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Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-91-OR21949

Post-Remedial Action Report for the Remedial Actions Conducted in St. Louis, Missouri During Calendar Year 1996

November 1997

DOE/OR/21949-409

POST-REMEDIAL ACTION REPORT

FOR THE REMEDIAL ACTIONS CONDUCTED IN ST. LOUIS, MISSOURI,

DURING CALENDAR YEAR 1996

NOVEMBER 1997

Prepared for

United States Department of Energy

Oak Ridge Operations Office

Under Contract No. DE-AC05-91OR21949

By

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Oak Ridge, Tennessee

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ACRONYMS

AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
BNI	Bechtel National, Inc.
DAC	derived air concentration
DCG	derived concentration guide
DOE	U.S. Department of Energy
FUSRAP	Formerly Utilized Sites Remedial Action Program
IVC	independent verification contractor
MDA	minimum detectable activity
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
SEC	Safety and Ecology Consultants
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site

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, Missouri, as part of the U.S. Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP) during calendar year 1996. The remedial actions were performed at a proposed bike trail (riverfront trail), which is a vicinity property of the St. Louis Downtown Site (SLDS) and owned by the city of St. Louis, and along the haul roads bordering 13 St. Louis Airport Site (SLAPS) vicinity properties on Frost and Hazelwood avenues in Hazelwood, Missouri. The remedial actions were conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act.

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 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 currently has 46 sites in 14 states.

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, industrial hygiene, and laboratory functions were provided by Thermo NUtech, the environmental support services subcontractor. Oak Ridge Institute for Science and Education (ORISE), the FUSRAP independent verification contractor (IVC) for the St. Louis sites, performed independent verification surveys. ORISE will issue a final report for each property after the final post-remedial action report is published.

1.2 HISTORY AND SITE DESCRIPTION

1.2.1 SLDS Riverfront Trail

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.

Radiological and chemical characterization and surveys conducted at the riverfront trail in 1996 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. The riverfront trail surveys indicated that residual contamination exceeding DOE guidelines existed along the proposed route of the riverfront trail. Additional boundary delineation and waste classification activities were performed before remediation began at the riverfront trail (BNI 1990b, BNI 1996).

1.2.2 SLAPS Vicinity Properties

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 13 SLAPS vicinity properties remediated during 1996 are located approximately 0.8 km (0.5 mi) northeast of SLAPS within the city of Hazelwood (Figure 1-2). Vicinity properties 21-24, 26, 27, and 30 are located on Frost Avenue. Vicinity properties 32, 33, 34, 36, 37, and 48 are located on Hazelwood Avenue.

SLAPS is located north of the Lambert-St. Louis International Airport in St. Louis County, Missouri, approximately 24 km (15 miles) northwest of downtown St. Louis.

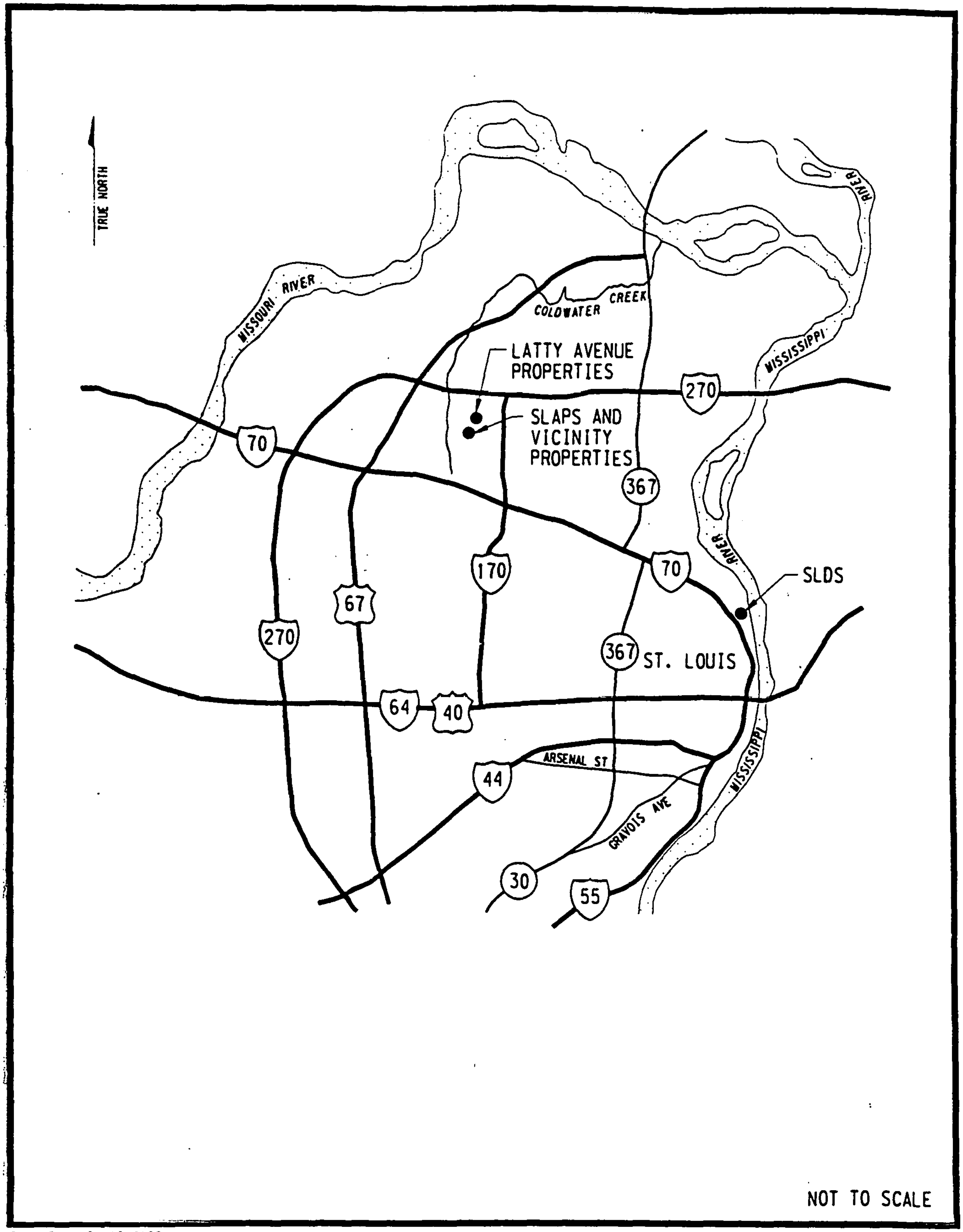

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Figure 1-1
Locations of FUSRAP Properties in the St. Louis, Missouri, Area

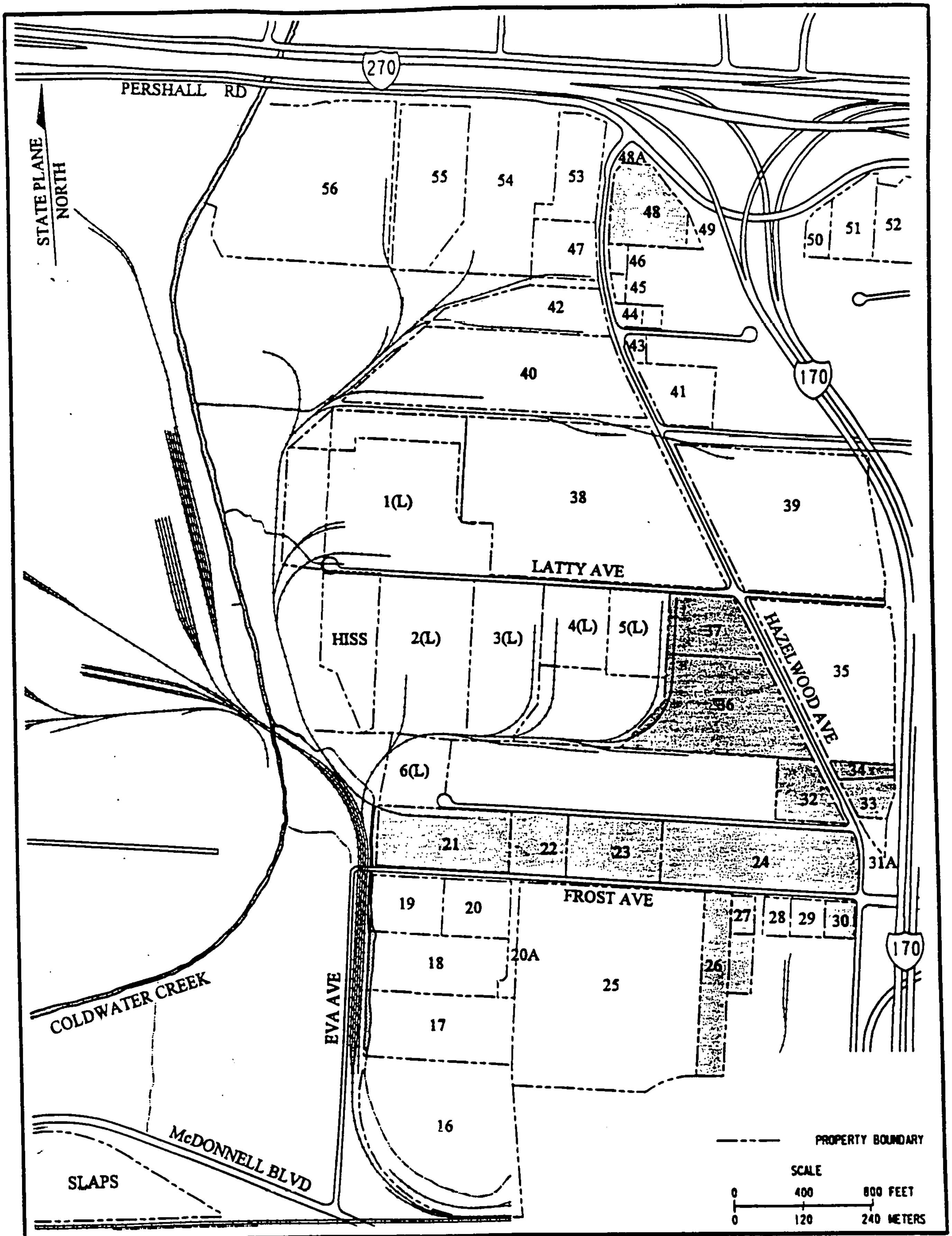

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Figure 1-2
Vicinity Properties Along the Haul Roads

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 contiguous 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 as a result of flooding, surface runoff, and road and utility line installation and maintenance activities.

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.

The Latty Avenue site was assigned to DOE by Congress in 1984. During a radiological survey of the 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 1990). Additional boundary delineation and waste classification activities were performed for the vicinity properties before remediation began. In 1996, BNI performed remedial actions on 13 of the vicinity properties that border haul roads.

During transit, some of these materials spilled onto the roadway, right-of-ways, and contiguous properties...In 1996, BNI performed remedial actions on 13 of the vicinity properties that border haul roads.

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 vicinity properties on Frost and Hazelwood avenues and the riverfront trail are listed in Table 2-1.

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 (DOE Order 5400.5).

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 (DOE Order 5400.5).

Soil Guidelines (concentrations above background)

Radium-226 Radium-228 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 more than 15 cm below the surface (DOE Order 5400.5)
Uranium-238	50 pCi/g, any depth, site-specific guideline for St. Louis, Missouri (Fiore 1990)

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 derive 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 (see Section 4.3).

3.0 REMEDIAL ACTION

3.1 PRE-REMEDIATION ACTIVITIES

Before remedial action began at the vicinity properties, surveys to accurately define the boundaries of radioactive contamination were performed to supplement existing characterization information and to obtain the information necessary to classify the waste to be generated during remediation.

The following activities were conducted to prepare the site for remedial action:

- Where applicable, in accordance with Missouri Standards, traffic barriers were placed to restrict traffic access to the excavations.
- Five-foot temporary construction fences were placed on the sides of the excavation areas to prevent inadvertent access and cross-contamination.
- Boundaries of the contaminated areas were identified, and sampling and surveys were performed to establish the areas and depths of the areas to be excavated.

3.2 REMEDIAL ACTIVITIES

Remedial activities at the vicinity properties included the excavation of radioactively contaminated soil on the properties. After remedial and verification activities were completed, the excavated areas were restored to a condition agreed upon by DOE and the property owner. Approximately 5,375 m^3 (7,040 yd^3) of soil was transported to an interim staging area on Eva Avenue where the material was stockpiled, loaded onto railroad gondola cars, and shipped to a licensed disposal facility (see Appendix A, Table A-1).

Remedial activities at the riverfront trail included 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 570 m^3 (750 yd^3) of radioactively contaminated waste resulting from remedial action was shipped to a licensed disposal facility (see Appendix A, Table A-2).

Approximately 5,375 m^3 (7,040 yd^3) of soil was transported from the SLAPS haul route properties to an interim staging area on Eva Avenue where the material was stockpiled, loaded onto railroad gondola cars, and shipped to a licensed disposal facility. Approximately 570 m^3 (750 yd^3) of radioactively contaminated waste resulting from remedial action at the riverfront trail was shipped to the disposal facility.

3.2.1 Decontamination

Radioactively contaminated soil adhering to the surfaces of utilities, culverts, or other structures within the excavation areas was removed by scraping the surfaces with a brush, shovel, or other suitable tool. Wood utility poles were scrubbed, then wire brushed at the base to remove any contamination remaining after excavation around the poles was completed.

3.2.2 Excavation

Excavation at the bike trail was identical to the excavation performed at North County. Excavation to the appropriate depths was performed using earth-moving equipment; areas with limited access and around utility lines were excavated by hand. All soil, gravel, rocks, asphalt, concrete, and organic materials within the contaminated zone were excavated and subsequently disposed of at the Envirocare of Utah licensed disposal facility in Clive, Utah.

Excavation of the properties proceeded in the direction of natural drainage to prevent cross-contaminating clean areas. The excavation depths on the vicinity properties ranged from 15 cm (0.5 ft) to 60 cm (2.0 ft). Initial excavation depth for the riverfront trail was 30 cm (1 ft). The excavated material was loaded into trucks and transported to interim storage piles. Material from the piles was then placed into intermodal containers for shipment to the licensed disposal facility.

3.3 CONTAMINATION CONTROL DURING REMEDIAL ACTION

During remedial action at the riverfront trail and the SLAPS vicinity properties, 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. These controls were outlined in a site-specific safety and health plan. Measures were also taken to minimize the potential for migration of radioactive material to adjacent, uncontaminated areas of the site. Before field activities began, the field crew completed site-specific training and reviewed applicable work-controlling documents.

Restricted work areas were set up around the remediation areas, and access was controlled by physical barriers, postings, and signs. Because the decontamination activities involved potential exposure to radioactively contaminated material, work was performed under hazardous work permits issued by the site safety and health representative. The hazardous work permits specified PPE to be used and provided specific safety and health instructions for various tasks. Work in contaminated areas required Tyvek coveralls, gloves, hard hats, safety glasses, and sturdy work boots. When conditions warranted, additional protective clothing, such as hoods and respirators, were used.

Fugitive dust emissions were controlled to minimize safety and health risks to site workers and the public from radioactive material. Dust-control measures were implemented during excavation, loading, and transportation of radioactive materials to prevent the spread of contamination. Dust-control techniques included curtailing activities during unusually windy conditions, employing dust-suppression techniques such as water sprays, and constructing environmental barriers such as silt fences and tarpaulins. Water usage was kept to a minimum to reduce disposal volumes and to prevent the spread of contamination. Ambient air monitoring was also conducted at the excavation sites. All equipment was surveyed and, if above the DOE release criteria, decontaminated before it was removed from the controlled area.

Fugitive dust emissions were controlled to minimize health and safety risks to site workers and the public from radioactive material.

Workers exiting controlled areas were subjected to a radiological survey (frisk) at the control point by a health physics technician with a hand-held Geiger-Mueller radiation detection instrument. A frisk is a search for radioactive material that may have been transferred onto the clothing or skin of individuals inside the work area. The radiation detection instrument was held approximately 1 cm (0.4 in.) away from the area to be frisked and moved slowly about 5 cm/s (2 in./s) across each worker's body and clothing. PPE worn by the workers that was suspected or known to be contaminated was packaged and shipped to a licensed disposal facility.

3.3.1 Occupational Exposure

The primary potential exposure pathways for personnel during remediation activities were inhalation and ingestion of radioactively contaminated dust particles during excavation and loading of the soil. Work practice controls, procedures, the use of PPE, and personnel monitoring were used to minimize the potential for contaminants becoming airborne and to protect workers against unwarranted exposure.

During remediation, workers wore lapel air samplers, and particulate air monitoring devices were placed in the areas being remediated. The concentrations of radionuclides were conservatively derived by collecting air particulate samples daily from the lapel air samplers worn by workers. After the gross activity per volume of air that passed through the filter was determined, the source of all activity on the filter was measured. The airborne concentrations were then compared with the applicable guidelines, derived air concentrations (DACs). DAC refers to the intake of a specified radionuclide alone. The DAC is the concentration of a particular radionuclide that would yield a committed effective dose equivalent to an individual continuously exposed to the radionuclide by one pathway for an entire year. The DAC is 2.0×10^{-11} µCi/ml (0.002 pCi/L) (10 CFR 835) for occupational exposures to airborne uranium-238. All samples were determined to be well below the guideline for uranium-238. The results ranged from less than the minimum detectable activity (<MDA) to 1.6×10^{-13} µCi/ml. MDAs ranged from 4.4×10^{-14} to 3.0×10^{-13} µCi/ml.

3.3.2 Exposure to the General Public

The primary potential exposure pathways for members of the general public were inhalation and ingestion of radioactively contaminated airborne dust particles generated during the remediation. The potential for dust migration was minimized by maintaining adequate moisture with a fine mist of water during remediation operations and implementing safe work practices and procedures.

A high-volume air sampler was used for air particulate sampling adjacent to areas being remediated to verify that no member of the general public was exposed to radioactivity above the current standards and criterion. 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); a DCG is a value of the DAC for the radionuclides and is tabulated for use as a guide. A DCG is the concentration of a particular radionuclide that would yield a committed effective dose equivalent of 100 mrem/yr (the DOE basic dose limit) to an individual continuously exposed to the radionuclide by one pathway 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 ranged from <MDA to 4.6×10^{-14} µCi/ml. MDAs ranged from 2.4×10^{-15} to 3.2×10^{-14} µCi/ml. The DCG is 1.0×10^{-13} µCi/ml for uranium-238.

A high-volume air sampler was used for air particulate sampling adjacent to areas being remediated to verify that no member of the general public was exposed to radioactivity above the current standards ...

4.0 POST-REMEDIAL ACTION MEASUREMENTS

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 surveys included direct surface measurements on structures in the areas being remediated and external gamma exposure rates.

4.1 BACKGROUND SAMPLES AND SURVEYS

During the radiological characterization conducted in 1990 (DOE 1990a), soil samples were obtained from three remote background locations in the general vicinity of the properties to be remediated to determine the naturally occurring levels of radium-226, thorium-230, thorium-232, uranium-234, uranium-235, and uranium-238. Background data (BNI 1990b) present typical conditions for the areas unaffected by the transportation of material from SLAPS and serve as a frame of reference for evaluating the data from the vicinity properties. The background sampling locations are shown in Figure 4-1.

4.2 SOIL SAMPLING

To confirm that all contamination above DOE guidelines was removed from the riverfront trail and vicinity properties remediated during this interim action, samples were collected and analyzed for radium-226, thorium-230, thorium-232, uranium-234, uranium-235, and uranium-238 (BNI 1990b).

To confirm that all contamination above the DOE guidelines was removed from the properties remediated, soil samples were collected and analyzed ...

The characterization and boundary delineation sampling results for the SLAPS vicinity properties were used to establish grids approximately 100 m^3 in area along the roadway. The grids were used during remediation and for use in taking post-remedial action samples and measurements. Thirty locations within each grid were sampled from the bottom of the excavated area down to 15 cm (6 in.) below the surface and composited into one sample. Figures 4-2 through 4-10 show the areas and depths of excavation and locations of the grids on the vicinity properties and along the riverfront trail.

The post-remedial action concentrations of thorium-230, the contaminant of concern for SLAPS vicinity properties, are listed in Appendix B, Tables B-1 through B-10. The post-remedial action concentrations of radionuclides for the riverfront trail are listed in Table B-11. The concentrations are above background, as shown in Table B-12 (BNI 1990b).

4.3 EXTERNAL GAMMA RADIATION EXPOSURE RATE SURVEY

External gamma exposure rates were recorded using a pressurized ionization chamber (PIC). The external gamma radiation exposure rate survey results for the riverfront trail ranged from 7.2 to 15.8 μR/h with the average being 9.6 μR/h. The external gamma exposure rate was measured 1 m (3.3 ft) above the ground surface in the center of each survey grid block. Readings taken at this height provide an estimate of the potential exposure from external gamma radiation resulting from residual radioactivity to the critical body organs.

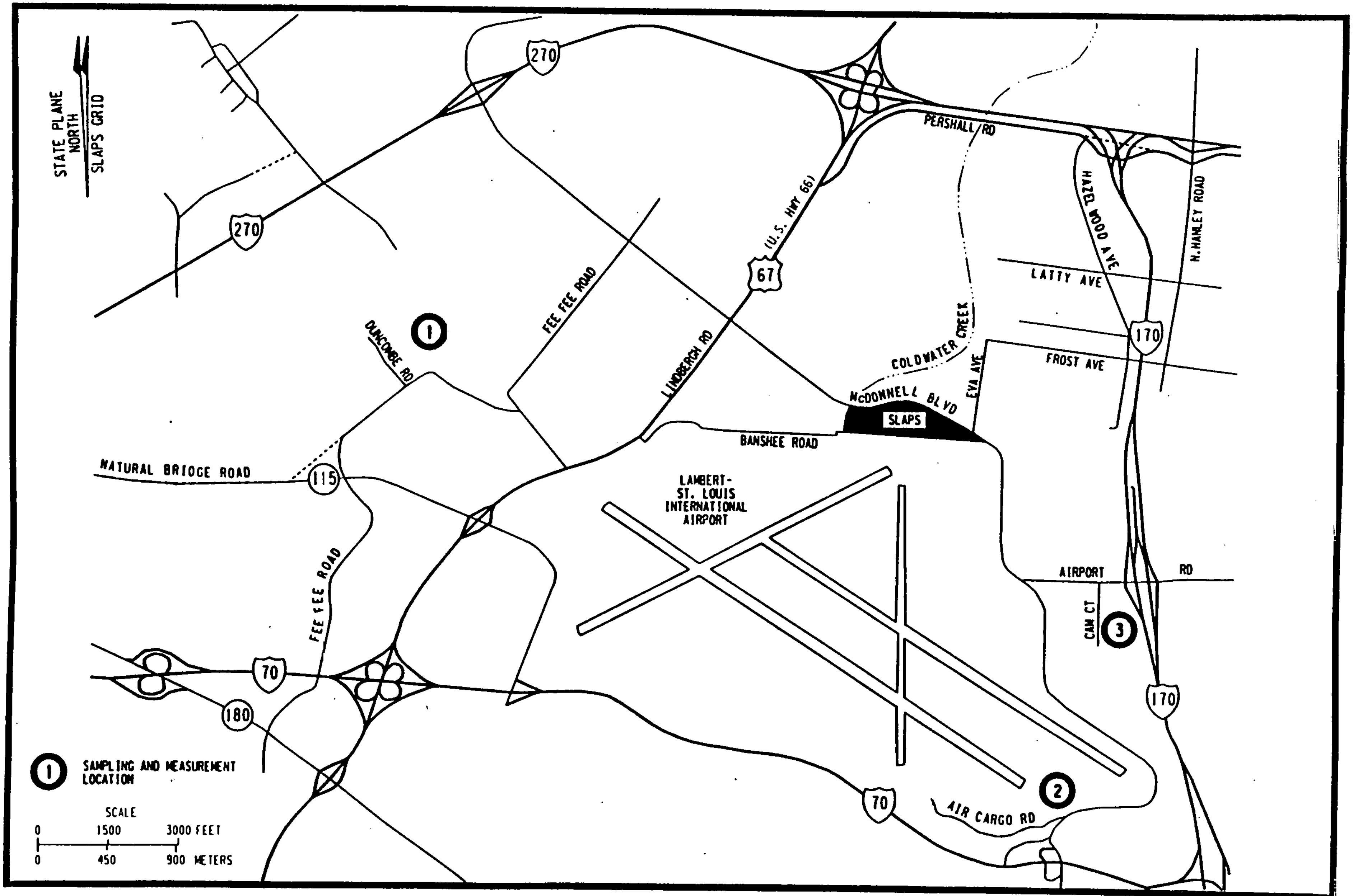

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Figure 4-1
Background Sampling Locations

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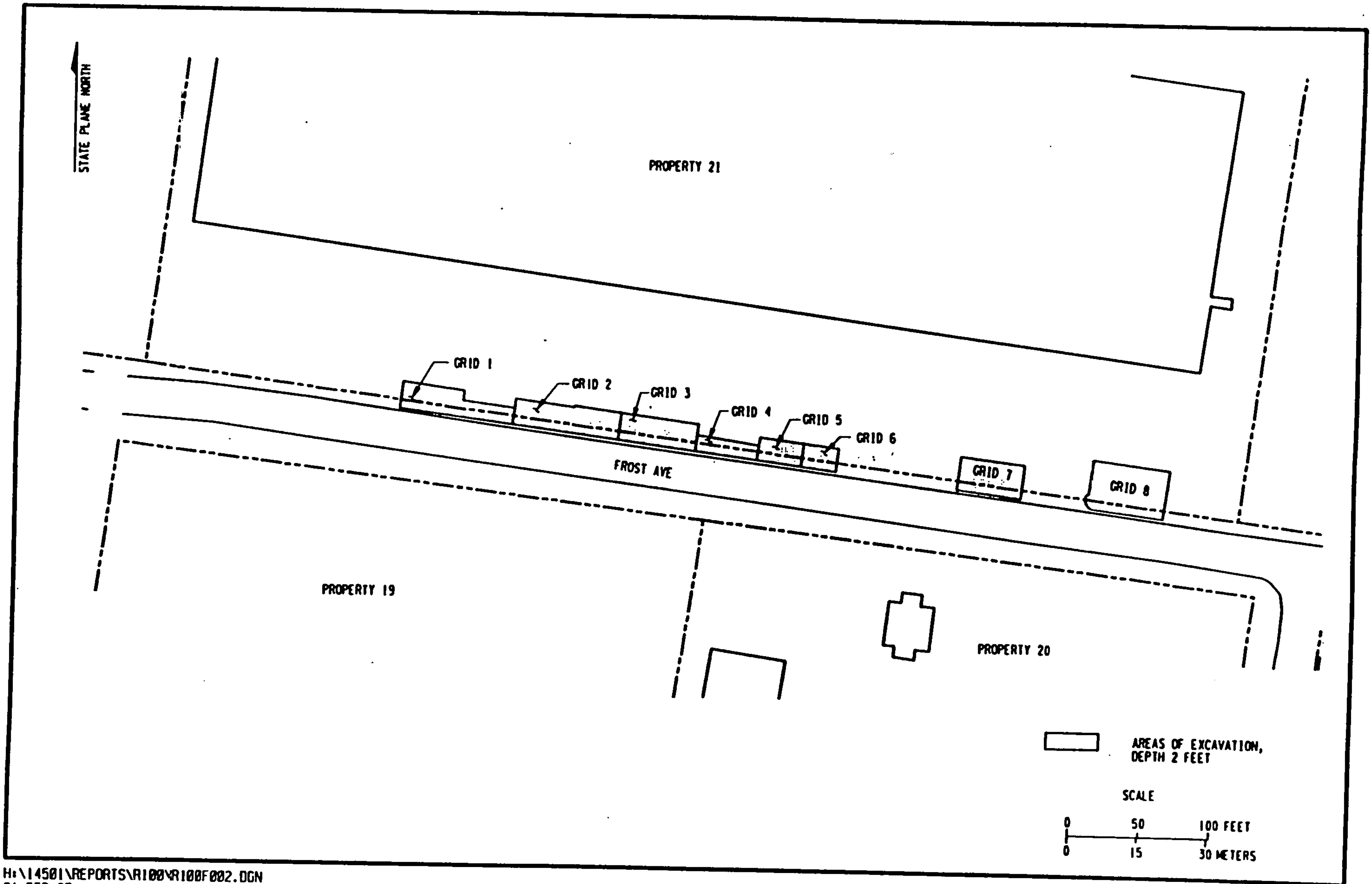

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Figure 4-2
Remediated Areas of Property 21

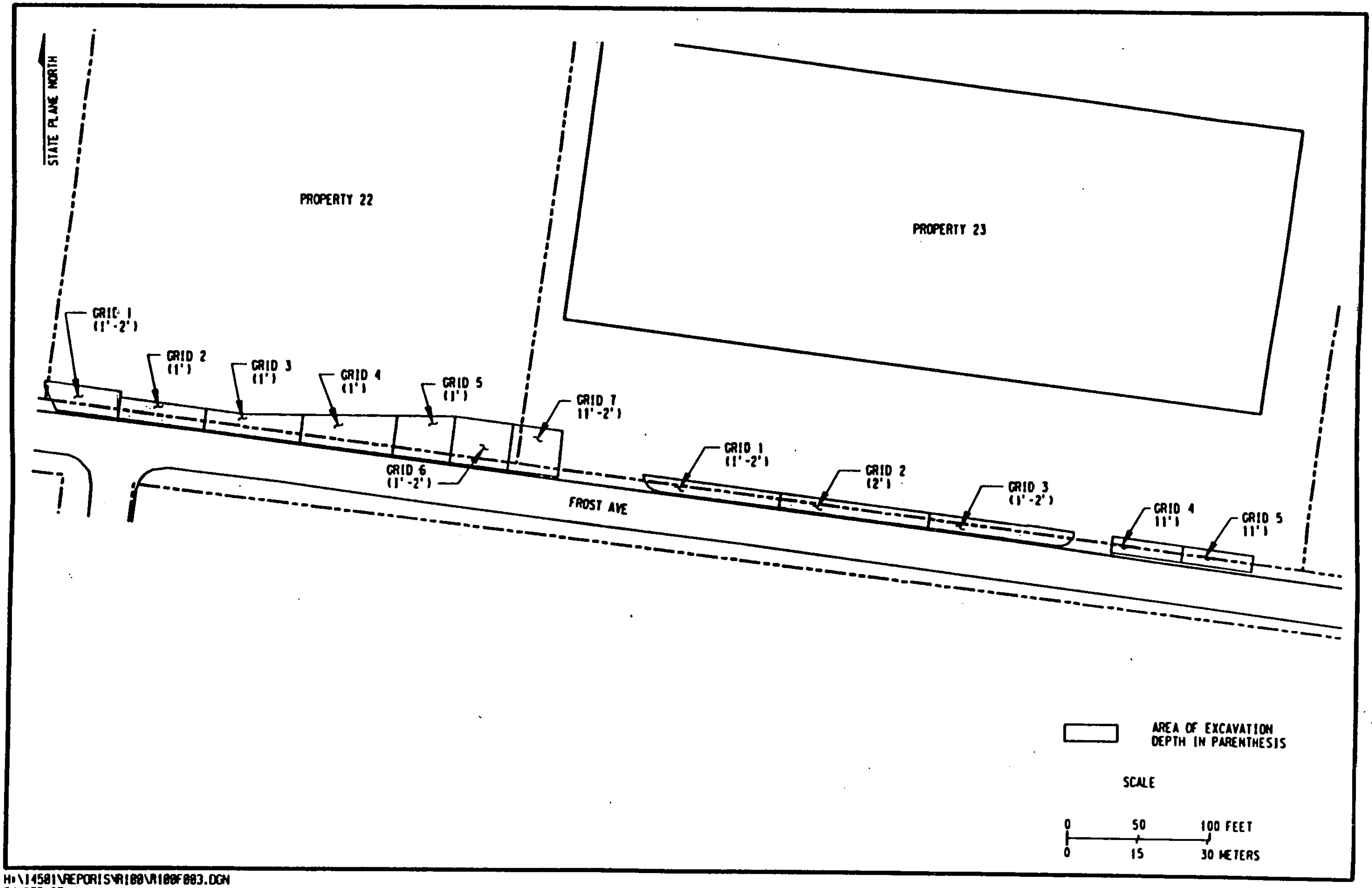

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Figure 4-3
Remediated Areas of Properties 22 and 23

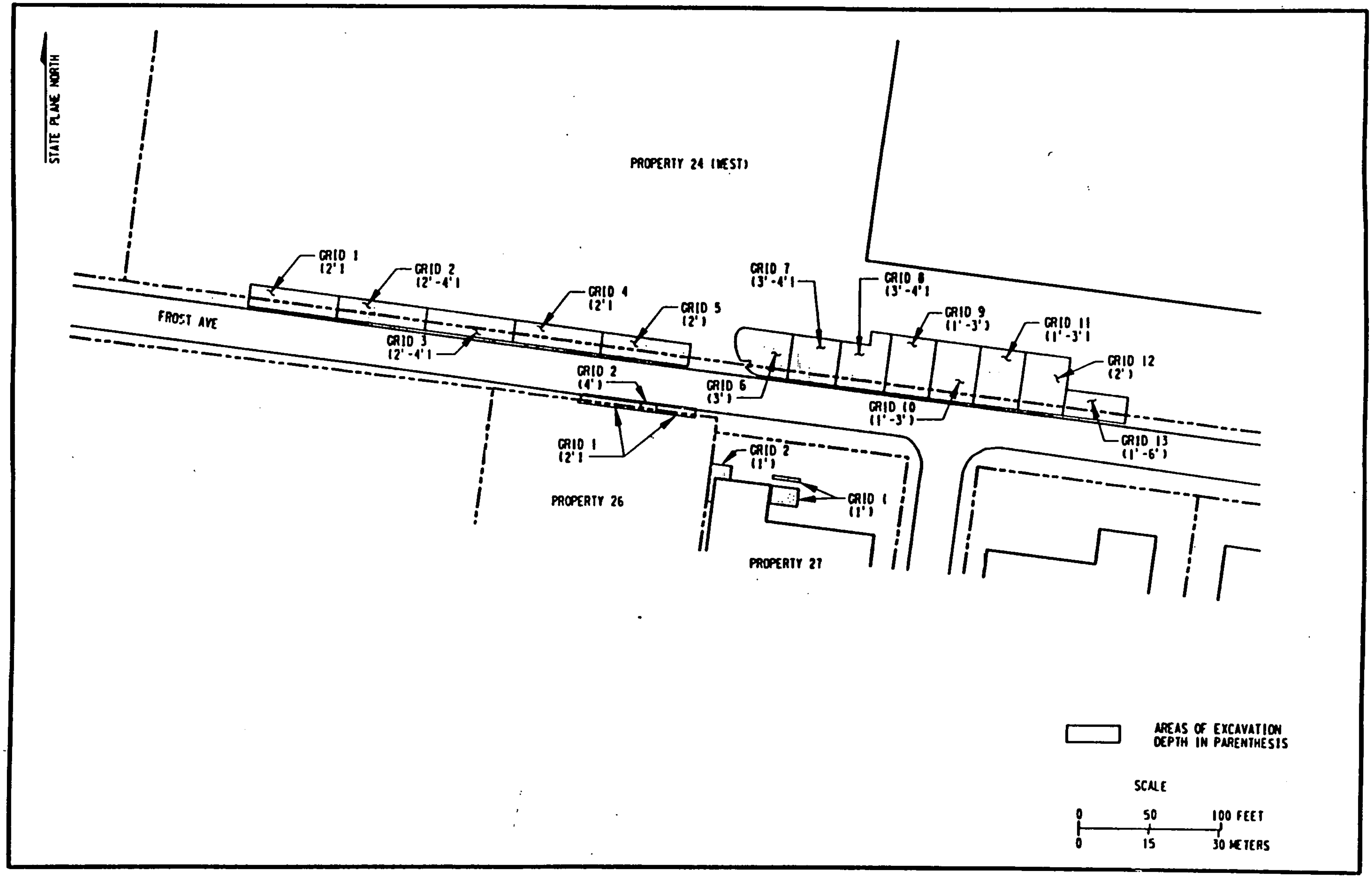

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Figure 4-4
Remediated Areas of Properties 24 (West), 26, and 27

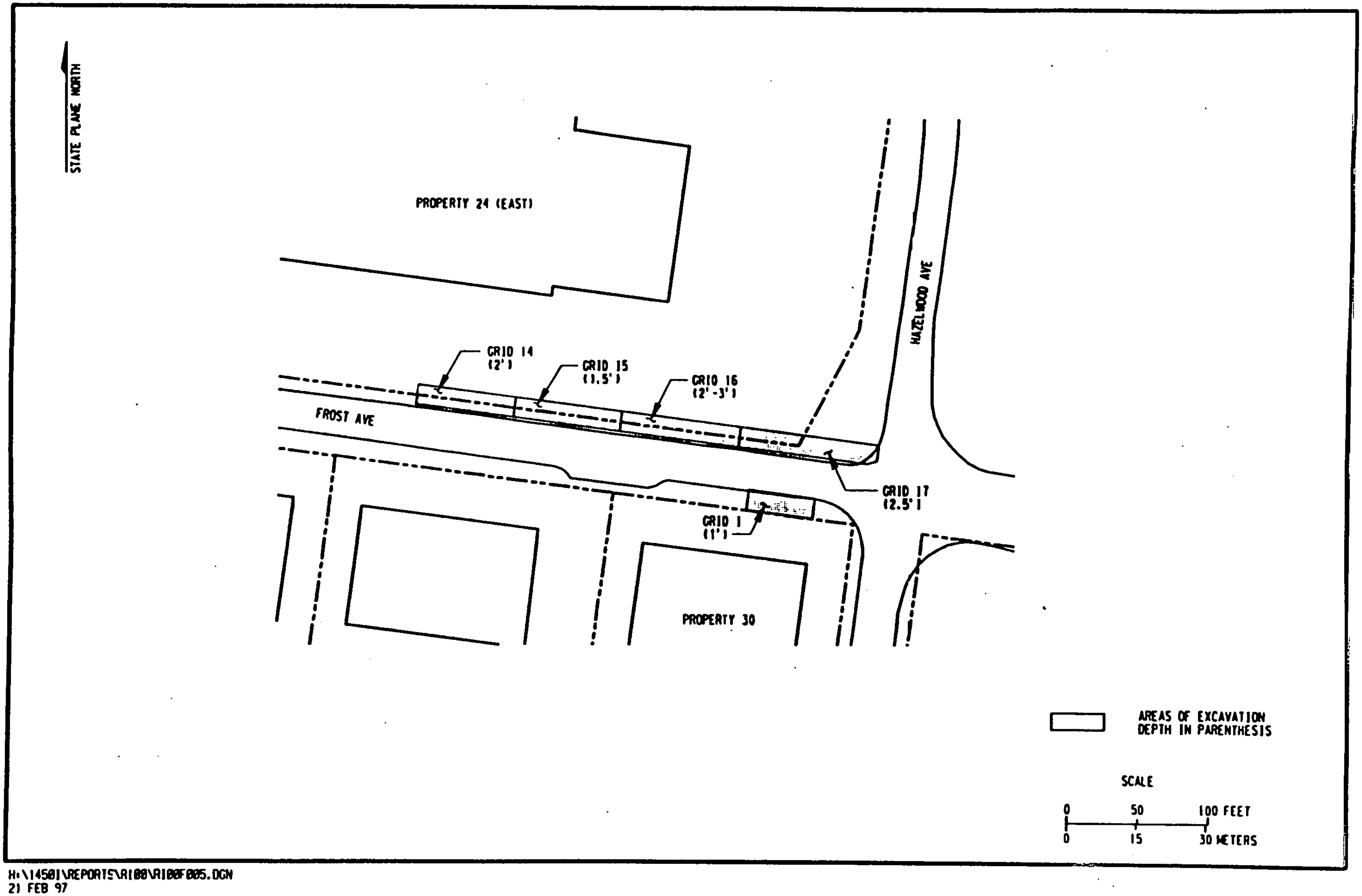

Figure 4-5
Remediated Areas of Properties 24 (East) and 30

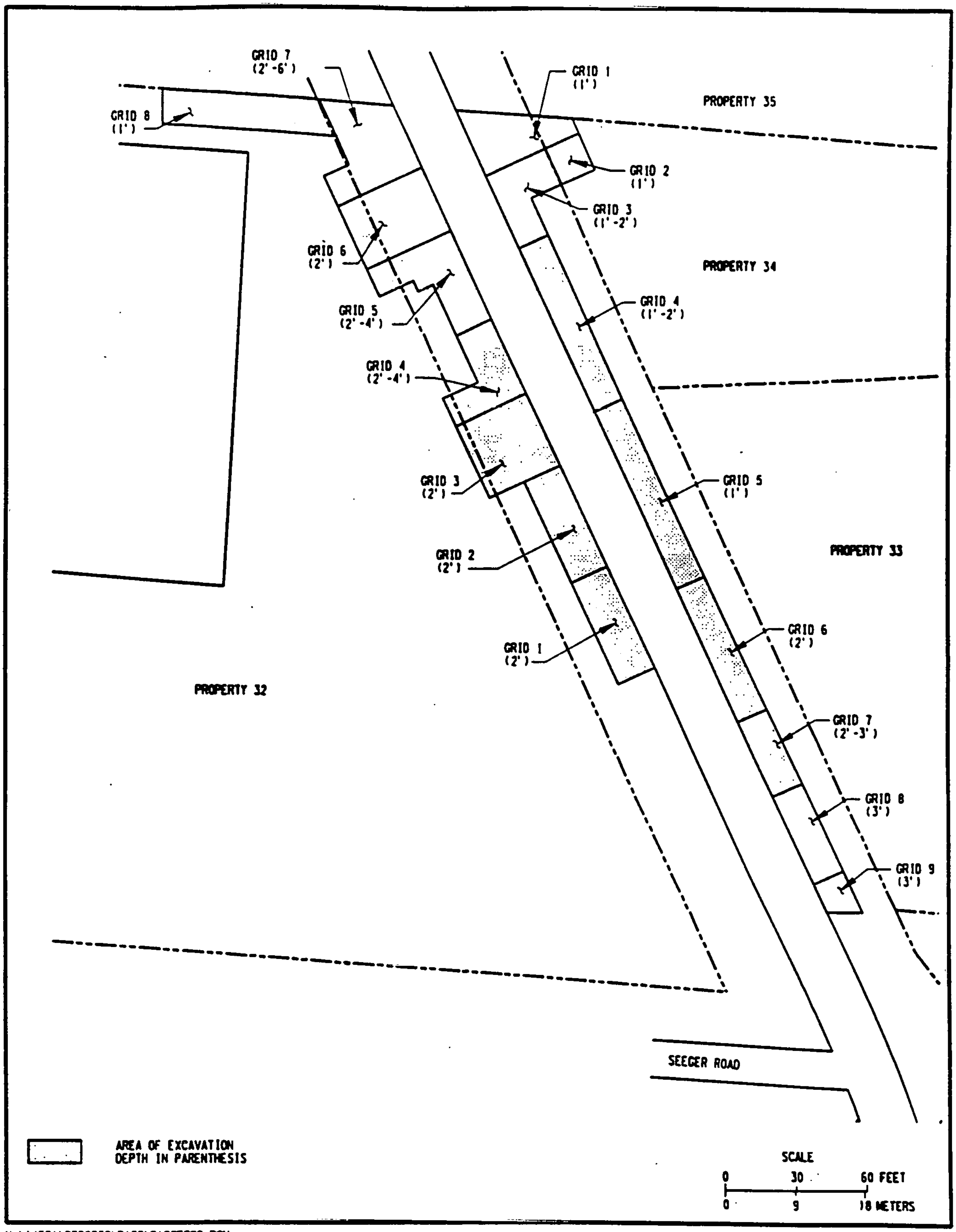

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Figure 4-6
Remediated Areas of Properties 32, 33, and 34

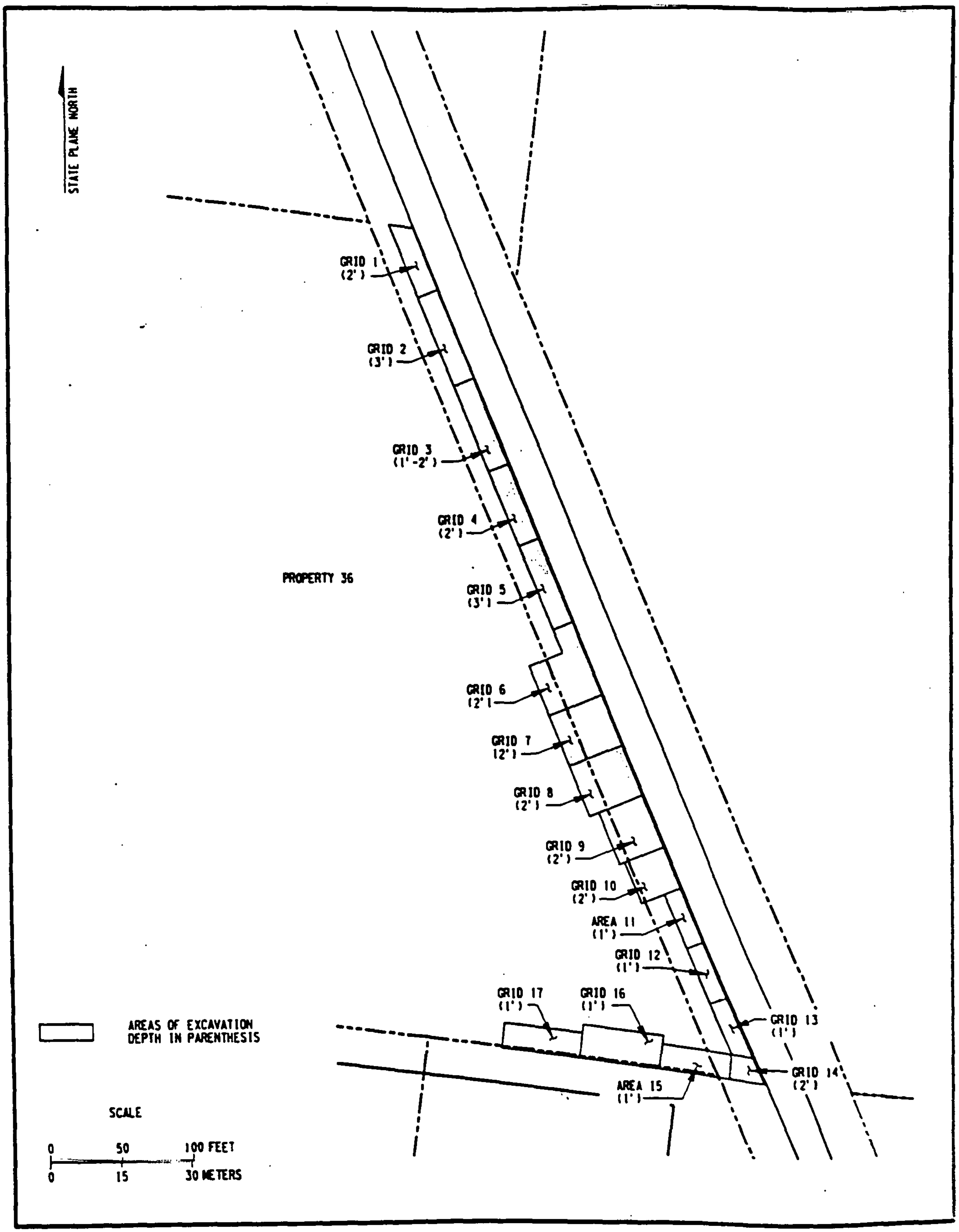

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Figure 4-7
Remediated Areas of Property 36

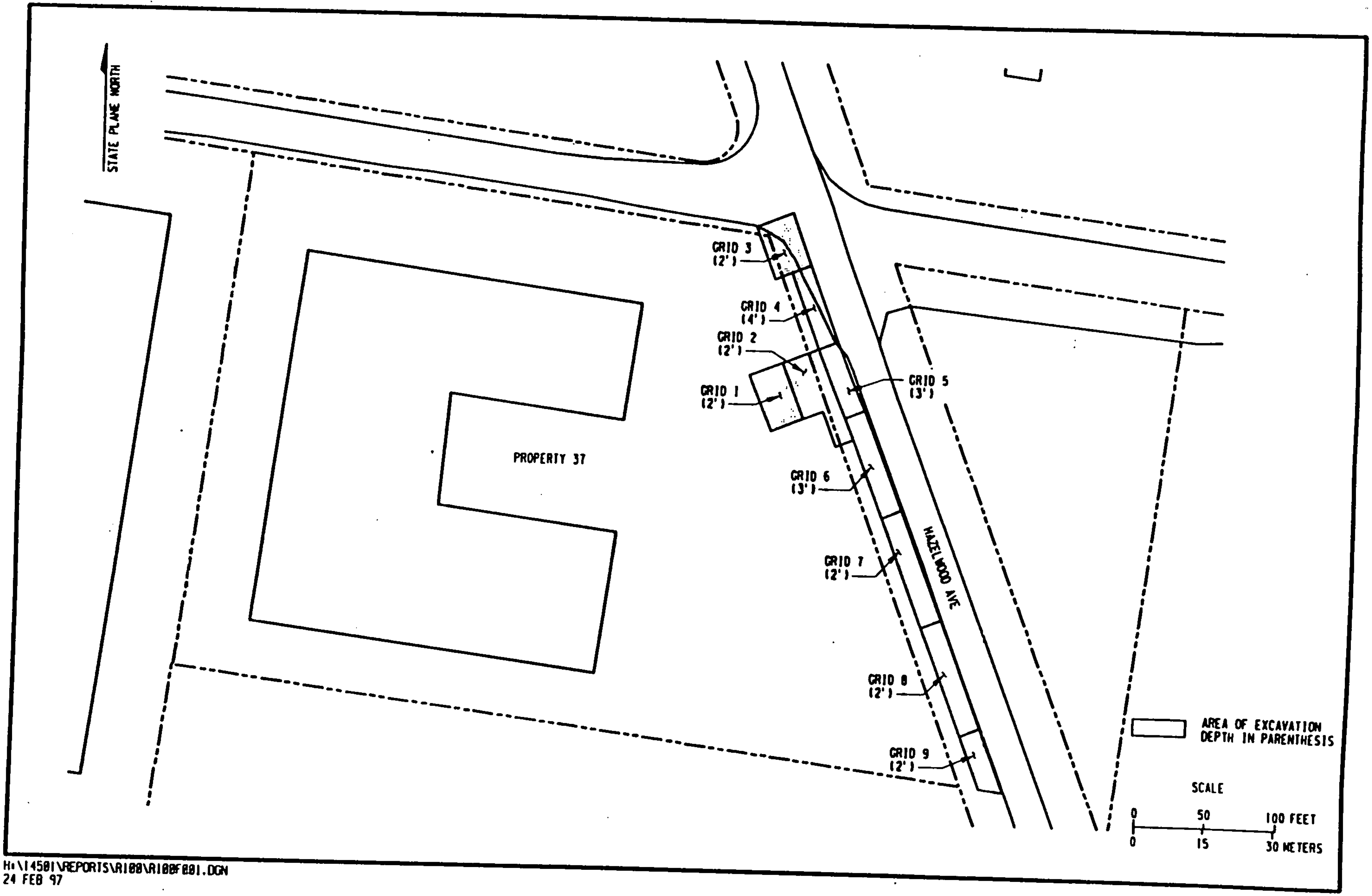

Figure 4-8
Remediated Areas of Property 37

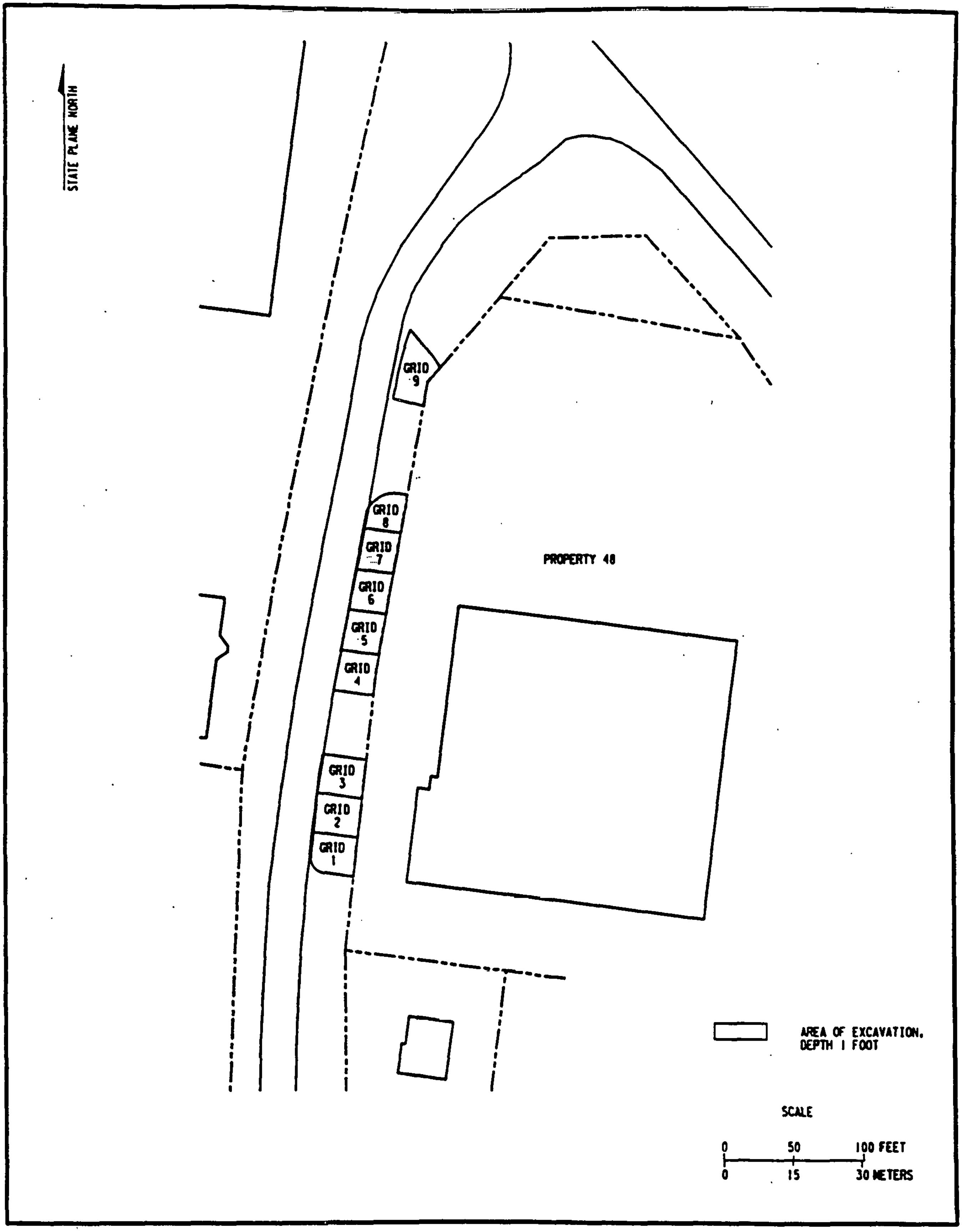

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Figure 4-9
Remediated Areas of Property 48

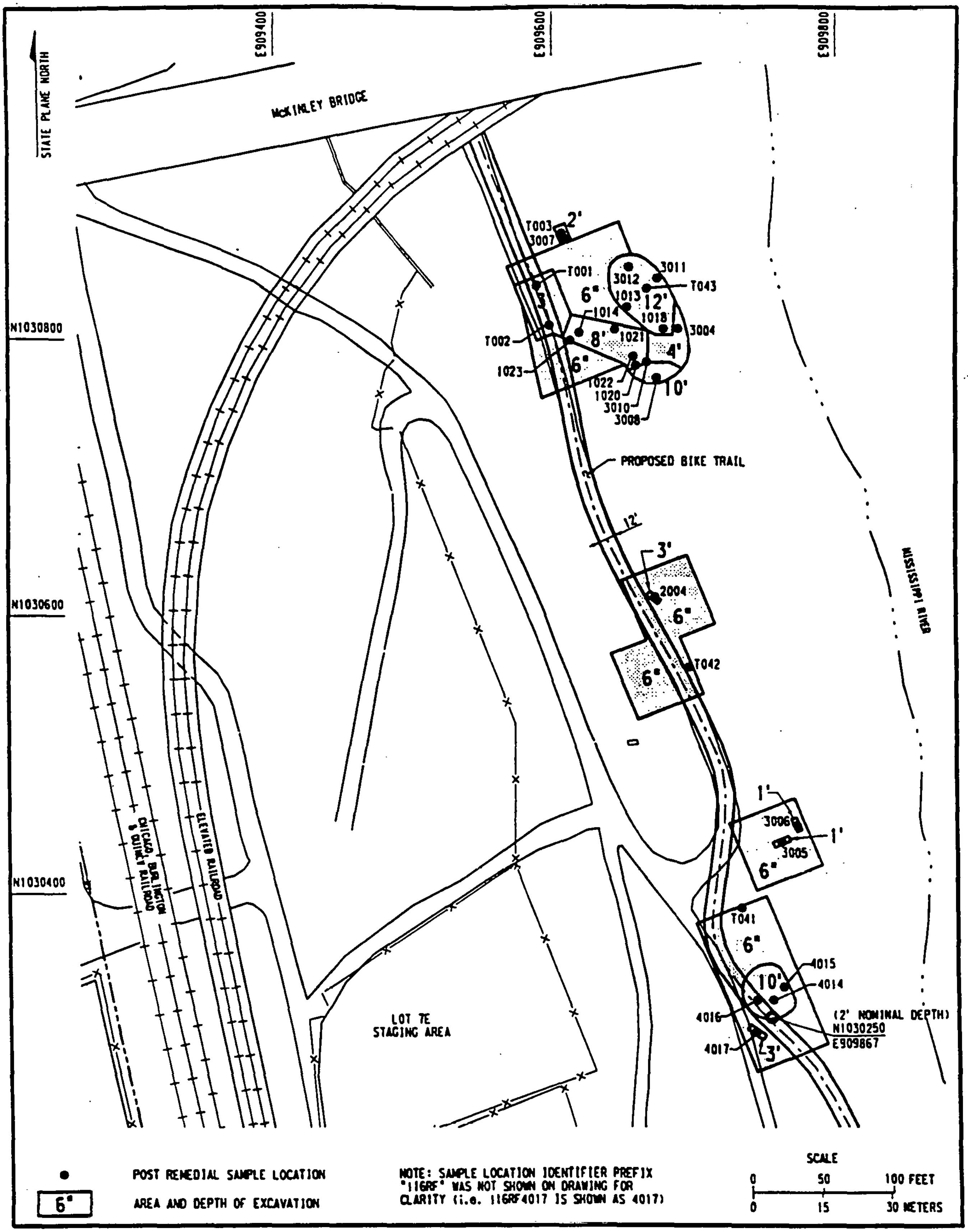

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Figure 4-10
Riverfront Trail
Post-Remedial Action Sampling Locations

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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 VICINITY PROPERTIES 21-24, 26, 27, 30, 32, 33, 34, 36, 37, and 48

WBS: 134

SITE: Vicinity properties 21-24, 26, 27, 30, 32, 33, 34, 36, 37, and 48

CITY, STATE: Hazelwood, Missouri

REMEDIATION AUTHORITY
- ☒ 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: 7,040 yd^3
To Remain In Situ: ______
Volume Reduction: ______
Net Disposal: 7,040 yd^3

Documentation Used: N/A

TYPE OF WASTE FOR NET DISPOSAL:

REGULATORY	VOLUME	DISPOSAL SITE
☐ LLRW		
☒ 11(E)2	7,040 yd^3	Envirocare of Utah
☐ MIXED ______		
☐ CHEMICAL ______		

PHYSICAL	VOLUME	DISPOSAL SITE
☐ BUILDING RUBBLE		
☐ SOIL	7,040 yd^3	
☐ LIQUID		
☐ OTHER ______		

TREATMENT TECHNOLOGIES APPLIED AT THE SITE:

N/A

TABLE A-2

REMEDIAL ACTION/WASTE MANAGEMENT SUMMARY FOR SLDS RIVERFRONT TRAIL

WBS 116

SITE SLDS Vicinity Property (Riverfront Trail)

OWNERS City of St. Louis

SITE ADDRESS North Broadway

CITY, STATE St. Louis, Missouri

REMEDIATION AUTHORITY

☒ 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 750 yd^3
To Remain In Situ ______
Volume Reduction ______
Net Disposal 750 yd^3

Documentation Used: N/A

TYPE OF WASTE FOR NET DISPOSAL:

REGULATORY	VOLUME	DISPOSAL SITE
☐ LLRW		
☒ 11(E)2	750 yd^3	Envirocare of Utah
☐ MIXED ______		
☐ CHEMICAL ______		

PHYSICAL
☐ BUILDING RUBBLE
☐ SOIL
☐ LIQUID
☐ OTHER ______

TREATMENT TECHNOLOGIES APPLIED AT THE SITE:

N/A

APPENDIX B

POST-REMEDIAL ACTION SOIL SAMPLE TABLES

Table B-1
Vicinity Property 21 Post-Remedial Action Soil Samples (pCi/g)[a, b]

Grid	Sample ID Number	Thorium-230 (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Uranium-238 (pCi/g)
1	VP-01R	2.6	1.3	1.3	1.4
2	VP-002	8.6	1.3	1.1	2.6
3	VP-03R	2.6	1.2	1.3	1.1
4	VP-04R	5.3	1.3	1.3	1.7
5	VP-05R	2.7	0.7	1.3	1.0
6	VP-070	2.5	1.1	1.3	1.8
7	VP-007	5.2	1.2	1.3	2.7
8	VP-008	7.3	1.2	1.4	2.2

[a]Includes background levels for the St. Louis area.
[b]Subsurface soil.

Table B-2
Vicinity Property 22 Post-Remedial Action Soil Samples (pCi/g)[a, b]

Grid	Sample ID Number	Thorium-230 (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Uranium-238 (pCi/g)
1	VP-014	4.4	1.4	1.1	0.8
2	VP-016	2.2	1.5	1.4	2.2
3	VP-020	2.7	0.7	1.3	3.1
4	VP-022	4.1	1.3	1.3	2.8
5	VP-026	2.7	1.2	1.2	2.1
6	VP-030	4.7	1.3	1.4	0.8
7	VP-064	1.5	1.1	1.3	1.5

[a]Includes background levels for the St. Louis area.
[b]Subsurface soil.

Table B-3
Vicinity Property 23 Post-Remedial Action Soil Samples (pCi/g)[a, b]

Grid	Sample ID Number	Thorium-230 (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Uranium-238 (pCi/g)
1	VP-032	4.7	1.4	1.3	3.3
2	VP-035	2.9	1.0	1.3	1.6
3	VP-037	6.6	1.1	1.1	0.7
4	VP-104	4.0	1.2	1.1	0.9

[a]Includes background levels for the St. Louis area.
[b]Subsurface soil.

Table B-4

Vicinity Property 24 Post-Remedial Action Soil Samples (pCi/g)[a, b]

Grid	Sample ID Number	Thorium-230 (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Uranium-238 (pCi/g)
1	VP-161	2.5	1.0	1.4	0.9
2	VP-185	3.8	1.2	1.1	0.9
3	VP-085	5.2	1.1	1.1	0.9
4	VP-086	3.4	1.4	1.1	0.9
5	VP-087	5.2	0.9	1.2	1.1
6	VP-096	7.0	1.3	1.1	1.5
7	VP-212	9.2	1.3	1.3	1.5
8	VP-213	3.9	1.2	1.3	1.1
9	VP-201	6.2	1.5	1.3	1.0
10	VP-100	7.8	0.9	1.1	1.0
11	VP-101	9.8	0.8	1.1	0.9
12	VP-211	9.1	1.1	1.5	0.8
13	VP-105	13.1	0.8	1.1	0.8
14	VP-170	3.1	1.2	1.6	1.0
15	VP-116	4.3	1.2	1.2	1.1
16	VP-173	1.8	1.5	1.2	1.1
17	VP-183	6.1	1.2	1.3	0.9

[a]Includes background levels for the St. Louis area.
[b]Subsurface soil.

Table B-5

Vicinity Properties 26, 27, and 30 Post-Remedial Action Soil Samples(pCi/g)[a, b]

Grid	Sample ID Number	Thorium-230 (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Uranium-238 (pCi/g)
26/1	VP-138	2.1	1.1	1.3	0.8
26/2	VP-145	14.4	1.4	1.3	1.6
27/1	VP-133	2.7	1.1	1.0	2.0
27/2	VP-147	2.2	1.3	0.9	1.2
30/1	VP-128	2.2	1.1	1.1	1.6

[a]Includes background levels for the St. Louis area.
[b]Subsurface soil.

Table B-6

Vicinity Property 32 Post-Remedial Action Soil Samples (pCi/g)[a, b]

Grid	Sample ID Number	Thorium-230 (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Uranium-238 (pCi/g)
1	VP-247	6.3	1.1	1.3	1.9
2	VP-190	5.1	1.2	1.3	2.0
3	VP-192	8.4	1.1	1.1	1.2
4	VP-250	10.1	1.3	1.1	0.9
5	VP-197	12.4	0.9	1.5	1.1
6	VP-199	6.8	1.1	0.9	1.1
7	VP-212	9.2	1.2	0.9	1.2
8	VP-205	2.5	1.3	1.0	1.1

[a]Includes background levels for the St. Louis area.
[b]Subsurface soil.

Table B-7
Vicinity Properties 33 and 34 Post-Remedial Action Soil Samples (pCi/g)[a, b]

Grid[a]	Sample ID Number	Thorium-230[b] (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Uranium-238 (pCi/g)
1	VP-341	3.6	1.0	1.4	1.9
2	VP-342	3.8	1.0	1.0	1.4
3	VP-343	3.9	1.2	1.1	1.7
4	VP-344	5.3	1.0	0.9	2.0
5	VP-345	3.6	0.9	0.9	1.8
6	VP-358	10.6	1.2	1.0	1.0
7	VP-359	6.1	1.3	1.0	1.5
8	VP-360	4.7	1.3	1.0	1.4
9	VP-364	10.7	1.4	0.9	1.1

[a]Includes background levels for the St. Louis area.
[b]Subsurface soil.

Table B-8
Vicinity Property 36 Post-Remedial Action Soil Samples (pCi/g)[a, b]

Grid	Sample ID Number	Thorium-230 (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Uranium-238 (pCi/g)
1	VP-265	8.9	1.1	1.2	1.5
2	VP-295	3.5	1.2	1.1	1.2
3	VP-269	10.7	1.1	1.1	1.3
4	VP-272	6.9	1.1	1.4	1.3
5	VP-281	3.0	1.4	1.4	2.0
6	VP-277	10.4	1.3	1.2	1.6
7	VP-296	4.1	1.6	0.8	2.1
8	VP-298	2.4	1.3	1.4	2.0
9	VP-300	2.3	1.1	0.9	1.8
10	VP-302	2.4	0.7	0.9	1.4

Table B-8 (continued)

Grid	Sample ID Number	Thorium-230 (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Uranium-238 (pCi/g)
11	VP-305	2.3	1.0	0.8	0.9
12	VP-308	4.6	1.3	1.0	1.1
13	VP-311	3.0	1.1	1.1	1.1
14	VP-323	4.8	1.3	1.0	1.2
15	VP-325	4.7	1.1	0.9	1.2
16	VP-327	5.5	1.5	1.0	21.0
17	VP-317	7.1	1.0	1.6	1.6

[a]Includes background levels for the St. Louis area.
[b]Subsurface soil.

Table B-9
Vicinity Property 37 Post-Remedial Action Soil Samples(pCi/g)[a, b]

Grid[a]	Sample ID Number	Thorium-230[b] (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Uranium-238 (pCi/g)
1	VP-223	2.2	1.0	0.9	1.1
2	VP-227	3.9	1.1	0.9	1.4
3	VP-235	4.6	1.1	1.1	2.1
4	VP-257	3.5	1.2	0.9	1.2
5	VP-258	5.0	1.0	1.2	1.2
6	VP-243	4.1	1.0	0.8	1.3
7	VP-245	3.7	1.0	0.9	1.4
8	VP-254	12.0	1.0	0.9	1.4
9	VP-255	5.0	1.0	0.9	1.3

[a]Includes background levels for the St. Louis area.
[b]Subsurface soil.

Table B-10
Vicinity Property 48 Post-Remedial Action Soil Samples(pCi/g)[a, b]

Grid	Sample ID Number	Thorium-230 (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Uranium-238 (pCi/g)
1	VP-354	8.8	1.0	0.9	2.0
2	VP-362	2.4	1.1	0.9	2.0
3	VP-363	3.0	1.0	0.9	1.6
4	VP-365	2.2	1.0	0.9	2.1
5	VP-366	3.0	1.1	1.0	1.2
6	VP-367	2.0	1.2	0.9	1.0
7	VP-368	3.3	1.2	0.8	1.7
8	VP-369	2.9	1.0	0.9	1.7

[a]Includes background levels for the St. Louis area.
[b]Subsurface soil.

Table B-11
SLDS Riverfront Trail Post-Remedial Action Soil Samples[a,b,c] (pCi/g)

BNI ID	Th-228	Th-230	Th-232	Ra-226	Ra-228	U-235	U-238
116RFT001	1.41	3.67	1.32	1.28	1.19	0.48	6.58
116RFT002	1.35	13.83	1.17	2.54	1.05	0.72	9.63
116RFT003	1.48	4.77	0.75	68.95	0.80	2.67	2.97
116RF2004	0.89	3.00	0.86	1.03	1.00	0.15	1.94
116RF3005	1.15	4.15	1.02	2.88	0.92	0.72	8.65
116RF3006	1.51	4.65	1.45	3.90	1.58	0.95	10.83
116RF3007	1.51	3.90	1.43	3.43	1.17	0.19	4.77
116RF3008	1.26	23.52	0.74	7.37	0.68	0.79	3.84
116RF3009	0.93	30.81	0.68	8.34	0.78	0.91	5.71
116RF3010	1.32	37.02	1.04	5.47	0.95	0.64	3.26
116RF3011	1.25	28.89	1.39	7.57	0.82	1.27	10.13
116RF3012	0.93	10.62	0.71	4.01	1.01	0.80	7.36
116RF3013	1.07	33.53	1.13	7.14	0.85	0.83	4.16
116RF4014	0.79	4.20	0.84	2.17	0.96	0.60	7.79
116RF4015	1.01	3.55	0.91	3.14	0.75	0.60	6.12
116RF4016	1.24	3.63	0.85	2.42	0.97	0.36	4.65
116RF4017	1.35	3.42	0.89	2.73	0.86	0.57	4.19
116RF1018	0.94	45.85	1.16	15.41	0.89	1.59	12.67
116RF1019	0.75	10.12	1.14	2.54	0.93	0.85	12.58
116RF1020	0.91	3.60	0.48	2.24	0.75	0.37	2.44
116RF1022	0.98	10.21	1.12	5.17	0.81	0.66	3.39
116RF1023	1.23	6.87	0.95	1.89	0.87	0.74	11.54
116RF1021	0.95	16.07	0.95	2.53	0.95	0.95	14.63

Sample Results for Areas of the Riverfront Trail after Additional Excavation was Completed

BNI ID	Th-228	Th-230	Th-232	Ra-226	Ra-228	U-235	U-238
116RFT041	1.07 / 0.79	10.20 / 3.09	1.01 / 1.33	3.89	1.08	0.35	3.33
116RFT042	0.69	14.03	1.06	2.09	0.92	0.22	4.70
116RFT043	0.85	2.27	1.06	4.65	0.92	0.74	5.22

Analytical method for Th-228, Th-230, Th-232 concentration is alpha spectrometry;
analytical method for Ra-226, Ra-228, U-235, U-238 concentration is gamma spectrometry.

Subsurface soil.

Includes background levels for the St. Louis area.

TABLE B-12

BACKGROUND RADIONUCLIDE CONCENTRATIONS IN SOIL

AND RADIATION LEVELS IN THE ST. LOUIS AREA

Measurement Location	Gama Exposure Rate at 3 ft (μR/h)	Gama Radiation at 3 ft (cpm)	Near-Surface Gama Radiation (cpm)	Radionuclide Concentration (pCi/g) +/- 2 sigma					
				Uranium-234	Uranium-235	Uranium-238	Radium-226	Thorium-232	Thorium-230
1	10	10,000	10,000	1.2 ± 0.3	< 0.1	1.2 ± 0.3	0.9 ± 0.4	1.0 ± 0.6	1.2 ± 0.3
2	10	9,000	9,000	1.0 ± 0.2	< 0.1	1.0 ± 0.2	0.9 ± 0.4	1.0 ± 0.5	1.3 ± 0.3
3	10	10,000	10,000	1.2 ± 0.2	0.1 ± 0.1	1.0 ± 0.2	0.9 ± 0.4	1.1 ± 0.3	1.5 ± 0.5
Average	10	10,000	10,000	1.1 ± 0.2	0.1 ± 0.1	1.1 ± 0.2	0.9 ± 0.4	1.0 ± 0.5	1.3 ± 0.4

Predecisional Draft—Do Not Cite

APPENDIX C

POST-REMEDIAL ACTION SURVEY PLAN

SLAPS VICINITY PROPERTIES
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 SLAPS Vicinity Properties 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 Project 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, at this time, 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 radioactive contamination is present on many of the SLAPS vicinity properties (Figure 1). Redistribution of the contamination on the properties has occurred as a result of flooding, surface runoff, and road and utility construction 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 was issued by DOE and 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, and 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 (DOE Order 5400.5 & 5480.11):

	(dpm/100 cm^2)		
	average	maximum	removable
Alpha	500	1,500	20
Beta-Gamma	5,000	15,000	1,000

Note: Alpha and Beta-Gamma limits are applied independently. The measured values may be averaged over 1 square meter to meet fixed and removable criteria provided the maximum values in any 100 cm^2 do not exceed three times the fixed and removable criteria.

DECONTAMINATION ACTIVITIES

All designated areas of contamination are exterior to any buildings. In general, remediation of the site will consist of excavation of soil exceeding the applicable residual contamination guidelines and decontamination of structures exceeding the fixed and transferable surface residual contamination guidelines. Contaminated structures such as culverts, utility poles, and pipelines may be encountered during excavation.

Consequently, post-remedial action 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 on the design drawings as issued, indicating the general areas and depths of excavation.

POST-REMEDIATION SURVEYS AND SAMPLING

Following remediation, the FUSRAP Radiological Support Services Subcontractor (RSSS), ThermoNuclear Services (TNS), will perform post-remedial action surveys and sampling to determine the completeness of the removal action and prepare a verification report to document that the site complies with the applicable site-specific criteria.

Survey Equipment

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

- Gamma scintillation detector (Eberline SPA-3 or equivalent)
- Reuter-Stokes Pressurized Ion Chamber (PIC)
- Fidler

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 the IVC to insure compatibility and reproducibility of results.

Background Measurements

For radiological surveys background measurements from three remote background locations in the general vicinity of the site (0.5 to 3 miles) have been taken in accordance with TNS procedure 3C.2 (Reference 4A). For soil samples TNS and the IVC 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 & Soil Sampling

General

After completion of the excavation of contaminated soils, TNS shall conduct post-remedial action surveys to verify area has been decontaminated 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 100 m^2 grid. The grids shall be numbered in sequential order and recorded in the sample logbook with the coordinates for the center of each grid. To ensure comparability of post-remedial action results, the IVC will use the same grid number system.

Surveys

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 surface 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). For the SLAPS vicinity properties, PIC readings are required for 10 to 20% of the grids. The results of all surveys will be submitted to the Bechtel ET team lead, including a sketch of grid locations and approximate excavation depths, before backfilling the excavation.

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). One composite sample will be collected from each sample grid. Composite samples will be collected by taking individual samples (25 per 100 m^2) from each sample grid and compositing these individual samples into the one composite for that grid (Figure 2). The IVC will be given the opportunity to take 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 analyzed by the mobile laboratory at HISS for uranium-238, isotopic thorium, and radium-226 in accordance with approved TNS sample analysis procedures and the Mobile Lab Management Plan (Reference 12). Alternatively, samples can be shipped to the TNS laboratory in Oak Ridge, TN, for analysis.

Hazard Assessment Sampling

Discrete samples, in support of a future hazard assessment, shall be collected as follows:

- In areas where the face of the excavation under the road is vertical, take one sample per grid, biased to areas associated with increased instrument countrates (if present) from the uppermost portion of the sub-base material immediately below the gravel base (Figure 3).

- In areas where the face of the excavation adjacent to the road is sloped, material should be removed with a hand shovel or equivalent in order to create a vertical face and then sampled in the same manner as described above (Figure 4). The material removed from the sloped face should be treated as contaminated material and added to the soil wastestream.

- Samples collected for the purpose of performing hazard assessments should not be composites. All samples should be collected from the most probable contaminated areas. If survey instrument readings do not indicate countrates above background, the samples should be collected from areas adjacent to excavated areas where activity significantly above background was known to exist prior to excavation.

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 may 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). If practical, a smear of the decontaminated sampling equipment may be collected and counted as determined by the Bechtel sampling coordinator.

Data Quality Objectives

The lower limit of detection 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 and the remedial investigation.

Bechtel will have responsibility for excavation of contaminated soil. Upon completion of these activities, TNS will perform a post-RA survey. The IVC will then commence verification of the remediated properties. The IVC 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 provide the IVC access to post-remediation results as they become available. Bechtel will notify the IVC when remediation of an area is complete. The IVC will perform final independent verification surveys of the area following remediation, post-RA surveys, and receipt of post-RA data for the remediated area. The IVC may collect soil sample splits concurrent with Bechtel sampling efforts.

Measurements taken by Bechtel and the IVC 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 the IVC shall utilize the same, or similar, type of calibration techniques, calibration sources, and survey techniques in conducting the surveys. Bechtel shall establish a survey grid across the decontaminated areas and the IVC 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, the IVC will then demobilize, and Bechtel will remain to restore the site to the condition agreed upon by the property owners.

Bechtel will provide final validated sample results to the IVC 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 and publish. 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).

Predecisional Draft–Do Not Cite

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) 3A.2	"Direct Surface Contamination Survey"
B) 3A.3	"Transferable Surface Contamination Survey"
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) 3C.2	"Determination of Background"
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.

(12) BNI, 1995, *Mobile Lab Management Plan for St. Louis, Missouri*, Draft.