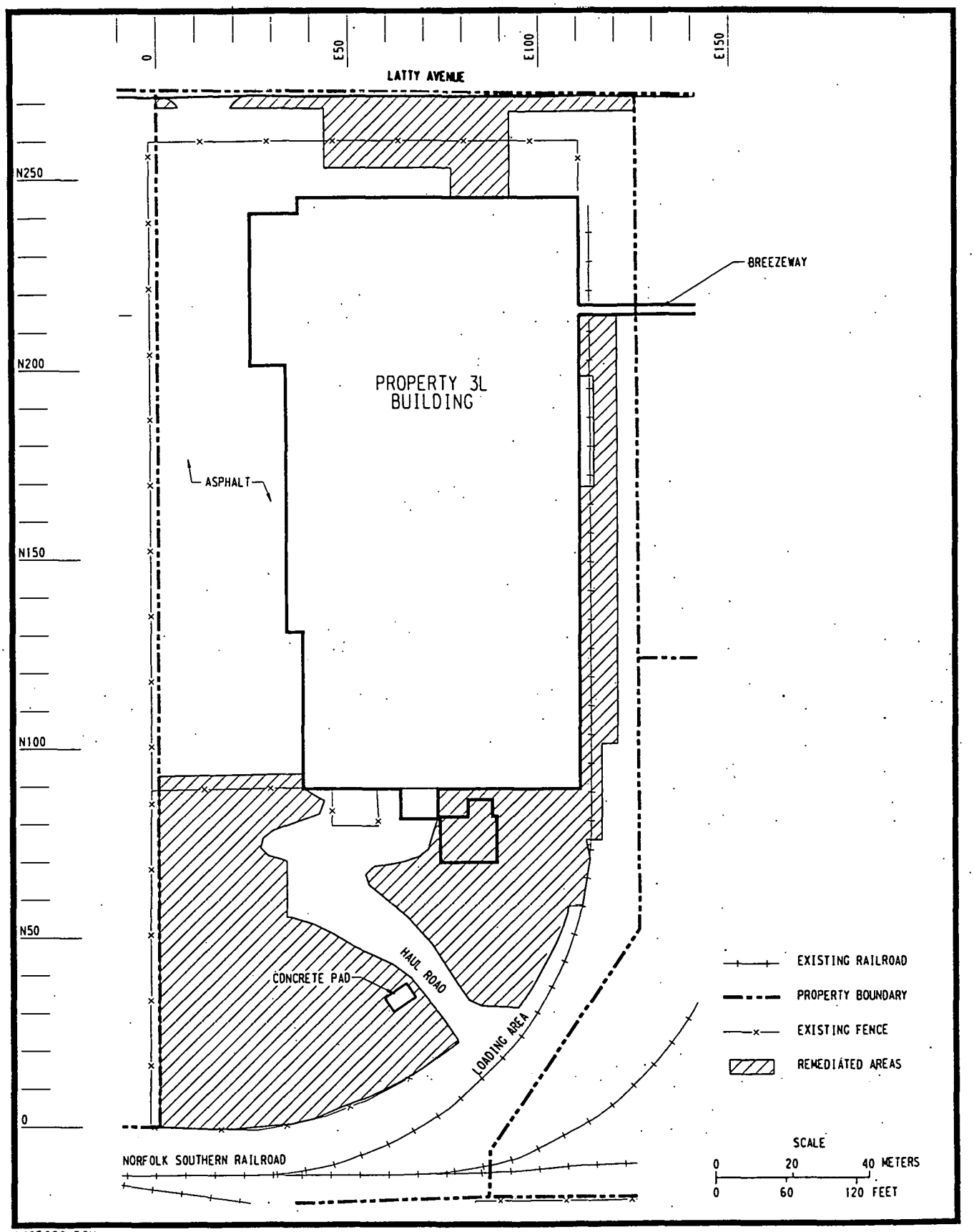
Table B-3
(continued)

Grid	Grid Center[a]		Uranium-238[b,c] (pCi/g)
	Northing (m)	Easting (m)	
40	85	-5	2.3
41	75	-5	14.9
42	62.5	34	<3.8
43	67.5	33	<3.4
44	75	32	<3.4
45	104	68	<2.9
46	65	25	11.4
47	75	25	<3.9
48	85	25	9.5
49	85	15	<3.6
50	75	15	6.4
51	65	15	5.4
52	65	5	5.6
53	75	5	6.9
54	85	5	<3.5
55	65	-5	4.3
56	67	45	<2.1
57	55	25	15.2
58	67	55	<2.5
59	67	65	5.0
60	75	55	<2.6
61	75	65	7.7
62	75	45	<2.9
63	85	55	<2.0
64	85	65	<3.2
65	55	-5	7.8
66	55	5	6.8
67	55	15	5.9
68	45	-5	2.0
69	45	5	<3.2
70	45	15	<3.8
71	35	-5	4.4
72	35	5	5.1
73	35	15	4.3
74	85	45	<2.8
75	85	38	<3.0
76	95	38	<3.0
77	102	38	<2.7
78	95	45	<2.1
79	95	55	<2.9
80	95	65	4.3

Table B-3
(continued)

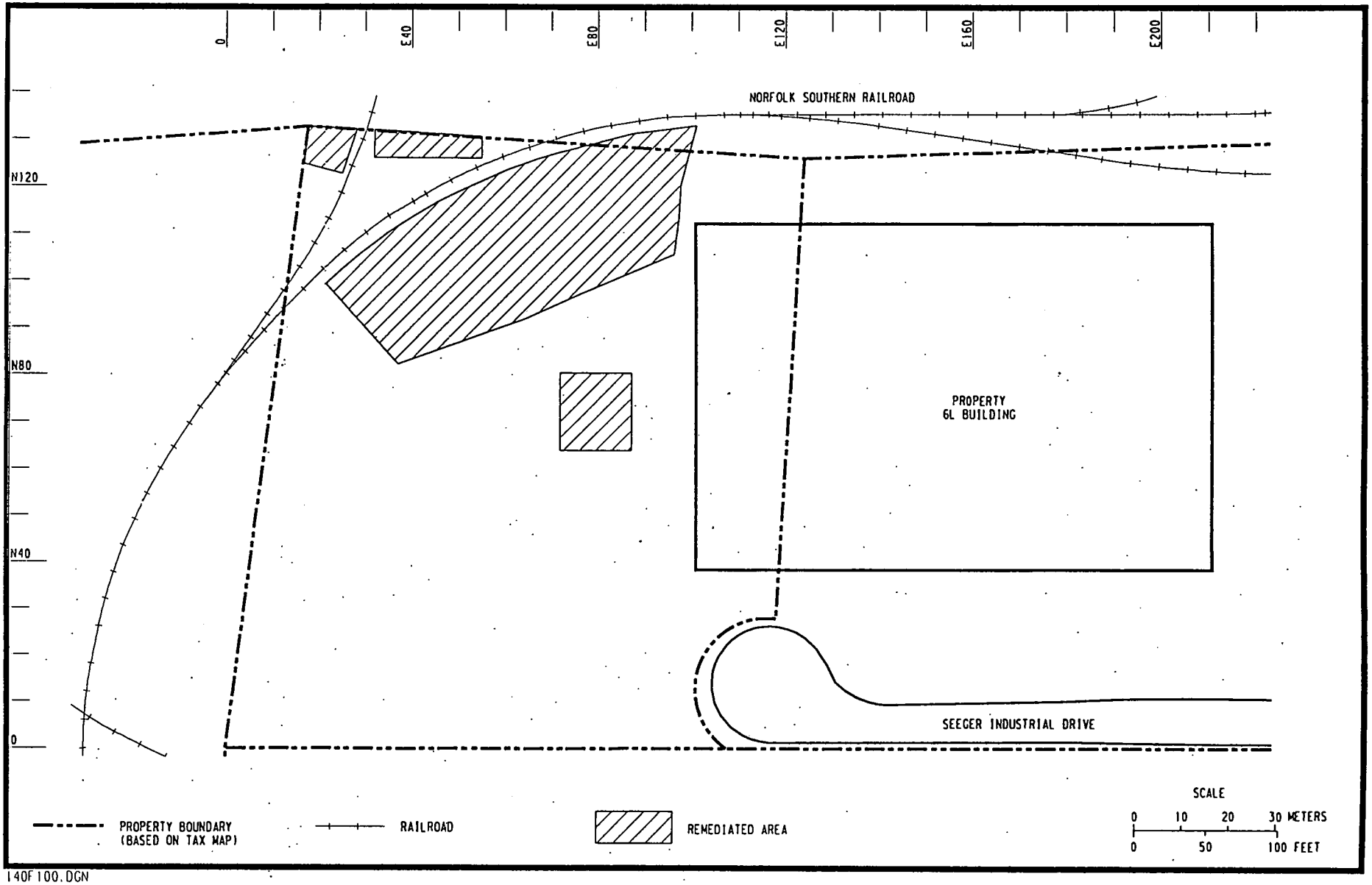
Grid	Grid Center[a]		Uranium-238[b,c] (pCi/g)
	Northing (m)	Easting (m)	
81	102	45	<2.7
82	102	55	<2.2
83	102	63.5	<2.2
84	25	-11	<2.1
85	25	-5	<3.0
86	2	58	4.4
87	25	15	<3.4
88	15	-11	<2.1
89	15	-5	<3.4
90	15	5	4.7
91	15	15	<3.8
92	15	25	<2.4
93	15	35	4.2
94	5	-11	<2.1
95	5	-5	2.9
96	5	5	4.2
97	8	15	2.9
98	8	25	5.3
99	8	33	5.3
Background	--	--	1.1
Guideline[d]	--	--	50

[a]Property coordinates are shown in Figure B-3.
[b]Includes background levels from the St. Louis area.
[c]< indicates that the result was less than the minimum detectable activity (MDA).
[d]Above background.



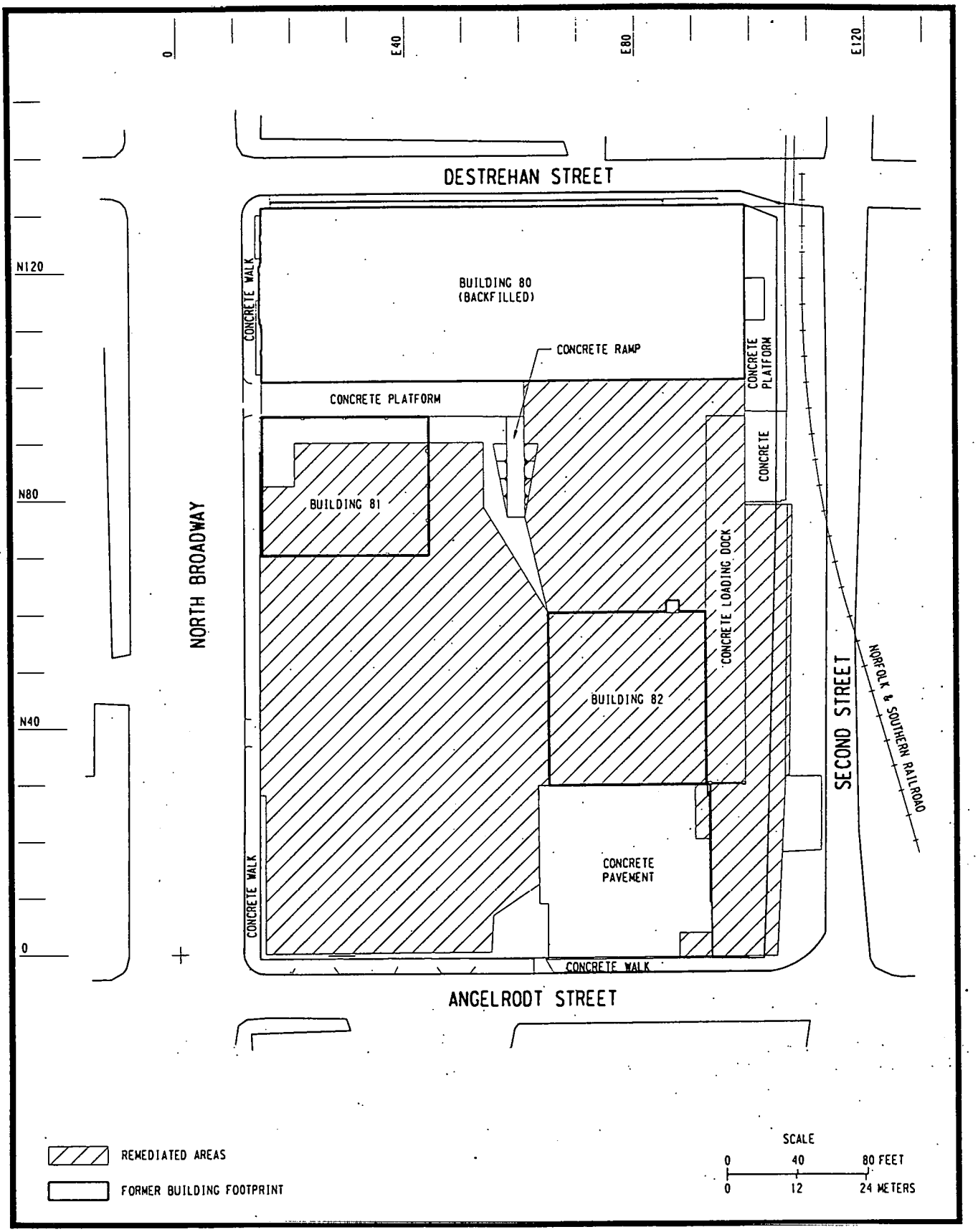
140F099.DGN
10/24/96

Figure B-1
Areas of Remediation at Vicinity Property 3L
With Metric Property Grid



140F100.DGN
10/24/96

Figure B-2
Areas of Remediation at Vicinity Property 6L
with Metric Property Grid



116F160.DGN
10/24/96

Figure B-3
Areas of Remediation at SLDS Plant 10
with Metric Property Grid

APPENDIX C

POST-REMEDIAL ACTION SURVEY PLANS

[Note: As stated in the following Post-Remedial Action Survey Plans, TN and ORISE obtained site-specific background measurements from three remote background locations in the general vicinity of the site. However, the exact locations used by TN and ORISE were not the same.]

LATTY AVENUE VICINITY PROPERTIES 3L AND 6L
POST-REMEDIAL ACTION SURVEY PLAN

PURPOSE

The purpose of this plan is to describe the methodologies that the Formerly Utilized Sites Remedial Action Program (FUSRAP) will use for radiological surveys, sampling, and analysis to document the final condition of the Latty Avenue Vicinity Properties 3L and 6L as free of radioactive contamination above the Department of Energy's health based criteria [DOE Order 5400.5 (Reference 1)]. Nothing herein is intended to compromise the Independent Verification Contractor's (IVC) independence; the purpose is to document the Prime Management Contractor's (PMC) plans to conduct post-remedial action surveying/sampling and to coordinate their actions with the IVC. This plan implements the DOE protocol for verification and certification of sites under FUSRAP (Reference 2).

Bechtel National, Inc. (BNI) will be the FUSRAP PMC, and the Oak Ridge Institute for Science and Education (ORISE) will act as the IVC.

BACKGROUND

Manhattan Engineer District acquired the St. Louis Airport Site (SLAPS) in 1946 and used it from 1946 until 1966 to store residues from the St. Louis Downtown Site (SLDS). The residues included pitchblende raffinate residues, radium-bearing residues, barium sulfate cake, Colorado raffinate residues, and contaminated scrap. In 1966, these residues were purchased by Continental Mining and Milling Company of Chicago, removed from SLAPS, and placed in storage at 9200 Latty Avenue [currently the Hazelwood Interim Storage Site (HISS) and the adjacent Futura Coating site]. In the process of transporting the residues from SLAPS to Latty Avenue, some of the material was spilled from trucks onto the roadside. Characterization activities have established that contamination is present on most of the HISS vicinity properties (properties along Latty Avenue). Redistribution of the contamination on the properties has probably occurred as a result of flooding, surface runoff, and road and utility line activities (Reference 3).

RESIDUAL CONTAMINATION GUIDELINES

The source of contamination of the designated properties was residues from the processing of uranium bearing ores. The applicable residual contamination guidelines are as follows:

radionuclide [a]	soil concentration above background [b]
Radium-226 Thorium-230 Thorium-232	5 pCi/g averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over any 15-cm-thick soil layer below the surface layer.
Uranium-238	50 pCi/g averaged over any 15-cm-thick soil layer.

[a] Radium and thorium guidelines from Reference 1. Uranium guideline is site specific.

[b] These guidelines take into account ingrowth of radium-226 from thorium-230 and of radium-228 from thorium-232, and assume secular equilibrium. If either thorium-230 and radium-226 or thorium-232 and radium-228 are both present, not in secular equilibrium, the guidelines apply to the higher concentration. If other mixtures of radionuclides occur, the sum of the ratios of the soil concentration of each radionuclide to the allowable limit for that radionuclide will not exceed 1.

The residual contamination guidelines for fixed and transferable radioactive contamination (dpm/100 cm^2) (Reference attached):

	average	maximum	removable
Alpha	500	1,500	20
Beta-Gamma	5,000	15,000	1,000

DECONTAMINATION ACTIVITIES

A Real Estate Instrument (REI) shall be in place for the properties to be remediated. All designated areas of contamination are exterior to any buildings. At a minimum, remediation of the site will consist of excavation of soil exceeding the applicable residual contamination guidelines and decontamination of structures exceeding the residual contamination guidelines for fixed and transferrable criteria. Contaminated structures such as culverts, utility poles, and pipelines may be encountered during excavation.

Consequently, verification surveys and sampling will focus on confirming that soil and structures remaining after remedial action do not contain radioactive contamination at concentrations exceeding the applicable guidelines. To the extent necessary, equipment used during the decontamination activities will be cleaned and surveyed for surface contamination prior to release.

Areas where remedial activities will be conducted will include, but will not be limited to, those identified in the site characterization report (Reference 3) and the Design Drawings 140-DD433-C01, indicating the general areas to be excavated.

POST-REMEDIATION SURVEYS AND SAMPLING

Following remediation, the FUSRAP Radiological Support Subcontractor (RSS), ThermoNuclear Services (TNS), will perform post-remedial action surveys and sampling to determine the completeness of the removal action and to document that the site now complies with the applicable criteria and can be released for use without radiological restrictions.

Survey Equipment

The recommended equipment for use by FUSRAP for Post-RA verification includes:

- Gamma scintillation detector (Eberline SPA-3 or equivalent)
- Low range/high range detector (HP-270 or equivalent)
- Reuter-Stokes Pressurized Ion Chamber (PIC)

The recommended equipment for use by FUSRAP for release of equipment and materials from the site includes:

- Alpha scintillation detector (Eberline AC-3 or equivalent)
- Alpha scintillation counter (Eberline SAC-4 or equivalent)
- Beta/Gamma Pancake GM detector (7 mg/cm^2 mylar shielded Eberline HP-210 or equivalent)

The types of calibration sources and methods for instrument calibration will be coordinated between Bechtel/TNS and ORISE to insure compatibility and reproducibility of results.

Background Measurements

Prior to performing post-remedial action surveys, TNS will obtain site-specific background measurements from three remote background locations in the general vicinity of the site (0.5 to 3 miles) according to TNS procedure 3C.2 (Reference 4A). The location for background measurements will be selected by Bechtel and TNS, and background measurements will be made at each location by TNS and ORISE. TNS and ORISE will utilize background concentrations for radionuclides in soil that were established for the St. Louis area and reported in the *Radiological Characterization Report for FUSRAP Properties in the St. Louis, Missouri, Area*, August 1990.

Surveys

After completion of the excavation of contaminated soils, TNS shall conduct post-remedial action surveys to verify satisfactory decontamination of the area. A survey grid shall be established at the site, conforming to the specifications in TNS procedure 3B.1 (Reference 4B) and 191-IG-032, "Instruction Guide for Post-Remediation Radiological Survey of Soil" (Reference 5), and surveys shall be conducted in each square of the 10 m by 10 m grid. The grids shall be numbered in sequential order and recorded in the logbook with the coordinates for the center of each grid. To ensure comparability of post-remedial action results, ORISE will use the same grid.

Any structures within the excavations, such as culverts, utility poles, or pipes, will be surveyed for release according to TNS procedures 3A.2 and 3A.3 (References 4D and 4E) after all visible dirt has been removed.

TNS will measure external gamma radiation exposure rates at a height of 1 meter as required by 191-IG-032 (Reference 5); at the number of locations necessary to be representative of the entire remediated area as required by FCR-116-17 (attached, applies to all St. Louis Sites); using methods in accordance with TNS procedure 3B.3 (Reference 4C). The results of this survey will be submitted to the Bechtel ET team lead, including a sketch of grid locations and approximate excavation depths, before backfilling the excavation. This information will also be recorded in the sampling logbook.

Soil Sampling

TNS shall also collect post-remedial action soil samples to verify satisfactory remediation of the properties. One post-remedial action composite sample shall be collected in each 100 m^2 grid as directed in 191-IG-032 and TNS procedure 4A.1 (References 4F and 5). Composite samples will be collected by taking individual samples (25 per 100 m^2) from each sample grid and compositing these individual samples into one composite for that grid (Figure 1). ORISE may request concurrent splits.

The averaging criteria contained in *A Manual for Implementing Residual Radioactive Material Guidelines* (Reference 11) and DOE Order 5400.5, Chapter IV, Section 4 will be used for point sources/hot spots.

Samples from each grid shall be collected using properly decontaminated sampling equipment (Reference 6).

Proper chain of custody of the TNS samples shall be maintained by using the sample custody and labeling methodology described for sediment samples in 191-IG-028, "Instruction Guide for Surface Water and Sediment Sampling Activities" (Reference 7) and the sample

surveying, packaging, and shipping methodology in PI R4.7, "How to Ship Samples from a FUSRAP Site" (Reference 8).

All samples shall be shipped to the TNS laboratory in Oak Ridge, TN, for analysis by alpha spectroscopy (isotopic uranium, isotopic thorium, and radium-226). Seven day turn around time shall be requested.

Safety and Health

Safety and health risks associated with tasks described herein have been identified and addressed by the *Health and Safety Plan for the St. Louis Site* (Reference 9).

The work will be performed under a Hazardous Work Permit specific to the activities.

Quality Assurance/Quality Control

QA/QC field duplicate samples and measurements shall be collected at a frequency of one additional sample/measurement for each 20 collected.

Rinse blanks from decontaminated sampling equipment shall be collected at the rate of one rinse per day of sampling. Rinse blanks shall be collected according to the recommendations in 191-IG-028 (Reference 7).

Data Quality Objectives

The detection limit for alpha spectroscopy shall be no greater than 0.1 pCi/g. Quality indicator goals shall be as follows: Precision, ± 2 sigma; completeness, 100%; Accuracy, ± 25%. QA/QC samples are discussed in the previous section.

BECHTEL/ORISE COORDINATION

Bechtel is the contractor responsible for completing the remedial action. To define the areas for remediation, Bechtel used data collected by ORNL during designation, as well as supplemental information obtained by Bechtel as part of the pre-RA planning and scoping activities.

Bechtel will have responsibility for excavation of contaminated soil. Upon completion of these activities, TNS will perform a post-RA survey. ORISE will then commence verification of the remediated properties. ORISE will perform a walkover survey on the surface of the ground. The result of this walkover survey shall be used to determine whether there are areas requiring additional remediation. This survey is expected to include all areas

previously identified as being contaminated on the designated properties. Bechtel will assist ORISE in this survey by interfacing with the property owners in advance to secure their approval for property access.

Bechtel will initiate remediation concurrent with ORISE verification activities, to the extent that remediation does not interfere with verification. Bechtel will provide ORISE access to remediation results as they become available. The Bechtel Site Superintendent will notify ORISE when remediation of an area is complete, and ORISE will perform final independent verification surveys of the area. ORISE may collect soil sample splits concurrent with Bechtel sampling efforts.

Measurements taken by Bechtel and ORISE at identical locations should agree within the 95 percent confidence interval for the analytical methods used (Reference 2). For consistency and ease of data comparison, Bechtel and ORISE shall utilize the same type of calibration techniques, calibration sources, and survey techniques in conducting the surveys. Bechtel and ORISE shall establish a mutually agreeable survey grid across the decontaminated areas and shall conduct their surveys referring to that grid.

Upon agreement by both parties that the site meets the applicable residual contamination guidelines as determined by direct measurements and analytical results, ORISE will then demobilize, and Bechtel will remain to restore the site to the condition agreed upon by the property owners.

Bechtel will provide final verified sample results to ORISE as soon as they are available. A letter documenting the release of the properties for unrestricted use shall be prepared by Bechtel and sent to the property owners within 3 months following demobilization. Bechtel will also prepare one Post-Remedial Action Report (PRAR) per year for the St. Louis properties remediated during the year for DOE review (copy to ORISE). A Certification Docket will be completed by Bechtel after the completion of all additional St. Louis vicinity properties. ORISE will issue a verification report to DOE with a copy to Bechtel (Reference 2).

REFERENCES

(1) DOE Order 5400.5, *Radiation Protection of the Public and Environment*, Washington, D.C.

(2) DOE, 1990, *Verification and Certification Protocol for the Office of Environmental Restoration FUSRAP and D&D Program*, Revision 3, November.

(3) DOE/OR/20722-203, *Radiological Characterization Report for FUSRAP Properties in the St. Louis, Missouri, Area*, August 1990.

(4) ThermoNuclear Services (TNS), *Health Physics Operational Procedures Manual*:

A) 3C.2 "Determination of Background"
B) 3B.1 "Delineation of Survey Areas in Open Land"
C) 3B.3 "Gamma Ray Exposure Rate Surveys at 1-Meter in Open and Enclosed Areas"
D) 3A.2 "Direct Surface Contamination Survey"
E) 3A.3 "Transferable Surface Contamination Survey"
F) 4A.1 "Systematic and Bias Surface Soil Sampling (Radiological)"

(5) BNI, 1993, "Instruction Guide for Post-Remediation Radiological Survey of Soil," 191-IG-032, Revision 0; and FCR 116-17.

(6) BNI, 1992, "Instruction Guide for Decontamination of Field Sampling Equipment at FUSRAP Sites," 191-IG-011, Revision 5.

(7) BNI, 1993, "Instruction Guide for Surface Water and Sediment Sampling Activities," 191-IG-028, Revision 0.

(8) BNI, 1994, "How to Ship Samples from a FUSRAP Site," PI R4.7, Revision 2.

(9) BNI, 1993, *Health and Safety Plan for the St. Louis Site*, 116/134/140/153-HSP, Rev. 0.

(10) Fiore to Price, "Uranium Cleanup Guidelines for St. Louis, MO, FUSRAP Sites," November 6, 1990, CCN 072892.

(11) DOE/CH/8901, *A Manual for Implementing Residual Radioactive Material Guidelines*, June 1989.

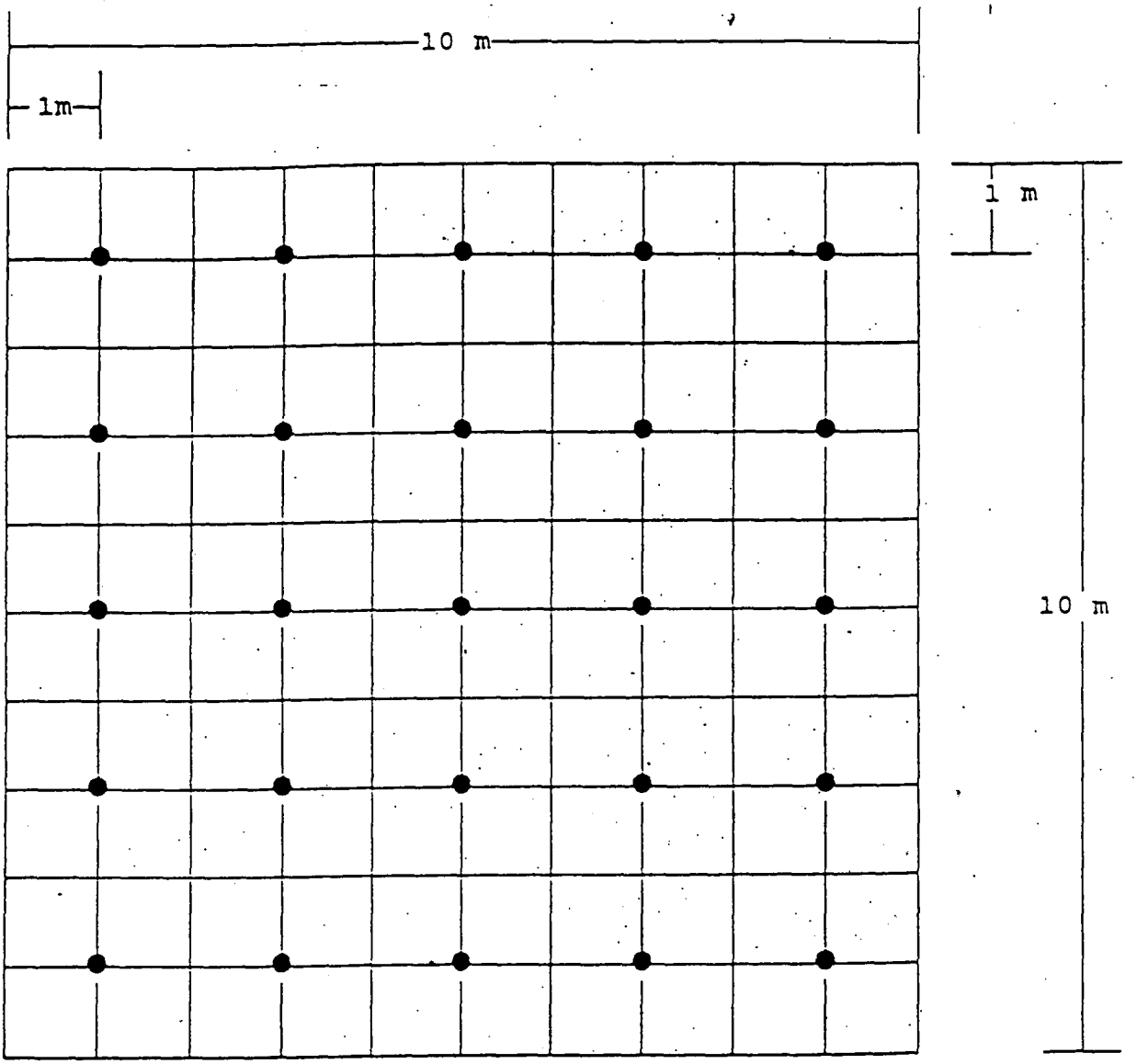


FIGURE 1: Survey Grid - 10 m x 10 m

SAINT LOUIS DOWNTOWN SITE
POST-REMEDIAL ACTION SURVEY PLAN

PURPOSE

The purpose of this plan is to describe the methodologies that the Formerly Utilized Sites Remedial Action Program (FUSRAP) will use for radiological surveys, sampling, and analysis to document the final condition of the St. Louis Downtown Site (SLDS) Plant 10 Area (city block 1201) as free of radioactive contamination above the release standards of the Department of Energy (DOE) Order 5400.5 (reference 1). Nothing herein is intended to compromise the Independent Verification Contractor's (IVC) independence; the purpose is to document the Prime Management Contractor's (PMC's) plans to conduct post-remedial action surveying/sampling and our understanding of how we will coordinate with the IVC. Specifically, the Plant 10 area of the Mallinckrodt Chemical Works will be addressed in this plan. This plan addresses the DOE protocol for verification and certification of sites under FUSRAP (reference 2).

Bechtel National, Inc. (BNI) will be the FUSRAP PMC, and the Oak Ridge Institute for Science and Education (ORISE) will act as the IVC.

BACKGROUND

The source of contamination of the Saint Louis Downtown Site was residue from the processing of uranium bearing ores.

RESIDUAL CONTAMINATION GUIDELINES

At SLDS, uranium is the controlling radionuclide. The applicable residual contamination guidelines are as follow (see reference 1):

Radionuclide[a]	Soil Concentration Above Background[b]
Radium-226 Thorium-230 Thorium-232	5 pCi/g averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over any 15-cm-thick soil layer below the surface layer.
Uranium-238	50 pCi/g averaged over any 15-cm-thick soil layer.

[a] Radium and thorium guidelines are from Reference 1. The uranium guideline is site specific

[b] These guidelines take into account ingrowth of radium-226 from thorium-230 and of radium-228 from thorium-232, and assume secular equilibrium. If either thorium-230 and radium-226 or thorium-232 and radium-228 are both present, not in secular

equilibrium, the guidelines apply to the higher concentration. If other mixtures radionuclides occur, the sum of the ratios of the soil concentration of each radionuclide to the allowable limit for that radionuclide will not exceed 1.00.

The residual contamination guidelines for fixed and removable radioactive contamination (dpm/100 cm^2) are as follow:

	Alpha	Beta
Removable:	1000	1000
Fixed: (average)	5000	5000
(maximum)	15000	15000

DECONTAMINATION ACTIVITIES

The St. Louis Downtown Site Plant 10 is the designated area addressed in this plan.

All areas of contamination are limited to soil and below grade structures. The site owne demolish existing above grade structures in Plant 10 prior to the start of remedial actio Contaminated structures such as culverts, concrete elements, and underground utilities ma be encountered during excavation of the designated areas.

Real Estate Instruments shall be in place for the remedial action.

At a minimum, remediation of the site will consist of excavation of soil exceeding the sit specific criteria and decontamination of below grade structures exceeding the DOE guidel for fixed and transferable radioactive contamination.

Post-remedial action surveys and sampling will focus on confirming that soil and structure buried within the soil which remain after remedial action, do not contain radioactive contamination at concentrations exceeding applicable guidelines. To the extent necessary, equipment used during the decontamination activity will be cleaned and surveyed accordi to ThermoAnalytical (TMA) procedure 2C.1 "Release of Equipment and Materials" (reference 4A). prior to release.

Areas where remediation activities will be conducted will include, but not be limited to, those identified in the site characterization report (reference 3) and the following design drawings: 116-DD433-C01 and 116-DD433-C02.

The design drawings (see above) delineate those general areas that will be excavated. Tho areas of radioactive contamination include areas beneath Building 81, Building 82, and t Loading Dock area near Building 82. The remedial action will be limited to areas within fenced Mallinckrodt Plant 10 property.

POST-REMEDIATION SURVEYS AND SAMPLING

Following remediation, the FUSRAP Radiological Support Subcontractor (TMA) will perform post-remedial action surveys and sampling to determine the completeness of the removal action and to document that the site now complies with the applicable criteria and can be released for use without radiological restrictions.

Survey Equipment

The recommended equipment for use by FUSRAP for boundary delineation includes:

- Field Instrument for Detection of Low Energy Radiation (FIDLER)
  (calibration source: Am-241)

- Gamma Scintillation Detector (Eberline SPA-3 or equivalent), or low range/high range HP-270 or equivalent
  (calibration source: Cs-137)

The recommended equipment for use by FUSRAP for Post-RA Surveys includes:

- Gamma Scintillation Detector (Eberline SPA-3 or equivalent), or low range/high range HP-270 or equivalent
  (calibration source: Cs-137)

- Reuter-Stokes Pressurized Ion Chamber (PIC)
  (calibrated by manufacturer)

The recommended equipment for use by FUSRAP for release of equipment and materials from the site includes:

- Alpha Scintillation detector (Eberline AC-3 or equivalent)
  (calibration source: Th-230)

- Beta/Gamma Pancake GM detector (7 mg/cm^2 mylar shielded (Eberline HP-210 or equivalent)
  (calibration sources: Sr-90, Y-90)

- Alpha Scintillation Counter (Eberline SAC-4 or equivalent)
  (calibration source: Th-230)

The same type calibration sources (i.e., same radionuclide) and methods for instrument calibration will be used by Bechtel and ORISE to insure compatibility and reproducibility of survey results.

Background Measurements

Prior to performing post-remedial action surveys, TMA will obtain site-specific instrument background measurements from three remote background locations in the general vicinity of the site (0.5 to 3 miles) according to TMA procedure 3C.2 (reference 4B). The location for background measurements will be selected by Bechtel and TMA, and background measurements will be made at each location by TMA and ORISE. TMA and ORISE will utilize background concentrations for radionuclides in soil that were established for the St. Louis area and reported in the *Radiological Characterization Report for* FUSRAP *Properties in the St. Louis, Missouri, Area*, August 1990.

Surveys

After completion of excavation of the contaminated soils, TMA shall conduct post-remedial action surveys to verify satisfactory decontamination of the area. A survey grid shall be established at the site, conforming to the specifications in TMA procedure 3B.1 (reference 4C) and the "Instruction Guide for Post-Remediation Radiological Survey of Soil" (191-IG-032, reference 5), and surveys shall be conducted in each square of a suggested 10 m by 10 m grid (100 m^2). When deviating from the 10 m by 10 m grid (due to small irregularities in area of contamination), total area shall not exceed 100 m^2.

After all visible loose dirt has been removed, structures (utility poles, culverts, etc.) formerly in the contaminated area will be surveyed for release.

TMA will measure external gamma radiation exposure at a height of 1 m in the center of each 10m by 10m grid as required by 191-IG-032 (reference 5) using methods in accordance with TMA procedure 3B.3 (reference 4D).

Uncontaminated soils which have been excavated will be stockpiled, surveyed, and sampled to confirm that they are uncontaminated.

Soil Sampling

TMA shall also collect post-remedial action soil samples to verify satisfactory remediation of the area. Samples shall be collected from an approximately 100 m^2 grid (suggested 10m by 10m) as directed in 191-IG-032, and TMA procedure 4A.1 (references 5 and 4G).

Point Sources ("Hot Spots") will be taken into account by using the averaging criteria contained in "A Manual for Implementing Residual Radioactive Material Guidelines" (reference 13) and DOE Order 5400.5, Chapter IV, Section 4. Where appropriate, a "hybrid grid" (made up of portions of one or more site grids) will be implimented to bound and assign the area (in square meters) to each "hot spot" in question.

Based on current estimates of anticipated areas of excavation, a minimum of 40 composite samples will be collected. Composite samples will be collected by taking individual samples (25 per 100 m^2, Figure 1) from each sample grid and compositing these individual samples into one composite sample for that grid. ORISE may collect splits concurrently.

Samples from each grid square shall be collected using properly decontaminated sampling equipment (reference 6).

TMA samples shall be handled using the sample custody and labeling methodology described for sediment samples in the "Instruction Guide for Surface Water and Sediment Sampling Activities" 191-IG-028 (reference 7) and the sample surveying, packaging, and shipping methodology in PI R4.7 "How to Ship Samples from a FUSRAP Site" (reference 8).

If available, the mobile gamma spectroscopy system will be used to analyze all samples; 5% of the samples will be shipped to the TMA laboratory in Oak Ridge, TN, for analysis by gamma spectroscopy (7 day turn around for uranium 238) and alpha spectroscopy (3 day turn around for isotopic uranium, isotopic thorium, and radium-226). Alternatively, samples shall be shipped to the TMA laboratory in Oak Ridge, TN prepared and analyzed using alpha spectroscopy (Isotopic U, Isotopic Th, and Ra-226). A three day turn around time shall be requested.

Soil Sampling From Excavation Face

Figures 2 and 3 contain general guidance for soil sampling from the excavation face. In areas where the face of the excavation under the sidewalk or other structure is vertical and where contamination extends to the Plant 10 boundary, take one sample per grid (biased to areas associated with increased instrument count rates if present) from the uppermost portion of the material (soil) immediately below any gravel base material (see Figure 2).

In areas where the face of excavation adjacent to the sidewalk or other structure is sloped, material must be removed in order to create a vertical face (see Figure 3) and then the sample should be collected in the same manner as above.

All material removed from the sloped face should be treated as contaminated material (bagged or placed in a bucket and ultimately placed into a container for disposal).

These samples should not be composites. All samples should be obtained from most probable areas of contamination. If survey instruments do not indicate count rates above background, the samples should be obtained from areas adjacent to excavated areas where activity, significantly above background, was known to exist prior to excavation.

Contamination along the western boundary of Plant 10 (CB 1201) will be left in-situ if it extends beyond the Mallinckrodt property line (under the sidewalk) along Broadway. Since

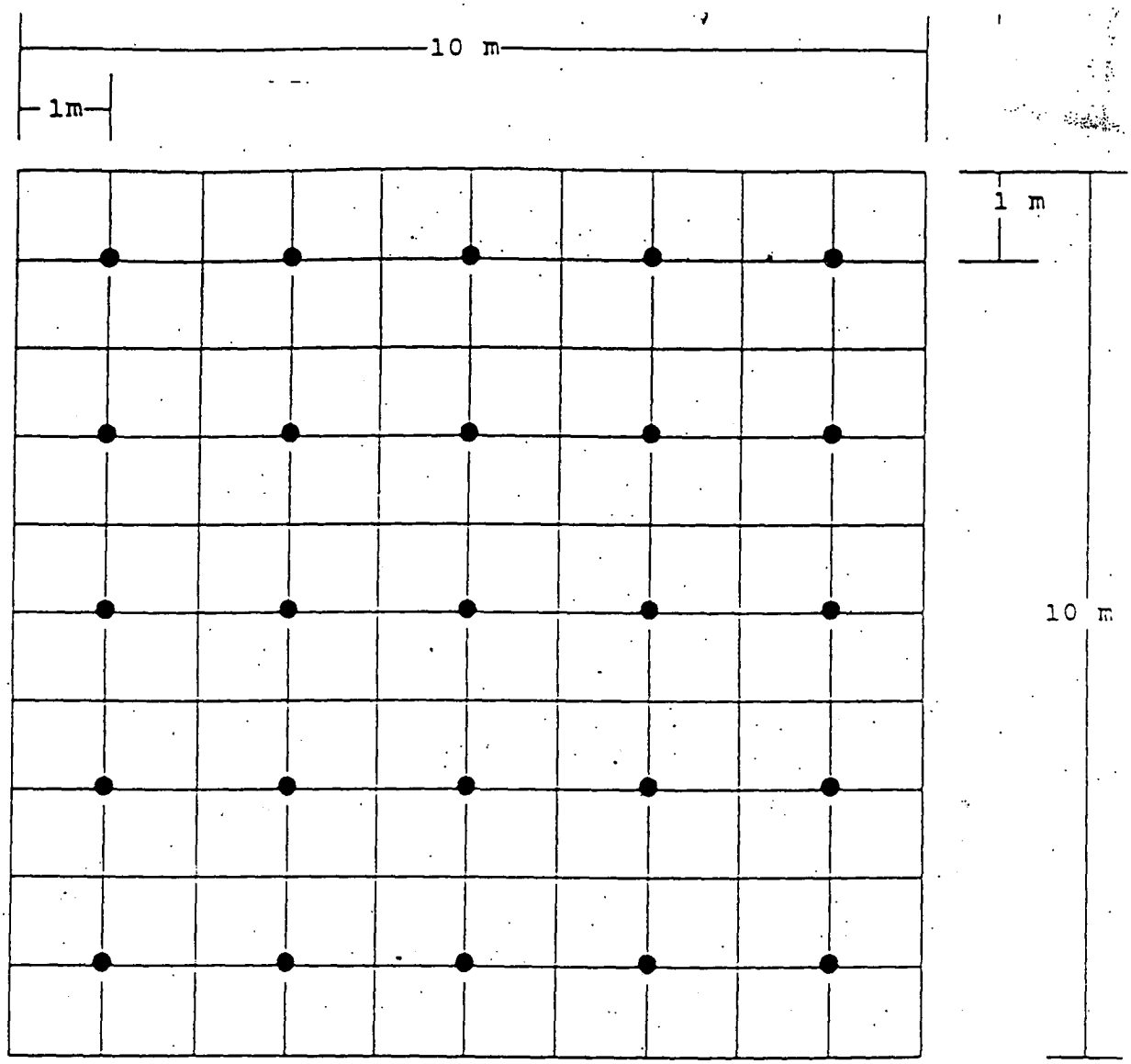


FIGURE 1: Survey Grid - 10 m x 10 m

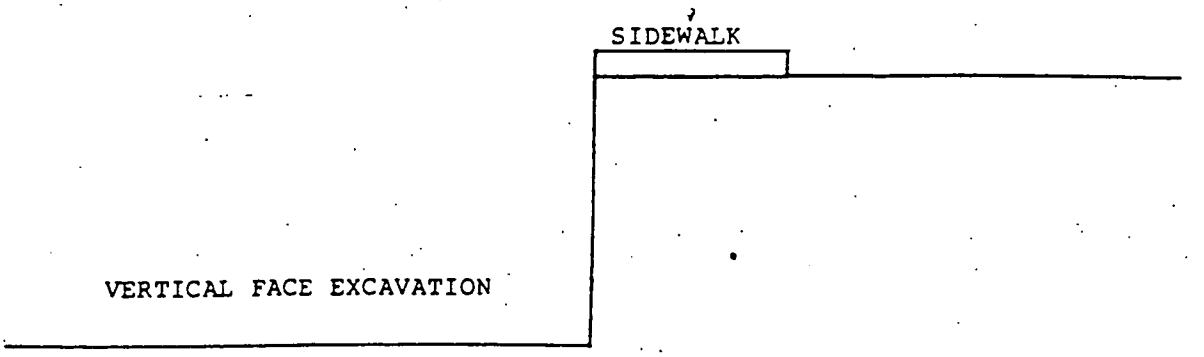


FIGURE 2

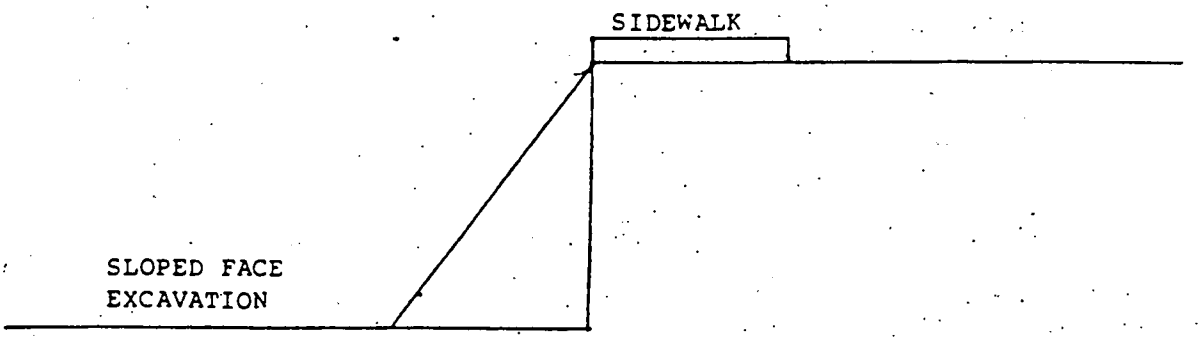


FIGURE 3

all of the above-guideline contamination on the Mallinckrodt property will have been removed, the property (Plant 10) will be releasable.

Safety and Health

Safety and health risks associated with tasks described herein have been identified and addressed by the *Health and Safety Plan for the St. Louis Site.*

The work will be performed under a Hazardous Work Permit specific to the survey activities as well as any permits required by Mallinckrodt (Hot Work Permit, site specific training, etc.).

Quality Assurance/Quality Control

QA/QC field duplicate samples and measurements shall be collected at a frequency of one additional sample/measurement for each 20 collected.

Rinse blanks from decontaminated sampling equipment shall be collected at the rate of one rinse per day of sampling. Rinse blanks shall be collected according to the recommendations in 191-IG-028 (reference 7).

Data Quality Objectives

The detection limit for total thorium by alpha spectroscopy shall be less than 2 pCi/g (half criterion) and the detection limits for thorium-230 and thorium-232 shall each be less than 1 pCi/g. Quality indicator goals shall be as follows: Precision, $\pm$ 2 sigma; completeness, 100%; Accuracy, $\pm$ 25%). QA/QC samples are discussed in the previous section.

BECHTEL/ORISE COORDINATION

Bechtel is the contractor responsible for completing the remedial action. To define the areas for remediation, Bechtel used data collected by ORNL during designation, as well as supplemental information obtained by Bechtel as part of pre-RA planning and scoping activities.

Bechtel will have responsibility for excavation of contaminated soil. Upon completion of these activities Radiological Site Support (RSS) will perform post-RA survey, then ORISE will commence verification of the remediation of the property. The result of this walkover survey shall be used to determine whether there are areas requiring additional remediation. This survey is expected to include all areas previously identified as being contaminated on the designated properties. Bechtel will assist ORISE in this survey by interfacing with the property owner in advance to secure approval for property access.

Bechtel will initiate remediation concurrent with ORISE verification activities, to the extent that remediation does not interfere with verification. Bechtel will provide ORISE access to remediation results as they become available. The Bechtel Site Superintendent will notify ORISE when remediation of an area is complete, and ORISE will perform independent verification surveys of the area. ORISE may collect soil sample splits concurrent with Bechtel sampling efforts.

Measurements taken by Bechtel and ORISE at identical locations should agree within the 95 percent confidence interval for the analytical methods used (reference 2). For consistency and ease of data comparison, Bechtel and ORISE shall utilize the same type of calibration techniques, calibration sources, and survey techniques in conducting the surveys. Bechtel and ORISE shall utilize the previously established SLDS survey grid across the decontaminated areas and shall conduct their surveys referring to that grid.

Once it has been established that the site meets criteria for future use with out radiological restrictions as determined by direct measurements and analytical results, Bechtel will proceed (at risk) to restore the site to the condition agreed upon by the property owner(s).

Bechtel will provide final verified sample results to ORISE as soon as they are available. Bechtel will prepare a post-remedial action report (PRAR) for DOE review (copy to ORISE) within 3 months following demobilization. The Certification Docket will be completed after the completion of remediation of the St. Louis Site.

REFERENCES

(1) DOE Order 5400.5, Radiation Protection of the Public and Environment, Washington, D.C.

(2) DOE, 1990, Verification and Certification Protocol for the Office of Environmental Restoration FUSRAP and D&D Program, Revision 3, November.

(3) DOE/OR/20722-203, Radiological Characterization Report for FUSRAP Properties in the St. Louis, Missouri, Area, August 1990.

(4) ThermoAnalytical (TMA), Health Physics Operational Procedures Manual.

A) 2C.1 "Release of Equipment and Materials"
B) 3C.2 "Determination of Background"
C) 3B.1 "Delineation of Survey Areas in Open Land"
D) 3B.3 "Gamma Ray Exposure Rate Surveys at 1-Meter in Open and Enclosed Areas"
E) 3A.2 "Direct Surface Contamination Survey"

F) 3A.3 "Transferable Surface Contamination Survey"
G) 4A.1 "Systematic and Bias Surface Soil Sampling (Radiological)"

(5) BNI, 1993, Instruction Guide for Post-Remediation Survey of Soil, 191-IG-032, Revision 0.

(6) BNI, 1992, Instruction Guide for Decontamination of Field Sampling Equipment at FUSRAP Sites, 191-IG-011, Revision 5.

(7) BNI, 1993, Instruction Guide for Surface Water and Sediment Sampling Activities, 191-IG-028, Revision 0.

(8) BNI, 1994, How to Ship Samples from a FUSRAP Site, PI R4.7, Revision 2.

(9) DOE/OR/21949-280, Remedial Investigation Report for the St. Louis Site, St. Louis, Missouri, January 1994.

(10) BNI, 1993, Health and Safety Plan for the St. Louis Site, Rev. 0.

(11) CCN 072892, Fiore to Price, Subject: Uranium Cleanup Guidelines for St. Louis, Mo, FUSRAP Sites, Nov. 6, 1990.

(12) DOE/OR/20722-258, Radiological, Chemical, and Hydrological Characterization Report for the St. Louis Downtown Site, September 1990.

(13) DOE/CH/8901, A Manual For Implementing Residual Radioactive Material Guidelines, June 1989.

(14) CCN 129456, V. Spicer to Distribution, Subject: Characterization Results for the Plant 10 Area, St. Louis Downtown Site, May 5, 1995.

132985

FIELD CHANGE REQUEST/FIELD CHANGE NOTICE

Page 1 of 1

JOB NO. 14501

FCR NO. 116-17

FCN NO.

PREPARER AND DATE: MAM 8/3/95

CHECKER AND DATE: P.Shoffner 8/3/95

AFFECTED DOCUMENTS (WI, drawings, specifications, Scope of Work, SSRS Form, etc.) and Rev. No.

USRAP 191-IG-032, Post Remediation Radiological Survey of Soil, Section 2.2.2, Rev. 0

REASON FOR CHANGE

To collect post-remedial action (RA) coneshield gamma measurements, and gamma exposure rate measurements in a cost effective and timely manner. Further, to provide adequate and sufficient information used to determine the Department of Energy guidelines for residual radioactive contamination in soil.

EXISTING CONDITIONS

Section 2.2.2 states that coneshield gamma scan locations shall be positioned so that total coverage of the post remedial action grid is provided. Section 2.2.2 also states that gamma exposure rate survey measurements shall be taken in the middle of each post-remediation survey grid block. These surveys, as stated, are currently being performed in post-RA areas at the St. Louis Site.

DESCRIPTION OF CHANGE

The intent of employing the cone shield when performing gamma scans is to eliminate the contribution of radioactivity from surfaces above and adjacent to the area actually being measured (i.e., the vertical faces of trench excavation). In most of the excavations being performed in the St.Louis area, the soils being surveyed are in open areas. Therefore, this contribution or "shine" is not a factor. Walkover scans of these areas with a FIDLER before post RA soil sample collection is done when releasing excavated areas. Therefore, use of a coneshield shall be necessary only in excavations where "shine" will be a factor, or unless otherwise directed by the ET Team Lead or designee.

Additionally, under the above guidance, gamma exposure rate measurements using a pressurized ion chamber or PIC, is prescribed and performed on each of the 100 square meter grids of a remediated soil area. These areas are typically measured with the PIC subsequent to a walkover with a FIDLER, which in turn directs collection of a post-RA soil sample. It is the current practice to perform this measurement after the collection of a soil sample that is below the site specific guidelines, or after successful remediation has been performed.

Based on current methodology, it has been determined to be more cost effective and productive to perform enough of the above readings necessary, in order to be representative of the entire remediated area. Frequency of measurements will be determined by the ET Team Lead or designee on a case by case basis. Upon determination of this frequency, direction to field personnel will be documented in the applicable work guidance document for the specific remedial action.

S/C NO. N/A CCO NO. N/A	DISPOSITION OF FCR REQUIRED BY DATE 8/9/95	SITE SUPERINTENDENT SIGNATURE AND DATE T.J. Mattson 8/8/95		
FCR CHANGE APPROVED YES [X] NO [ ]	FCR OR FCN TO BE INCORPORATED INTO AFFECTED DOCUMENTS YES [X] SEE REMARKS NO [ ]	REVISION TO QAA OR QAP REQUIRED YES [ ] NO [X]	TEAM LEADER CONCURRENCE INITIALS AND DATE 8/4/95	PROJECT ENGINEER DEPARTMENT MANAGER SIGNATURE AND DATE JLM 8.8.95

0023

ST. LOUIS DOWNTOWN SITE
ADMINISTRATIVE RECORD
CONTENTS
October 26, 1998

Document No.	Title Description	Author Affiliation	Recipient Affiliation	Document Location	Document Date
		Volume 2b			
9809301029	Post Remedial Action Report for the Remedial Actions Conducted in St. Louis, Missouri During Calendar Year 1995	BNI	USDOE – Oak Ridge	Vol. 2b	11/96
9810021016	Post Remedial Action Report for the Remedial Actions Conducted in St. Louis, Missouri During Calendar Year 1996	BNI	USDOE—Oak Ridge	Vol. 2b	11/97
9809211006	Post Remedial Action Analysis for SLDS Plant 10	USDOE – Oak Ridge	Mallinckrodt	Vol. 2b	4/96
9810231015	Verification Survey of the Plant 10 Area at Mallinckrodt	ORISE / ESSAP	USDOE	Vol. 2b	9/96
9809251066	St. Louis Site Action Memorandum for Radiologically Contaminated Properties	USDOE – Oak Ridge	USDOE – Oak Ridge	Vol. 2b	9/96
9809301046	USDOE Response to MDNR Comments on SLDS Plant 2 Supplementary Boundary Delineation Plan	USDOE – Oak Ridge	MDNR	Vol. 2b	1/97
9809071028	SLDS – Action Memorandum for the Removal of Contaminated Materials at SLDS	USDOE – Oak Ridge		Vol. 2b	6/95
9809301068	Release of 50 Series Buildings to be Razed	Nat'l Park Service	BNI	Vol. 2b	3/97