

SENSITIVE

Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-81OR20722

**PRELIMINARY RADIOLOGICAL
SURVEY REPORT FOR THE ST. LOUIS
TERMINAL RAILROAD PROPERTY
IN ST. LOUIS, MISSOURI**

St. Louis, Missouri

May 1989



Bechtel National, Inc.

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PRELIMINARY RADIOLOGICAL SURVEY REPORT
FOR THE
ST. LOUIS TERMINAL RAILROAD ASSOCIATION PROPERTY IN
ST. LOUIS, MISSOURI

MAY 1989

Prepared for
UNITED STATES DEPARTMENT OF ENERGY
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EXECUTIVE SUMMARY

Radiological characterization activities were conducted on the St. Louis Terminal Railroad Association property (adjacent to the St. Louis Downtown Site) in St. Louis, Missouri, to determine if radioactivity exists in concentrations above guidelines as set forth by the U.S. Department of Energy for its Formerly Utilized Sites Remedial Action Program. Survey activities included walkover gamma surveys, soil sampling, and gamma logging. Residual radioactivity was found to be present in soil at concentrations above guidelines. However, the concentrations are low and, given the current use of the property, are not believed to pose a health hazard to workers on the St. Louis Terminal Railroad Association property.

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ABBREVIATIONS

cm	centimeter
cm ²	square centimeters
cpm	counts per minute
dpm	disintegrations per minute
ft	foot
in.	inch
km	kilometer
m	meter
m ²	square meters
MeV	million electron volt
mi	mile
mR/h	milliroentgen per hour
mrad/h	millirad per hour
mR/h	milliroentgen per hour
pCi/g	picocurie per gram
WL	working level
yr	year

ACRONYMS

AEC	Atomic Energy Commission
BNI	Bechtel National, Inc.
DOE	Department of Energy
FUSRAP	Formerly Utilized Sites Remedial Action Program
MED	Manhattan Engineer District
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
TMA/E	Thermo Analytical/Eberline

1.0 INTRODUCTION

Characterization of the St. Louis Downtown Site (SLDS) was implemented in 1987 to determine the horizontal and vertical boundaries of radioactive contamination exceeding remedial action guidelines. As characterization activities progressed, it was determined that the potential existed for radioactive contamination to be present on properties adjacent to SLDS. As a result, limited radiological surveys were conducted on area properties suspected of having radioactive contamination above remedial action guidelines. The objective of this report is to document the findings of those surveys on one adjacent property.

The radiological surveys were conducted under the U.S. Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP was created to identify, cleanup, or otherwise control sites where residual radioactive contamination that exceeds current guidelines remains from the early years of our nation's atomic energy program. FUSRAP is currently managed by DOE Oak Ridge Operations. As Project Management Contractor for FUSRAP, Bechtel National, Inc. (BNI), is responsible for planning, managing, and implementing FUSRAP.

1.1 HISTORICAL OVERVIEW

SLDS encompasses approximately 45 acres in an industrial area of St. Louis, Missouri. The site is on the eastern border of the city, approximately 61 m (200 ft) west of the Mississippi River (Figure 1-1). The property is owned by Mallinckrodt, Inc. At present, there are numerous buildings and facilities on the site used for the production of various chemical products (Figure 1-2).

From 1942 to 1966, under contracts with the Manhattan Engineer District (MED) and the Atomic Energy Commission (AEC), several operations were performed on-site, including the processing and

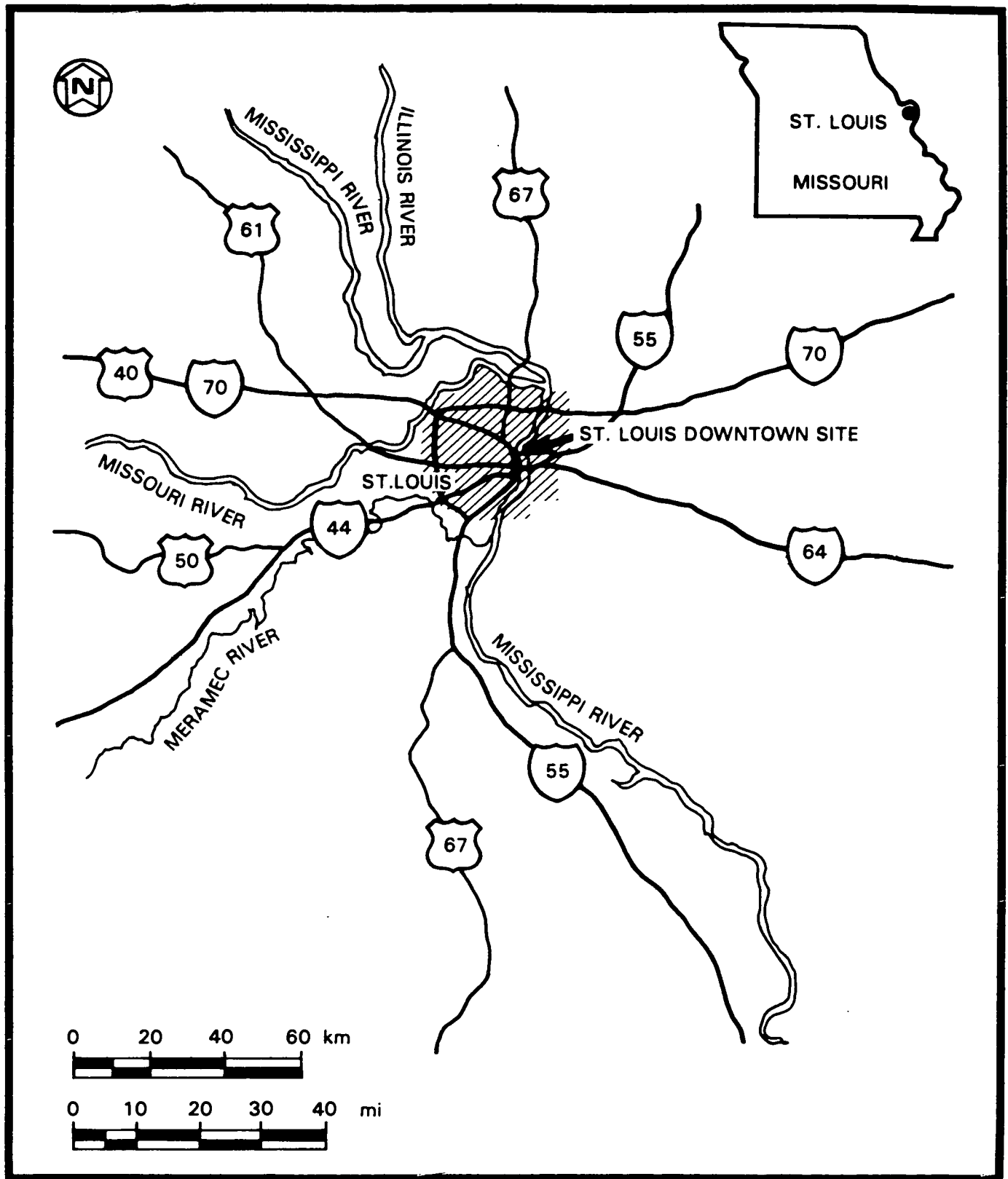


FIGURE 1-1 LOCATION OF THE ST. LOUIS DOWNTOWN SITE

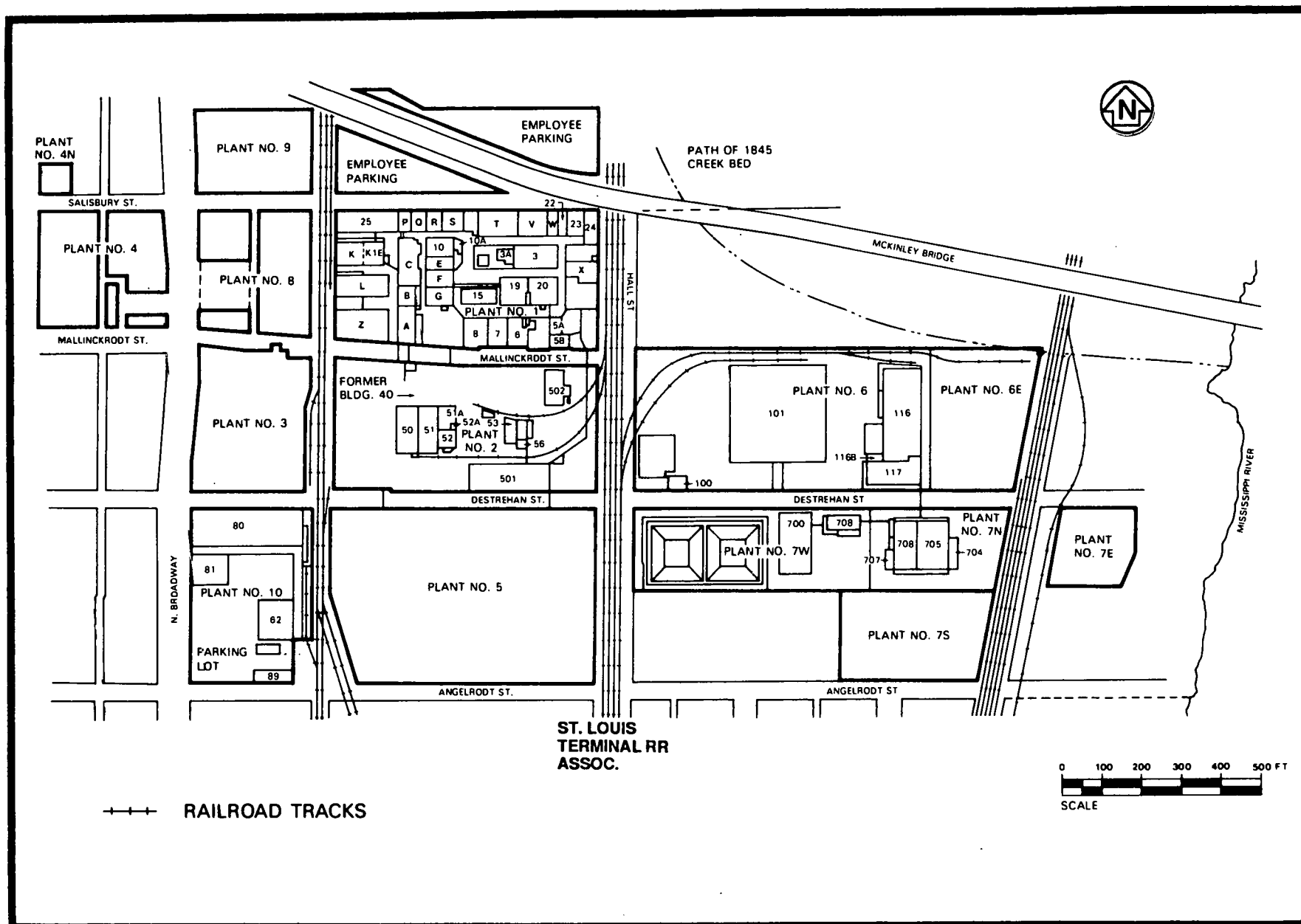


FIGURE 1-2 ST. LOUIS DOWNTOWN SITE

production of various forms of uranium compounds and the machining and recovery of uranium metal (Ref. 1).

In 1977, a radiological survey of portions of SLDS was conducted at DOE's request (Ref. 2). Results of this survey showed alpha and beta-gamma contamination levels above limits set by federal guidelines at locations inside and outside some of the buildings. Elevated external gamma radiation levels were measured at various outdoor locations and in several buildings. Concentrations of uranium up to 28,000 pCi/g were found in subsurface soil, while concentrations of radium-226 were found at levels up to 2,700 pCi/g. Elevated gamma radiation levels were measured in some of the indoor drains. Radon and radon daughter concentrations in three buildings were in excess of federal guidelines for non-occupational radiation exposure.

Current DOE guidelines governing remedial actions for radiological contamination are presented in Table 1-1. A site-specific guideline for uranium in soil is currently being developed by DOE. For the purpose of this report, a value of 50 pCi/g for uranium-238 in soil will be assumed as the guideline (Ref. 3).

1.2 SCOPE AND OBJECTIVE OF THE RADIOLOGICAL SURVEYS

Characterization activities at SLDS were conducted in two phases and included radiological, chemical, and hydrogeological surveys. The radiological surveys were designed to identify the areas of radioactive contamination (Phase 1) and to determine the vertical and horizontal extent of the contamination above remedial action guidelines (Phase 2). Upon completion of Phase 1 of the radiological survey, it was determined that the potential existed for radioactive contamination to be present beyond SLDS property boundaries.

The SLDS Phase 2 characterization was expanded to include limited radiological surveys of properties adjacent to SLDS where radioactive contamination was suspected. These limited radiological

TABLE 1-1
SUMMARY OF RESIDUAL CONTAMINATION GUIDELINES FOR SOILS

BASIC DOSE LIMITS

The basic limit for the annual radiation dose received by an individual member of the general public is 100 mrem/yr.

SOIL GUIDELINES

Radionuclide	Soil Concentration (pCi/g) Above Background ^{a,b,c}
Radium-226 Radium-228 Thorium-230 Thorium-232	5 pCi/g when 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.
Other Radionuclides	Soil guidelines will be calculated on a site-specific basis using the DOE manual developed for this use.

^aThese 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 concentrations of individual radionuclides shall be reduced so that 1) the dose for the mixtures will not exceed the basic dose limit, or 2) the sum of ratios of the soil concentration of each radionuclide to the allowable limit for that radionuclide will not exceed 1 ("unity").

^bThese guidelines represent allowable residual concentrations above background averaged across any 15-cm-thick layer to any depth and over any contiguous 100-m² surface area.

^cLocalized concentrations in excess of these limits are allowable, provided that the average concentration over a 100-m² area does not exceed these limits. In addition, every reasonable effort shall be made to remove any source of radionuclide that exceeds 30 times the appropriate soil limit, regardless of the average concentration in the soil.

surveys were not intended to determine the absolute extent of radiological contamination. Rather, the objective of these surveys were to determine if radioactive materials had migrated onto these properties from SLDS and if radioactivity existed in levels above federal guidelines. The scope of this work included walkover gamma surveys to identify areas of elevated gamma radiation, soil sample collection and analysis for selected radionuclides, and gamma logging of boreholes as a gross indicator of radioactivity in soil. Surveys were conducted on the adjacent properties in only those areas that were readily accessible to the field survey crew.

Available information does not indicate whether the St. Louis Terminal Railroad Association property was used for MED/AEC activities conducted at SLDS, although such use is possible. This property was investigated to determine if radioactive contamination above guidelines was present, whether it originated from MED/AEC activities on the property or through migration from SLDS onto the St. Louis Terminal Railroad Association property.

1.3 LOCATION AND USE OF PROPERTY

The portion of the St. Louis Terminal Railroad Association property surveyed is located in SLDS (Figure 1-2). The property is a narrow strip of land running north and south, bisecting SLDS, and is adjacent and parallel to Hall Street (Figure 1-3). The property consists solely of railroad tracks, which are used for commercial transport of a variety of products.

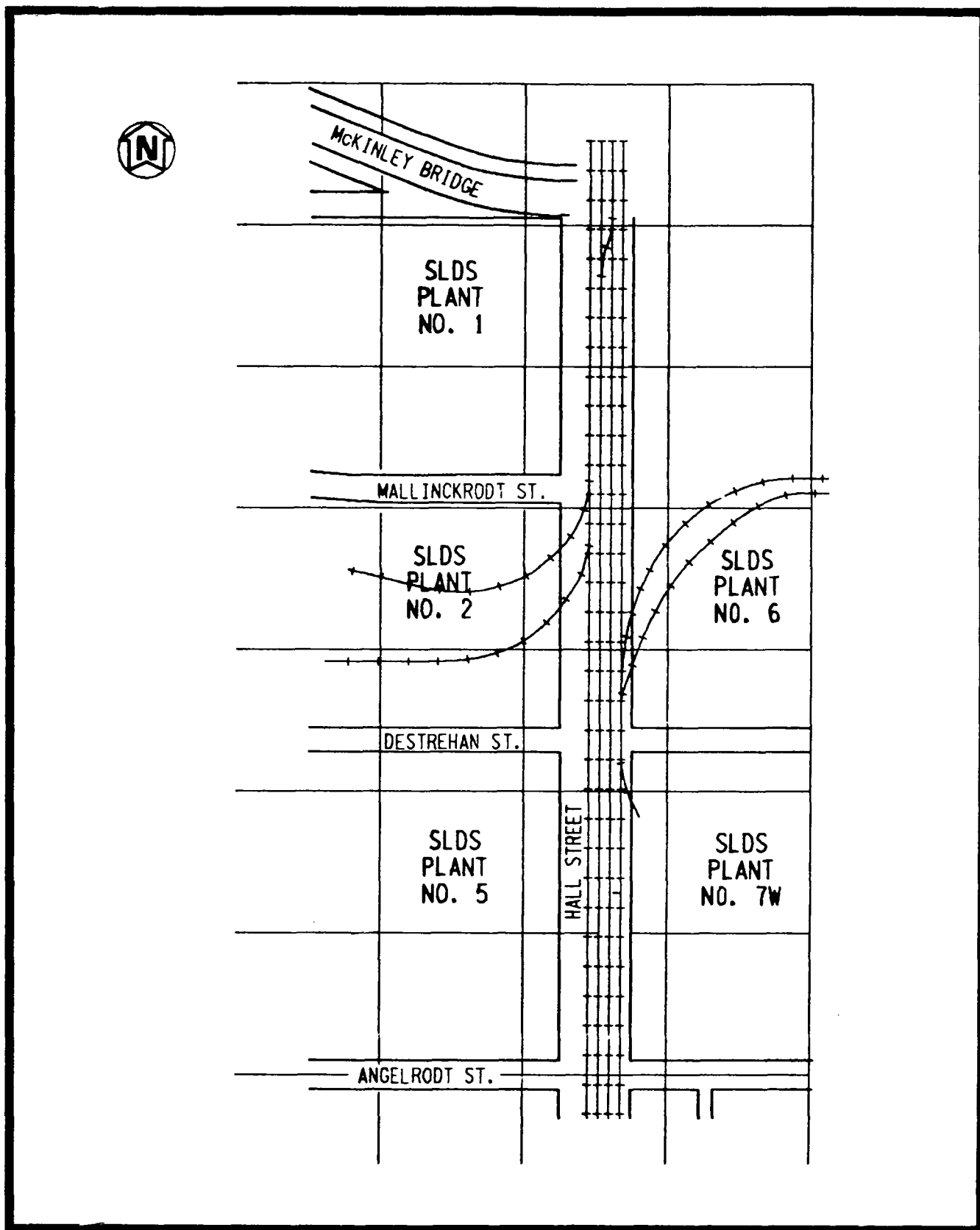


FIGURE 1-3 ST. LOUIS TERMINAL RAILROAD ASSOCIATION
PROPERTY AT SLDS

2.0 SURVEY METHODOLOGY


The limited radiological survey conducted at the St. Louis Terminal Railroad Association property included a walkover gamma survey, collection and analysis of shallow soil samples, and downhole gamma logging. The 15-m (50-ft) grid system that was developed for the SLDS characterization was used for this survey. This grid is tied to the State of Missouri grid system. All characterization data was collected in reference to this grid. Each of these survey activities is explained below.

2.1 WALKOVER GAMMA SURVEY

A walkover gamma survey was conducted on the portion of the property within the SLDS boundaries. The purpose of this survey was to identify areas of elevated gamma radiation. In areas exhibiting elevated gamma radiation (twice background), biased soil samples were collected and analyzed to determine radionuclide concentrations.

The walkover gamma radiation survey was performed by a walkover scan of 15- by 15-m (50- by 50-ft) grid sections and recording the ranges of radioactivity as determined by instrument response. A PRS-1 scaler coupled to an unshielded Eberline SPA-3 probe was used for the walkover gamma survey. The SPA-3 probe is a sodium iodide, thallium-activated [NaI(Tl)] gamma scintillation detector. Figure 2-1 shows the areas surveyed for elevated gamma radiation.

2.2 SOIL SAMPLING

Systematic and biased soil samples were collected on each side of the St. Louis Terminal Railroad Association property. A total of 23 locations were sampled, as shown in Figure 2-2. 

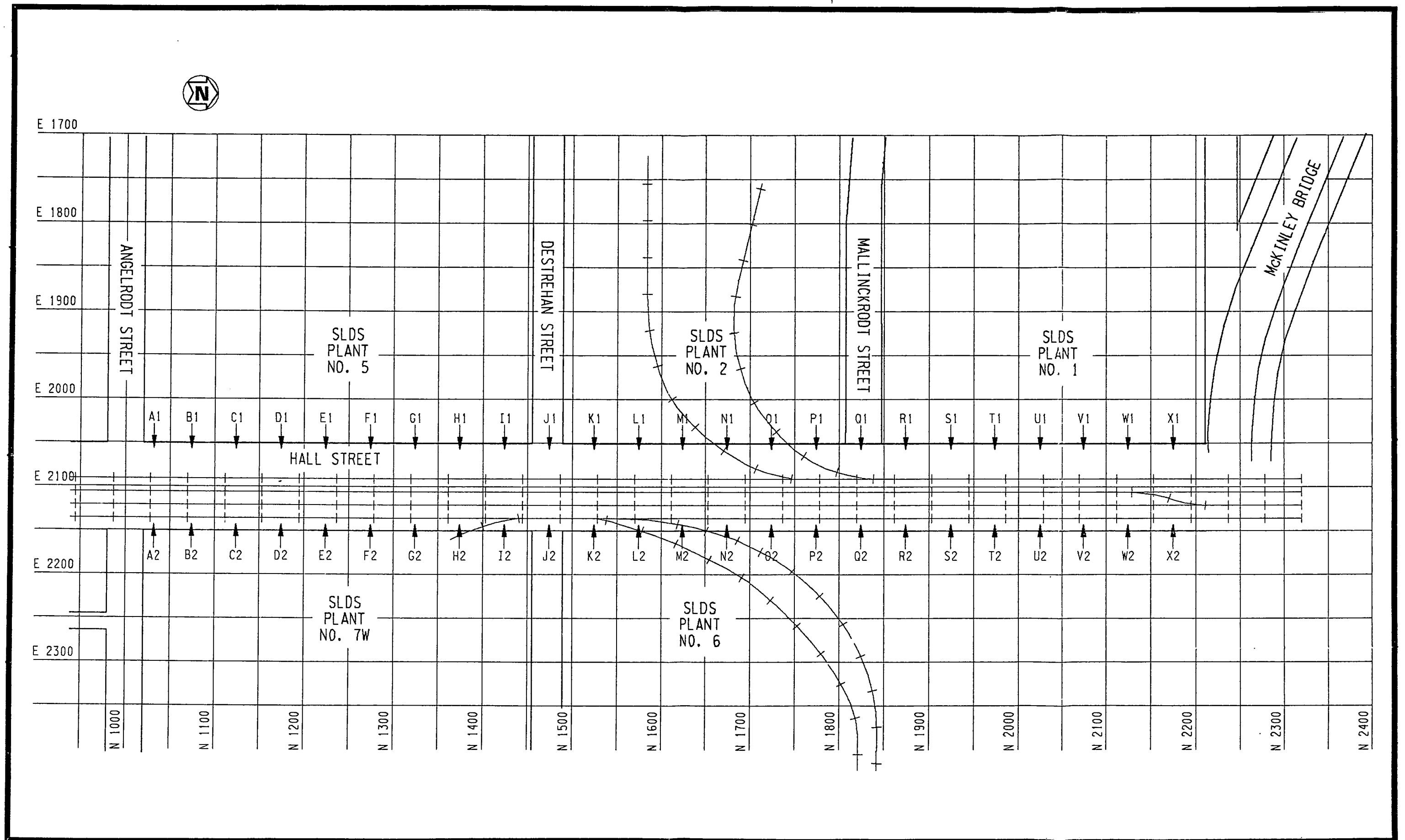


FIGURE 2-1 AREAS OF WALKOVER GAMMA SURVEY AT THE ST. LOUIS TERMINAL RAILROAD ASSOCIATION PROPERTY

Systematic soil samples were collected using either a hand-held or a gas-powered auger. The auger was advanced through the soil at increments of 0.0 to 0.15 m (0.0 to 0.5 ft), 0.15 to 0.3 m (0.5 to 1.0 ft), 0.3 to 0.6 m (1.0 to 2.0 ft), and 0.6 to 1.0 m (2.0 to 3.0 ft). A sample was collected at each increment and placed in a plastic jar. Biased soil samples were collected at the surface increment [0.0 to 0.15 m (0.0 to 0.5 ft)].

The samples were then sent to the Thermo Analytical/Eberline (TMA/E) laboratory where the surface sample [0.0 to 0.15 m (0.0 to 0.5 ft)] from each location was analyzed for uranium-238, radium-226, thorium-232, and thorium-230. The remaining samples were archived for future use, if needed.

2.3 GAMMA LOGGING

A number of the 1-m (3-ft) holes were gamma logged with a SPA-3 detector coupled to a PRS-1 scaler. The detector was lowered into the hole, and the level of gamma radiation at specific depths was measured by instrument response. The SPA-3 is not a typical downhole gamma logging probe, but it was used because the diameter of the hole was not of sufficient size to use the typical Bicron BHP-2 shielded downhole logging probe. These gamma logs have no correlation to a concentration of radionuclides, but they were used as gross indicators of radioactivity in subsurface soil. All sampling locations, including the gamma logged holes, are shown in Figure 2-2.

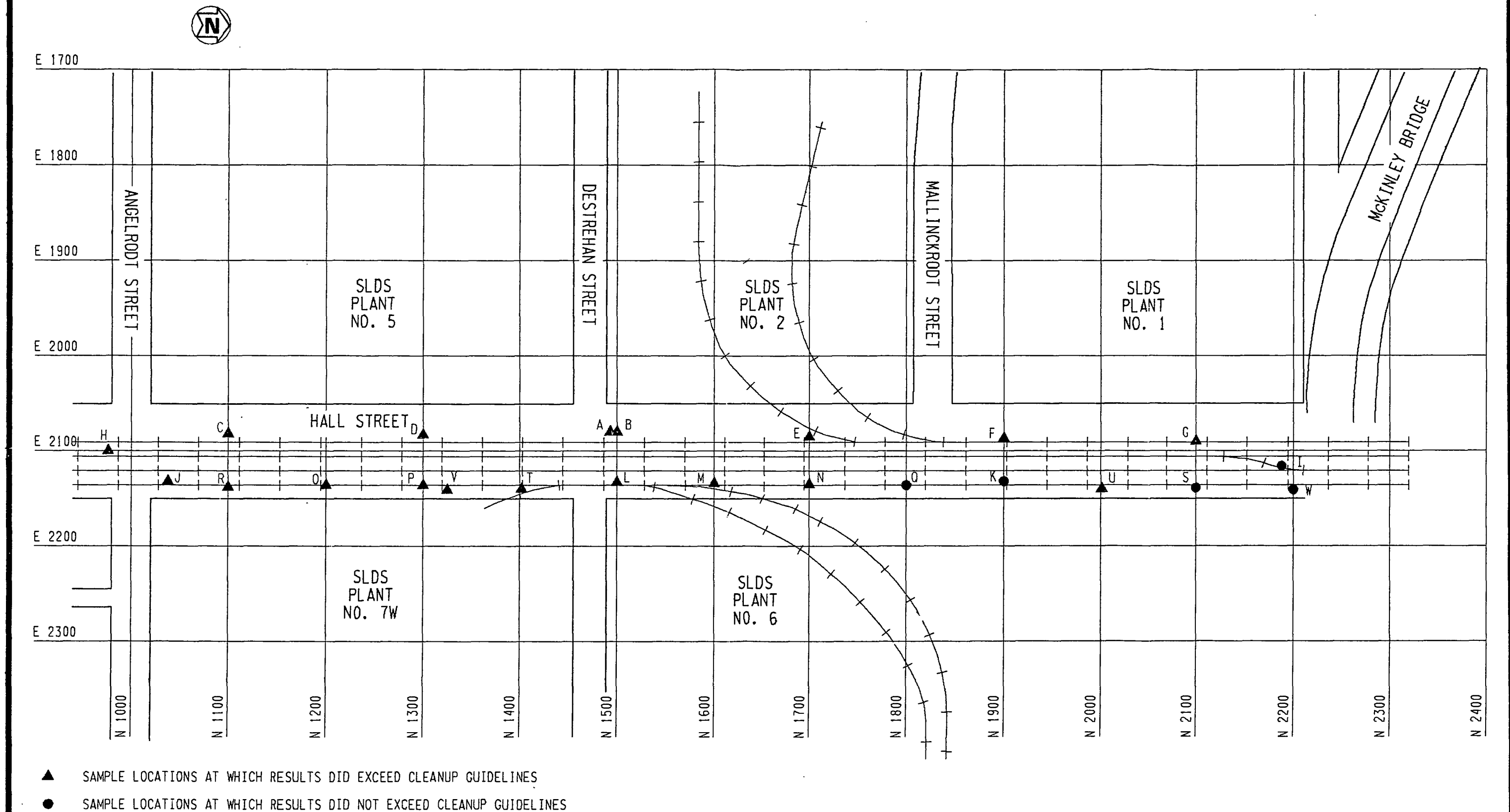


FIGURE 2-2 SOIL SAMPLING LOCATIONS AT THE ST. LOUIS TERMINAL RAILROAD ASSOCIATION PROPERTY

3.0 SURVEY RESULTS

This section provides the results of the limited radiological survey conducted on the St. Louis Terminal Railroad Association property.

3.1 WALKOVER GAMMA SURVEY

Background for near-surface gamma radiation in the St. Louis area is approximately 10,000 cpm (Table 3-1). This background measurement is based on previous radiological work conducted in 1988 in the St. Louis area. These background measurements were taken at distances of approximately 2.8 km (1.8 mi) (locations 1 and 2) and 1.6 km (1 mi) (location 3) from the St. Louis Airport Site (SLAPS). SLAPS is another FUSRAP site in St. Louis where ongoing radiological investigations are taking place. SLDS is approximately 17.2 km (10.7 mi) southwest of SLAPS. All direct field measurements represent gross readings; background measurements have not been subtracted.

Table 3-2 shows the results of the walkover gamma survey with the labeled grid blocks shown in Figure 2-1. Near-surface gamma radiation measurements from the walkover survey on the St. Louis Terminal Railroad Association property ranged from 5,000 to 100,000 cpm.

The levels of near-surface gamma radiation remained relatively constant across the property. These results indicate that gamma-emitting radionuclides are present in elevated concentrations on the St. Louis Terminal Railroad Association property. The highest readings were found to be on the property between SLDS Plant 2 and 6.

3.2 SOIL SAMPLES

A total of 23 locations were sampled. The surface sample from each location was analyzed for uranium-238, radium-226, thorium-232, and thorium-230. The results of these analyses are shown in Table 3-3

TABLE 3-1

BACKGROUND RADIONUCLIDE CONCENTRATIONS IN SOIL AND RADIATION LEVELS IN THE ST. LOUIS AREA

Measurement Location	Gamma Exposure Rate at 1 m (mR/h)	Gamma Radiation 1 m (cpm)	Near-Surface Gamma 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

TABLE 3-2
RESULTS OF WALKOVER GAMMA SURVEY
AT THE ST. LOUIS TERMINAL RAILROAD ASSOCIATION PROPERTY

Page 1 of 2

Grid Block	Counts per Minute (Range)
A1	6,000 - 11,000
B1	8,000 - 24,000
C1	8,000 - 12,000
D1	9,000 - 15,000
E1	9,000 - 16,000
F1	9,000 - 16,000
G1	9,000 - 13,000
H1	9,000 - 11,000
I1	9,000 - 20,000
J1	7,000 - 100,000
K1	9,000 - 16,000
L1	9,000 - 25,000
M1	9,000 - 12,000
N1	9,000 - 12,000
O1	9,000 - 12,000
P1	9,000 - 12,000
Q1	9,000 - 13,000
R1	9,000 - 13,000
S1	9,000 - 13,000
T1	9,000 - 13,000
U1	9,000 - 13,000
V1	9,000 - 13,000
W1	9,000 - 13,000
X1	9,000 - 13,000
A2	8,000 - 10,000
B2	8,000 - 18,000
C2	7,000 - 11,000
D2	7,000 - 13,000
E2	7,000 - 17,000

TABLE 3-2
(continued)

Page 2 of 2

Grid Block	Counts per Minute (Range)
F2	6,000 - 11,000
G2	11,000 - 48,000
H2	9,500 - 15,000
I2	8,000 - 17,000
J2	8,000 - 29,000
K2	7,000 - 19,000
L2	8,500 - 22,000
M2	8,000 - 27,000
N2	7,500 - 10,000
O2	9,000 - 30,000
P2	5,000 - 11,000
Q2	8,000 - 10,000
R2	5,000 - 10,000
S2	6,000 - 10,000
T2	6,000 - 10,000
U2	7,000 - 11,000
V2	7,000 - 14,000
W2	7,000 - 10,500
X2	10,000 - 23,000

TABLE 3-3

RADIONUCLIDE CONCENTRATIONS IN SOIL
AT THE ST. LOUIS TERMINAL RAILROAD ASSOCIATION PROPERTY

Hole I.D.	Coordinates		Depth (ft)	Concentration (pCi/g +/- 2 sigma)			
	East	North		Uranium-238	Radium-226	Thorium-232	Thorium-230
A	2080.0	1493.0	0.0 - 0.5	<45.0	48.0 ± 4.0	160.0 ± 10.0	13.0 ± 3.0
B	2080.0	1500.0	0.0 - 0.5	<12.0	6.0 ± 1.0	< 1.0	8.5 ± 0.8
C	2082.0	1100.0	0.0 - 0.5	< 9.0	6.0 ± 1.0	< 1.0	11.0 ± 1.0
D	2083.0	1300.0	0.0 - 0.5	<10.0	7.0 ± 1.0	2.0 ± 1.0	14.0 ± 1.0
E	2085.0	1700.0	0.0 - 0.5	< 6.0	3.6 ± 0.8	1.1 ± 0.7	18.0 ± 1.0
F	2087.0	1900.0	0.0 - 0.5	<10.0	5.0 ± 1.0	1.0 ± 1.0	5.6 ± 0.7
G	2090.0	2100.0	0.0 - 0.5	< 6.0	2.8 ± 0.8	1.1 ± 0.7	4.9 ± 0.6
H	2100.0	976.0	0.0 - 0.5	<10.0	3.0 ± 1.0	2.0 ± 2.0	4.5 ± 0.5
I	2116.0	2188.0	0.0 - 0.5	<10.0	1.6 ± 0.6	< 1.0	2.6 ± 0.4
J	2132.0	1038.0	0.0 - 0.5	22.0 ± 9.0	3.4 ± 0.9	1.3 ± 0.8	9.0 ± 0.8
K	2132.0	1900.0	0.0 - 0.5	< 7.0	1.3 ± 0.5	< 1.0	3.6 ± 0.5
L	2133.0	1500.0	0.0 - 0.5	< 8.0	4.0 ± 1.0	< 1.0	8.9 ± 1.0
M	2134.0	1600.0	0.0 - 0.5	<12.0	3.0 ± 1.0	< 1.0	3.8 ± 0.6
N	2135.0	1700.0	0.0 - 0.5	<10.0	11.0 ± 2.0	4.0 ± 1.0	29.0 ± 2.0
O	2136.0	1200.0	0.0 - 0.5	<11.0	3.0 ± 1.0	< 1.0	4.4 ± 0.6
P	2136.0	1300.0	0.0 - 0.5	<10.0	5.0 ± 1.0	4.0 ± 1.0	10.0 ± 2.0
Q	2136.0	1800.0	0.0 - 0.5	< 9.0	12.0 ± 1.0	< 1.0	27.0 ± 2.0
R	2138.0	1100.0	0.0 - 0.5	< 8.0	3.0 ± 1.0	< 1.0	4.7 ± 0.7
S	2139.0	2100.0	0.0 - 0.5	< 4.0	1.6 ± 0.5	1.3 ± 0.6	3.4 ± 0.6
T	2140.0	1402.0	0.0 - 0.5	<11.0	5.0 ± 1.0	< 1.0	6.5 ± 0.7
U	2140.0	2001.0	0.0 - 0.5	< 7.0	2.9 ± 0.8	< 1.0	4.4 ± 0.6
V	2141.0	1325.0	0.0 - 0.5	<19.0	39.0 ± 3.0	< 1.0	51.0 ± 4.0
W	2141.0	2200.0	0.0 - 0.5	< 7.0	1.6 ± 0.6	< 1.0	2.0 ± 0.8

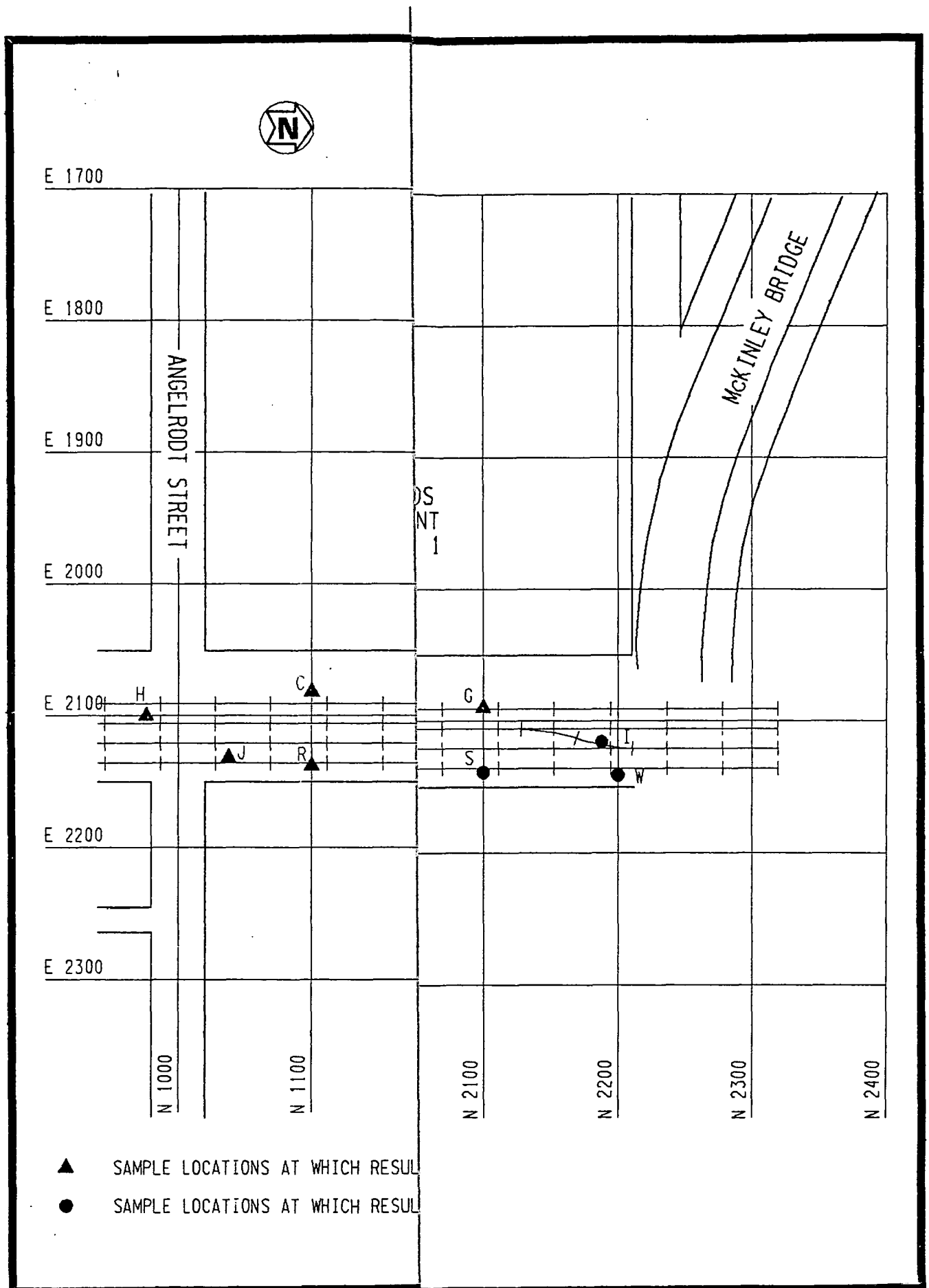


FIGURE PROPERTY

with the sample locations shown in Figure 2-2. Background concentrations have not been subtracted from the values given in Table 3-3. Uranium-238 concentrations ranged from <4.0 to <45.0 pCi/g with an approximate average of 11.4 pCi/g. Only one sample revealed a concentration above the detection limit of the measuring instrument. Radium-226 concentrations ranged from 1.3 to 48.0 pCi/g, with an average of approximately 7.8 pCi/g. Thorium-232 ranged from <1.0 to 160.0 pCi/g, with an average of approximately 8.3 pCi/g. Thorium-230 concentrations ranged from 2.0 to 51.0 pCi/g, with an average of approximately 10.9 pCi/g.

The DOE guideline for residual radium-226, thorium-232, and thorium-230 radioactivity in soil is 5 pCi/g above background when distributed within the first 15 cm (6 in.) of surface soil and 15 pCi/g for any 15-cm (6-in.) layer below the surface layer (Table 1-1). The guideline for uranium-238 in soil is currently being developed but was assumed to be 50 pCi/g for the purposes of this report. In addition to the individual radionuclide guideline, the sum of the ratios of the soil concentration (minus background of each radionuclide) to the allowable limit for that radionuclide cannot exceed 1 ("unity"). If a "less than" value is reported, the concentration of the radionuclide is assumed to be that value during data evaluation (e.g., <3.0 pCi/g is assumed to be 3.0 pCi/g).

On the St. Louis Terminal Railroad Association property, 18 of the 23 samples exhibited radionuclide concentrations above federal guidelines. Sample results that exceeded cleanup guidelines were found at locations along the entire length of the property.

3.3 GAMMA LOGS

The results of the gamma logs are shown in Table 3-4 and have been rounded to the nearest thousand. These logs were used as gross indicators of radioactivity. Because the holes were not of sufficient size to use the typical downhole gamma radiation detection probe, an unshielded probe was used. There is no direct correlation between cpm and pCi/g available for this particular probe.

TABLE 3-4
RESULTS OF DOWNHOLE GAMMA LOGGING AT THE
ST. LOUIS TERMINAL RAILROAD ASSOCIATION PROPERTY

Page 1 of 3

Hole I.D.	Coordinates		Depth (ft)	Counts per Minute
	East	North		
B	2080.0	1500.0	0.0	9,000
			0.5	28,000
			1.0	65,000
			2.0	27,000
			3.0	-a-
C	2082.0	1100.0	0.0	12,000
			0.5	19,000
			1.0	21,000
			2.0	22,000
			3.0	18,000
D	2083.0	1300.0	0.0	14,000
			0.5	20,000
			1.0	17,000
			2.0	22,000
			3.0	22,000
E	2085.0	1700.0	0.0	13,000
			0.5	18,000
			1.0	18,000
			2.0	17,000
			3.0	17,000
F	2087.0	1900.0	0.0	10,000
			0.5	14,000
			1.0	17,000
			2.0	18,000
			3.0	20,000
G	2090.0	2100.0	0.0	9,000
			0.5	14,000
			1.0	16,000
			2.0	18,000
			3.0	20,000
H	2100.0	976.0	0.0	12,000
			0.5	18,000
			1.0	15,000
			2.0	17,000
			3.0	-a-

TABLE 3-4
(continued)

Page 2 of 3

Hole I.D.	Coordinates		Depth (ft)	Counts per Minute
	East	North		
K	2132.0	1900.0	0.0	8,000
			0.5	10,000
			1.0	13,000
			2.0	14,000
			3.0	14,000
L	2133.0	1500.0	0.0	13,000
			0.5	18,000
			1.0	20,000
			2.0	17,000
			3.0	17,000
M	2134.0	1600.0	0.0	16,000
			0.5	12,000
			1.0	22,000
			2.0	15,000
			3.0	14,000
N	2135.0	1700.0	0.0	10,000
			0.5	16,000
			1.0	18,000
			2.0	14,000
			3.0	15,000
O	2136.0	1200.0	0.0	13,000
			0.5	20,000
			1.0	33,000
			2.0	24,000
			3.0	19,000
P	2136.0	1300.0	0.0	14,000
			0.5	31,000
			1.0	36,000
			2.0	20,000
			3.0	18,000
Q	2136.0	1800.0	0.0	16,000
			0.5	33,000
			1.0	48,000
			2.0	22,000
			3.0	18,000
R	2138.0	1100.0	0.0	11,000
			0.5	23,000
			1.0	34,000
			2.0	21,000
			3.0	18,000

TABLE 3-4
(continued)

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Hole I.D.	Coordinates		Depth (ft)	Counts per Minute
	East	North		
S	2139.0	2100.0	0.0	8,000
			0.5	12,000
			1.0	16,000
			2.0	13,000
			3.0	-a-
T	2140.0	1402.0	0.0	20,000
			0.5	39,000
			1.0	39,000
			2.0	28,000
			3.0	20,000
U	2140.0	2001.0	0.0	9,000
			0.5	13,000
			1.0	14,000
			2.0	15,000
			3.0	15,000
W	2141.0	2200.0	0.0	8,000
			0.5	12,000
			1.0	9,000
			2.0	14,000
			3.0	15,000

-a- Auger refusal at 2.0 ft depth.

Although no correlation between radionuclide concentrations and gamma logging data is available, the gamma logging data obtained from other properties where the SPA-3 probe was used indicate that readings above 30,000 cpm may be associated with areas of subsurface radioactivity above cleanup guidelines. This opinion is based on a comparison of the SPA-3 gamma logging data to soil sample results from the other properties.

Nineteen of the 23 sampled holes on the St. Louis Terminal Railroad Association property were gamma logged. The gamma-emitting daughters of the radionuclides of interest provided instrument responses up to 65,000 cpm. This value is greater than 30,000 cpm, which, as described above, may indicate subsurface radioactivity above cleanup guidelines. Section 3.2 substantiates this observation, in that the 19 holes that were gamma logged had samples containing radionuclide concentrations above guidelines for residual radioactivity in soil. Based on these results, additional subsurface investigations may be necessary to determine if subsurface contamination is present on the St. Louis Terminal Railroad Association property.

4.0 SIGNIFICANCE OF FINDINGS

As a result of the limited radiological survey conducted at St. Louis Terminal Railroad Association in St. Louis, Missouri, it has been determined that residual radioactivity is present in excess of federal guidelines. Contamination was found to be present along the entire length of the surveyed property.

Although radioactivity is present in concentrations above guidelines, the concentrations are low. Given the use of the property, the radioactivity does not represent a health hazard to workers on the St. Louis Terminal Railroad Association property.

REFERENCES

1. Ford, Bacon, and Davis Utah, Inc. Preliminary Engineering and Environmental Evaluation of the Remedial Action Alternatives for the Mallinckrodt, Inc. Site, Salt Lake City, UT, December 1981.
2. Oak Ridge National Laboratory. Radiological Survey of the Mallinckrodt Chemical Works, St. Louis, Missouri, DOE/EV-0005/27, ORNL-5715, Oak Ridge, TN, December 1981.
3. Meeting notes, Liedle, S. (BNI) to Distribution. Notes from SLDS Meeting on 1/18/89, CCN 059899, Oak Ridge, TN, March 15, 1989.

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